University of Lethbridge News Release

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Breakthrough discovery in U of L collaborative research study brings potential for new cancer therapies

Drs. Olga and Igor Kovalchuk at the University of Lethbridge, in collaboration with researchers at Qiqihar Medical University in China, the University of Michigan and Boston University, have shown for the first time that interactions between microRNAs, which are very small ribonucleic acid molecules, and transfer RNA (tRNA) can affect cell reproduction and cell death.

“This is the first time that anybody has shown such interaction is possible, that it is actually functional, that it regulates biological processes and also the processes that contribute to cancer,” says Dr. Olga Kovalchuk, a U of L biology professor. “These processes are pivotal for cancer because cancer cells get unlimited capacity to divide and no capacity to die. If you manipulate the levels of these RNAs, you affect these processes.”

The study, which was conducted over several years, was recently published in the Proceedings of the Natural Academy of Sciences of the United States of America (PNAS).

Deoxyribonucleic acid (DNA) contains genetic instructions used in the development and functioning of an organism. Genes tell a cell to make certain proteins. DNA and ribonucleic acid (RNA) work together to produce these proteins as part of a process called gene expression. RNA molecules can be of the coding variety, where they encode a protein, or the non-coding variety, which does not encode protein. Coding RNAs produce proteins that are involved in a variety of cellular processes, such as cell division, cell maintenance and cell metabolism, just to name a few.

“For a long time, we thought only coding RNAs were important,” says Kovalchuk. “But then it was discovered that there are small RNAs called microRNAs. They do not code proteins but they can interfere with the production of proteins. Sometimes, there may be a lot of RNA but the protein isn’t being produced because these small molecules are interfering. They are helping to fine-tune this process of gene expression.”

Scientists previously concluded that microRNAs only interact with coding RNAs called messenger RNAs (mRNAs) and interfere with full expression of genes.

“For quite some time, it was shown that only this specific interaction was possible, that microRNAs can only work with mRNAs,” says Kovalchuk. “By doing so, they can actually control cell division, cell death and malignant transformation. They are very powerful regulators even though they are small.”

Kovalchuk and her colleagues decided to examine one of the best-known microRNAs—a molecule called miRNA-34a which governs some key processes involved in cancer—and found it interacts with a small molecule —tRNAiMet — called initiator tRNA (transfer RNA) methionine.

“This was the first time anybody has shown that microRNAs can interact with other RNA molecules, especially tRNAs,” says Kovalchuk. “We had a lot of work to do to prove that the two actually interact with each other. It has functional consequences when this miRNA-34a interacts with tRNAiMet, affecting cell proliferation, cell-cycle arrest and levels of cell death.”

The study was conducted using a breast cancer model and the researchers are now looking at other types of cancers, specifically focusing on pediatric malignancies. Publication of the study opens the door to numerous other projects, including several articles already in the pipeline, and further collaborations.

“It has already started to garner attention and it will serve as a foundation for the big translational initiative, that is, taking results shown in a lab into a clinical setting,” says Kovalchuk. “If we show results with a couple of other cancers, we will have the potential to discuss the possibility of clinical trials and the therapeutic value of these molecules.”

This news release can be found online at MicroRNA Research Project.

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