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Rapid diagnosis

Israeli team develops tool to predict spread of cancerous tumors

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Israeli scientists have developed a method for early, rapid prediction of cancer metastases, which could provide vital information on the spread of the disease,within hours instead of weeks.

The new research approach, developed at the Technion Israel Institute of Technology, Haifa, is based on analyzing and characterizing the cancerous tumors according to their mechanical or physical attributes, which can then provide a tool for predicting the type, location and likelihood of metastases.

This approach has been spreaheaded in recent years by Prof. Daphne Weihs of the Technion's Biomedical Engineering Faculty and head of the Technion's laboratory for Mechanobiology of Cancer and Wounds.

Recently Weihs' team started testing the approach on patients with cancerous tumors in the pancreas, stomach and breast and on children with bone cancer, in collaboration with colleagues in the Rambam Medical Center.

The scientists' aim is to identify the transition from a local cancerous tumor to invasive cancer. Unlike the treatment for primary tumors, which is highly effective today, treating metastases is more complicated. The metastases spread to healthy organs through the blood and lymph systems and are hard to identify in the early stages. By the time they are traced they are generally large and have spread considerably, making treatment complicated and challenging.

"The idea is to take an engineering approach in looking at the cells' physical attributes and their interaction with the environment. For example, if they're stiff or soft, how they can change shape to squeeze into narrow places or what force they can apply," Weihs told Haaretz.

"Characterizing those features enables us not only to distinguish between a benign and cancerous tumor, it can provide rapid information about the tumor's level of aggressiveness, the chance that it will send out metastases, and the likelihood of metastases appearing in various organs. For example, looking at the cells' 'strength' together with their motility, we hope to identify whether they will spread to other parts of the body or reappear in the same place," she says.

The mechanical characterization of the cancer cells is conducted by means of synthetic gel surfaces produced in Weihs' laboratory to simulate the stiffness of soft body tissue, while serving as an obstacle to the cancer cells. The gel surfaces enable studying the conditions in which the cells apply force on the environment they try to invade. The scientists can measure the force the cells apply and characterize the differences between different kinds of cancer cells. The cells' physical attributes are a vital, inseparable part of the cancerous tumor's ingenuity and survival ability.

"The cancer cell aspires to invade and take over healthy tissue, so cancer cells have developed structural pliability that enables them to soften or stiffen swiftly to squeeze through small areas," Weihs says.

Apparently cancer cells interact differently with the surrounding tissue than benign ones. The vertical force cancer cells apply on surrounding tissue is stronger, and the attempt to penetrate is more forceful, with greater cell motility. "These are the clues that can help us to trace these cells early and quickly on the basis of their mechanical characteristics. These abilities are caused by genetic changes, but with the approach we developed there's no need for information about these [genetic] changes," she says.

Various methods have been developed in recent decades to identify cells' metastatic potential, but most of them are based on identifying genetic and biological changes in cancer cells. According to Weihs, these systems are expensive, take a long time to provide information and are inapplicable to certain kinds of cancer, like pancreatic cancer.

"With this discovery we intend to move ahead and develop a rapid, quantitative prediction of metastases formation and mechanical invasiveness of cancer cells – we're talking about something that could yield results in two to three hours instead of several weeks," she says.

That would enable treatment to begin at an earlier stage and could help slow down and combat metasteses.