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A new sensitive technique for detecting ovarian tumours

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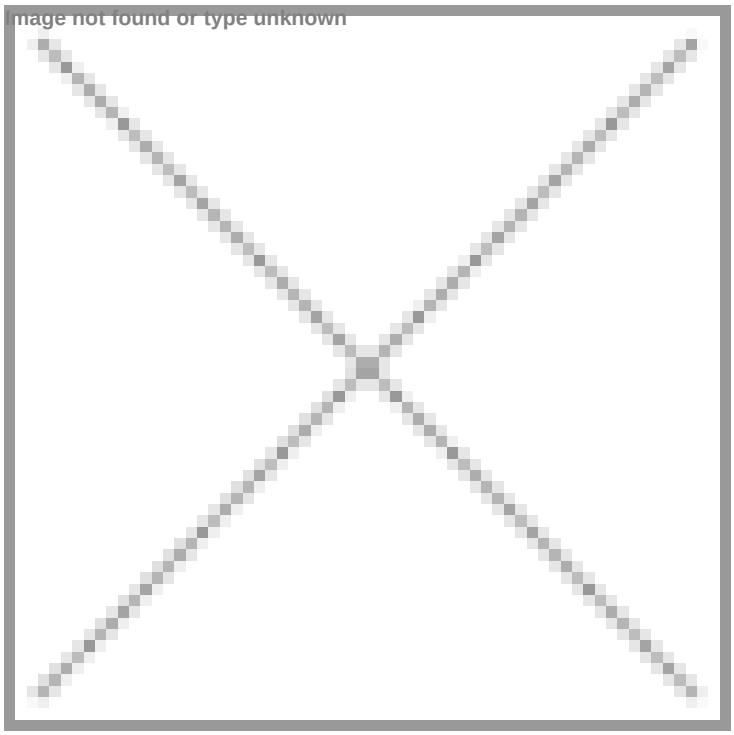

Most ovarian cancer is diagnosed at such late stages that patients' survival rates are poor. However, if the cancer is detected earlier, five-year survival rates can be greater than 90 percent.

Now, MIT engineers have developed a far more sensitive way to reveal ovarian tumors. The new test makes use of a "synthetic biomarker" -- a nanoparticle that interacts with tumor proteins to release fragments that can be detected in a patient's urine sample. This kind of test can generate a much clearer signal than natural biomarkers found in very small quantities in the patient's bloodstream.

Sangeeta Bhatia is a John and Dorothy Wilson Professor of Health Sciences and Technology and Electrical Engineering and Computer Science, and a member of MIT's Koch Institute for Integrative Cancer Research and Institute for Medical Engineering and Science. She first reported the strategy of diagnosing cancer with synthetic biomarkers in 2012. This method measures the activity of protein-cutting enzymes called endoproteases, which are made by tumors to help recruit blood vessels and invade surrounding tissues so the cancer can grow and spread.

To detect this sort of enzyme, the researchers designed nanoparticles coated with small protein fragments called peptides that can be cleaved by particular proteases called MMPs. After cleavage, tiny reporter fragments are then filtered out by the kidney and concentrated in the urine, where they can be detected using various methods, including a simple paper-based test.

In the current study, the researchers used two new strategies to boost the sensitivity of their detector. The first was to optimize the length of the polymer that tethers the peptides to the nanoparticle.

Second, the researchers added a targeting molecule known as a tumor-penetrating peptide to the nanoparticles, which causes them to accumulate at the tumor in greater numbers and results in boosting the number of cleaved peptides that end up secreted in the urine.

By combining these two refinements, the researchers were able to enhance the sensitivity of the sensor 15-fold. In humans, colon cancer often spreads to the liver and forms small tumors that are difficult to detect, similar to ovarian tumors.

Currently, doctors can look for blood biomarkers produced by ovarian tumors, but these markers don't accumulate in great enough concentrations to be detected until the tumors are about 1 centimeter in diameter, about eight to 10 years after they form. Another diagnostic tool, ultrasound imaging, is also limited to ovarian tumors that are 1 centimeter in diameter or larger.

Being able to detect a tumor five months earlier, which the MIT researchers believe their new technique could do, could make a significant difference for some patients.