Natalie Artzi, PhD, invented an adhesive being tested for use in gastrointestinal, orthopaedic, and cancer care. (Photo by Stu Rosner)

STICKING IT TO CANCER

Natalie Artzi, PhD, is another BWH bioengineer working to solve problems across multiple disciplines. Almost a decade ago, as a postdoctoral student at MIT, Artzi began investigating the challenges of sutures in gastrointestinal surgeries, which involve leaks and complications in as many as 30 percent of cases for patients with colitis, Crohn's disease, and colorectal cancer.

"When sutures don't hold after surgery for tumor removal in patients with colon cancer, the follow-up chemotherapy regimen can be delayed by many weeks while they heal, putting them at higher risk of cancer recurrence," she says.

Artzi's solution was an adhesive that could be used by surgeons to seal the site of tumor removal, which would eliminate holes created by sutures. Later, when a close friend of hers was diagnosed with cancer and struggling with the effects of chemotherapy, Artzi wondered if the adhesive could be adapted to treat cancer.

"With traditional chemotherapy, less than 1 percent of the drug reaches the primary tumor as it travels systemically throughout the body," says Artzi. "The rest accumulates in the liver and the kidneys and kills normal cells including immune cells, leading to many side effects including hair loss, anemia, and fatigue. We thought we could figure out how to attach drugs to the

adhesive. The adhesive can be injected immediately after tumor resection and solidify within 30 seconds to deliver cancer-fighting drugs directly to the site."

Artzi drew on nanotechnology to embed a range of drugs in the adhesive, including antibodies and gene therapies. Through this technology, scientists manipulate submicroscopic particles measuring 1/800th of the thickness of a human hair to engineer tiny devices or develop materials that can enhance products, such as fabrics, batteries, and adhesives.

Now, Artzi's cancer-fighting adhesive, which has shown success in pre-clinical testing of triple-negative breast cancer and colon cancer, is being tested for brain cancer. BWH neurosurgeon Pier Paolo Peruzzi, MD, PhD, approached Artzi to see if her adhesive could be customized to treat glioblastoma—one of the deadliest types of brain tumors with high rates of cancer recurrence.

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— NATALIE ARTZI, PHD

"To better understand how the adhesive would work with brain tumors, I observed one of his surgeries, which was incredibly valuable," Artzi says. "It helped us modify our materials and identify which therapies to include for brain cancer patients. Now, instead of 1 percent of a drug getting to the tumor, we load the adhesive with the drug directly next to the tumor and can program drug release to prolong its presence. Based on our research, this technology seems much superior to traditional systemic chemotherapy."

Artzi's journey typifies the multidisciplinary approach of BWH's bioengineers.

"Until I saw my friend dealing with the side effects of chemotherapy, our work mostly focused on designing devices for the gastrointestinal tract and for cardiovascular and orthopaedic uses," says Artzi. "Now that we've deciphered how to engineer the adhesive to carry multiple anti-cancer drugs, cancer is the biggest focus of my lab. You never know where inspiration will lead you."