

News Release

For immediate release

Success of electrical treatment for tumour removal

Jerusalem, February 13 2007 – A potential breakthrough in minimally invasive surgical removal of tumours has been demonstrated using an innovative technique involving microsecond electrical pulses that can punch permanent nanoscale holes in the membranes of targeted cells without harming adjacent healthy tissue.

The technique, known as irreversible electroporation (IRE), was developed by a research team headed by Boris Rubinsky, currently on leave as professor of bioengineering and mechanical engineering at the University of California, Berkeley, and now head of the Centre for Biomedical Engineering in the Service of Humanity and Society at the Hebrew University of Jerusalem. The success of a large-scale study on pigs that were treated using the technique is described in the February issue of the journal *Technology in Cancer Research and Treatment*.

"I've been working in this area of minimally invasive surgery for 30 years now," said Rubinsky, lead author of the paper in the journal. "I truly think that this will be viewed as one of the most important advances in the treatment of tumours in years. I am very excited about the potential of this technique. It may have tremendous applications in many areas of medicine and surgery."

Rubinsky co-authored the paper with Dr. Gary Onik, director of surgical imaging at Florida Hospital Celebration Health. They founded the Oncobionic Company two years ago to commercialize IRE. Oncobionic is in the process of being sold to AngioDynamics, a New York-based manufacturer of medical devices for minimally invasive surgery.

It was first reported in the early 1970s that the application to cells of very fast electrical pulses – in the microsecond and millisecond range – creates an electrical field that causes nanoscale pores to open in the cell membrane (electroporation). But research since then has mainly focused on reversible electroporation, which uses voltages low enough to temporarily increase the cell membrane's permeability. The holes in the cell membrane created by reversible electroporation close up shortly after treatment, allowing the cell to survive.

"This concept of reversible electroporation really caught on in modern biotechnology, especially over the last decade," said Rubinsky. "It is used primarily to help get genes and drugs into cells (but is not effective in killing "target" cells directly). The field of irreversible electroporation was pretty much forgotten."

Irreversible electroporation uses electrical pulses that are slightly longer and stronger than reversible electroporation. With IRE, the holes in the cell membrane do not reseal, causing the cell to die. IRE utilizes a range of electrical current that causes permanent damage to cell membranes without generating heat and thermal damage.

The advantage to this, say the researchers, is that IRE overcomes the limitations of current minimally invasive surgical techniques that use extreme heat, such as hyperthermia or radiofrequency, or extreme cold, such as cryosurgery, to destroy tumourous cells. They point out that this type of temperature damage to cells also causes structural damage to proteins and the surrounding connective tissue. For liver cancer, for example, the bile duct is at risk for damage. For prostate cancer, the urethra and surrounding nerve tissue is often affected.

Irreversible electroporation, on the other hand, acts just on the targeted cell membrane, leaving collagen fibres and other vascular tissue structures intact. The researchers said that leaving the tissue's "scaffolding" in place in this manner allows healthy cells to regrow far more quickly than if everything in the region were destroyed.

In the new study, the researchers set out to demonstrate that the IRE technique could produce reliable and predictable results in a large animal model. They performed the IRE surgical technique on 14 healthy female pigs under general anaesthesia, using the same procedures as if the patients were human.

They showed that selected cell membranes were destroyed, while untargeted adjacent tissue healed remarkably quickly. Although the tissue chosen for destruction in this study was healthy, the researchers found in a prior cell culture study that IRE effectively kills human liver cancer tissue.

A further chronic drawback of heat or cryo (cold) treatments for cancer is the difficulty in treating cells that are immediately adjacent to the blood vessels. Because blood maintains a relatively stable temperature, it actually transfers heat or cold away from a treatment area in an attempt to return the region to a normal temperature range. That means some cancerous cells might actually survive treatment.

"That counts for a lot of failures when treating liver cancers," said Onik. "With IRE, you can destroy cancerous cells right next to the blood vessels. It's a more complete treatment. In my clinical experience, this is about as good as it gets. We've been using other techniques for a long time. This provides significant improvements over other treatments."

"While we are obviously very excited about this advance in tumour removal, we are still in the early stages of our learning curve," Onik cautioned. "There is always the potential for unexpected results."

The U.S. Food and Drug Administration cleared the IRE technology for human use in November 2006. Onik is scheduled to begin human clinical trials for IRE this summer.

For more information, or for press contact with students, faculty or spokespersons from HU, please speak in the first instance to Jason Caplin, Communications Manager, on +44 (0)20 7691 1471 or email jason.caplin@bfhu.org.



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