HIGH-TECH HEALTH

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ADVANCED TOOLS & TECHNIQUES ENHANCE DIAGNOSIS & TREATMENT

Technology moves faster today than ever before, and medicine is no exception. That march of progress gives health care providers an array of new tools to help catch problems early and treat patients with greater precision. Let's take a look at a few pieces of technology that are helping EVMS providers give even better care to patients.

SYSTEMS CONVERGE TO BATTLE CANCER

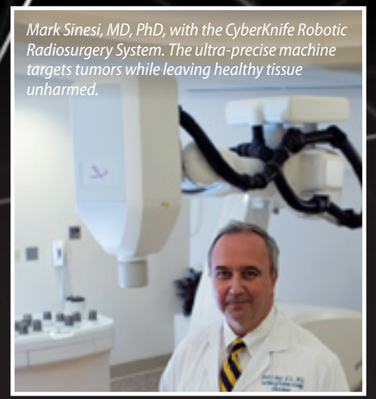
What do you get when you combine a robot made for welding cars, a linear accelerator and a computer similar to those found aboard cruise missiles? CyberKnife.

It's a technologically advanced system for delivering radiation therapy. As its name implies, it's as precise as a sharp blade, changing both the way tumors are treated with radiation and even the kinds of cancers it can fight.

Traditional radiation treatments damage healthy tissue surrounding the cancer. This damage is evident in side effects, such as blistered skin. Until recently, it's been a necessary evil of battling cancer. The risk of collateral damage can rule out radiation as a possible treatment for some forms of the disease — such as tissue that's previously been irradiated. CyberKnife changes that equation.

"It's a remarkable combination of technologies," says Mark Sinesi, MD, PhD, Chair of EVMS Radiation Oncology and Biophysics. He and his team runs the CyberKnife facility at Sentara Norfolk General Hospital, the only one in the region. "It's really opened up wonderful opportunities to take care of people where we couldn't before."

Unlike conventional treatment that irradiates uninvolved tissue, CyberKnife uses hundreds of smaller, less intense beams that pass harmlessly through



Mark Sinesi, MD, PhD, with the CyberKnife Robotic Radiosurgery System. The ultra-precise machine targets tumors while leaving healthy tissue unharmed.

surrounding tissue before converging on the tumor to deliver a full-power dose of treatment. It's so accurate that the machine's arm — the part originally intended to hold a welder — softly rises and falls as the patient breathes to stay pinpoint-focused on its target.

Brain tumors. Inoperable lung cancers. Cancer that has returned to previously irradiated tissue. Tumors near the spine. They may not be eligible for traditional radiation, but CyberKnife brings them back to the treatable side of the spectrum.

The technology is fascinating. However, Dr. Sinesi says the possibilities, the chances to fight back that this machine opens for patients, are the most significant aspects of this tool.

"It means patients have a chance for cancer control where there previously may not have been a viable option," Dr. Sinesi says, "and it allows treatment that is shorter in duration and higher in effectiveness."

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– MARK SINESI, MD, PHD, SPEAKING ABOUT THE CYBERKNIFE ROBOTIC RADIOSURGERY SYSTEM.

NEW TECHNIQUES FIND DIABETIC NERVE DAMAGE

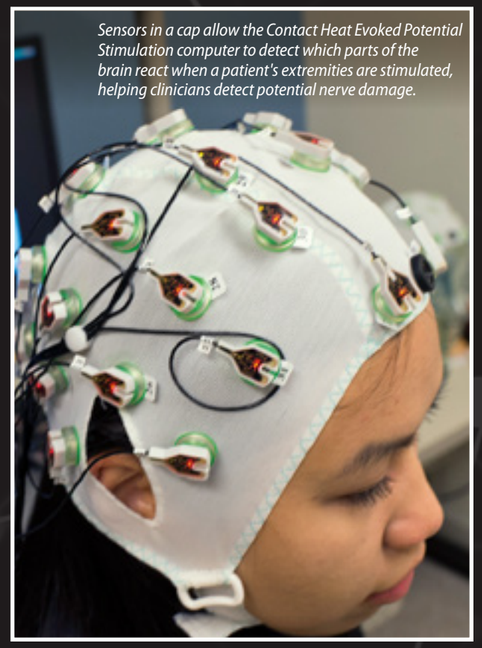
One of diabetes' cruel effects is damaged nerves, also known as neuropathy. High blood sugar can damage fragile nerve fibers, leaving patients with diminished sensitivity in their limbs and a variety of other, sometimes painful symptoms. Over the long term, this damage can lead to amputations and severely diminish quality of life, so spotting it early is a crucial step in living with diabetes. EVMS' Strelitz Diabetes Center is home to some of the world's leading experts in detecting and treating diabetic nerve damage, and their insight, combined with recently developed tools, is changing the way patients and clinicians battle neuropathy.

One such tool is Contact Heat Evoked Potential Stimulation — or CHEPS for short, and it is overturning traditional understanding of how neuropathy unfolds.

In the past, neuropathy was considered to start at distant extremities, such as the feet, and work up toward the hands. By using mild heat to activate nerves and their associated receptors in the brain, EVMS researchers have shown that nerves in the lower back and forearm may actually be the first to sustain damage from diabetes or pre-diabetes. This new understanding means that clinicians have a simple way to identify patients in need of more thorough follow-up testing as opposed to the traditional skin biopsy used to check for damage.

"This is changing our understanding of what causes neuropathy and how to treat it," says Aaron Vinik, MB ChB, PhD, the Murray Waitzer Endowed Chair for Diabetes Research and Research Director at the Strelitz Diabetes Center.

People with diabetes may also have trouble dissipating heat. Their upper body may sweat significantly while their lower body doesn't, potentially leading to dry, cracked skin that can become a site



Sensors in a cap allow the Contact Heat Evoked Potential Stimulation computer to detect which parts of the brain react when a patient's extremities are stimulated, helping clinicians detect potential nerve damage.

Beams from CyberKnife's robotic arm run through one of a variety of metal apertures, the size of which is selected based on the size of the treatment area.

of dangerous infections. This disturbance of thermoregulation stems from damage to minuscule nerves, some of the first to succumb to the biochemical imbalances diabetes created. An apparatus called Sudoscan can detect the movement of certain electrolytes in sweat glands and indicate whether those small nerve fibers are functioning properly.

A third tool gives yet another way to spot what is happening to delicate nerves by putting a device usually found in an optometrist's office to a new use. Corneal confocal microscopy — basically, a microscope designed to look into eyes — allows clinicians to closely examine the tiny nerve fibers that lace the clear front part of the eye. By counting the nerves in a given area, looking for division in the fibers and measuring their length, clinicians can see whether these sensitive nerves are healthy. Since they show damage very early in the diabetic process, it's possible to find problems and take action before diabetes fully takes hold.

SEEING THE BRIGHTEST HOPE FOR A FAMILY

As far as fertility science has come since EVMS introduced in vitro fertilization to the U.S. in 1981, a heavy reliance on the art component of "the art and science of medicine" still is necessary when it comes to selecting embryos with the best chance of thriving in the womb.

Embryologists use their experience and biological clues to judge which embryos look the strongest, since they can't constantly watch them grow. But a new piece of equipment lets them do exactly that. The EmbryoScope, developed by Unisense Fertilitech, is an incubator with an integrated camera that records the eggs' progression from fertilization to just before implantation.

"The equipment can be set up so that you can look at it every 10 minutes or every half an hour," says Jacob Mayer, PhD, Professor of Obstetrics and Gynecology. "It'll take pictures and stream them as a movie, so you can actually see the development of the embryo over time."

Embryologists can watch the time-lapse footage to see the timing of cell division, the presence of more than one nucleus — which is associated with poor implantation potential — and other key factors that contribute to an embryo's viability.

Another benefit is that embryos don't have to be taken out of the incubator to be examined under a microscope, which has been standard practice until now. Briefly taking them out of the incubator doesn't harm them. "But you don't want to keep them out too long. The incubator is where they want to be," Dr. Mayer says.

The step-by-step observation and more tightly controlled environment lead to as much as a 20-percent jump in IVF success — a world of difference to patients hoping to become parents. □