New microscopy may identify best sperm cells

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More than 10% of American women aged 15-44 struggle to conceive or maintain full-term pregnancies, according to the Centers for Disease Control and Prevention (CDC). Assisted reproductive technology (ART), through which eggs are fertilized with sperm in a lab and then returned to a woman's uterus, is often the last resort for reproductively-challenged couples. But the physical, emotional, and financial toll they exact is high because the success rates of ART treatments are low—only 20-30%, according to the CDC.

New microscopic technology from Tel Aviv University promises to be a game-changer in the field of reproductive assistance. A team of TAU

scientists has devised a new method of microscopy allowing scientists to perform clinical sperm analysis without the use of staining, which can affect the viability of sperm samples.

Sperm cells are nearly transparent under standard microscopy methods. Their optical properties differ only slightly from those of their surroundings, resulting in a weak image contrast. Sperm cells cannot be stained, if fertilization is the goal, because the process might damage the resulting fetuses. The challenge is to pinpoint strong sperm candidates without staining, while still being able to characterize their viability.

The research, recently published in *Fertility and Sterility*, was led by Dr. Natan Shaked, PhD, of the Department of Biomedical Engineering at TAU's Faculty of Engineering and his masters student, Dr. Miki Hifler, MD. Sperm cells for the study were obtained from the Male Fertility Clinic at Chaim Sheba Medical Center in Israel.

Improving the picture

There are two effective ART methods available today. The first is in vitro fertilization (IVF), in which a woman is treated with drugs that cause her ovaries to produce multiple eggs. These are placed in a Petri dish with a man's sperm for fertilization for three to five days, then implanted in the woman's uterus. The second is intracytoplasmic sperm injection (ICSI), in which a single sperm is injected into a mature egg and then transferred to a woman's uterus. Dr. Shaked's method is applicable to both methods, but is especially helpful in ICSI.

"Until now, clinicians have chosen the 'best' sperm according to their speed, but speed is not necessarily an indicator of DNA quality," Dr. Shaked says. "Some of the best sperm candidates are slow or even immobile because their tails have malfunctioned. If we can better determine the full structure and composition of the sperm, the success

rate of ART treatments will be higher. Success means more births without congenital defects. In cases where sample staining is impossible—such as in vitro fertilization and ICSI—our device provides a promising new direction."

A black box for better screening

His new device, a small "black box" attached to an existing microscope, is smaller, cost-effective, and easier to align than conventional interferometric imaging methods. It is joined to new automated software that produces a thickness map of the sample and other physical parameters to evaluate the sperm's viability in real time and, at a cost of only $1,000, can be used in any doctor's office already outfitted with a conventional microscope.

Dr. Shaked believes his new imaging process, which harnesses phase imaging methods to record the passage of light through a sample to assess its thickness, can quantify the quality of sperm used in ART, leading to more successful ART treatments.

The new method was developed with the support of Ramot, TAU's technology transfer company The team recently submitted their patent on the technology and are poised to begin clinical trials next year on IVF patients in Israel.

Provided by Tel Aviv University

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