Sperm found to swim in groups when in viscoelastic fluids

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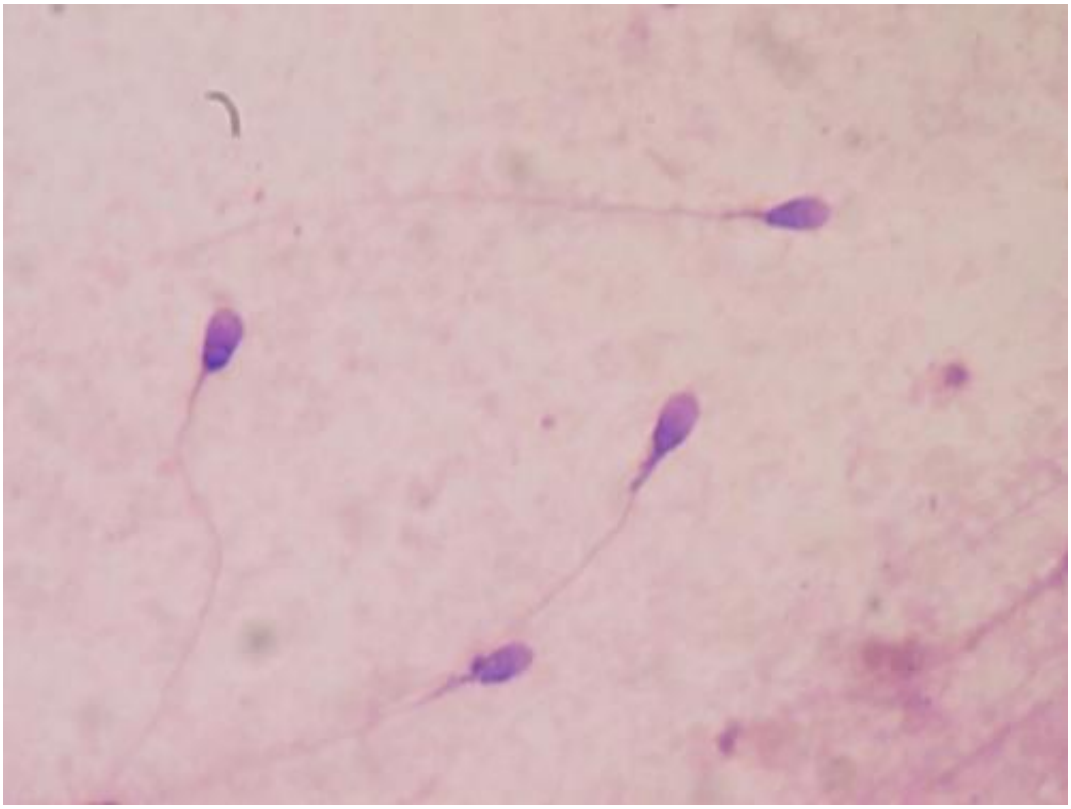

Human sperm stained for semen quality testing in the clinical laboratory. Credit: Bobjgalindo/Wikipedia

(Phys.org)—A team of researchers led by Chih-Kuan Tung of North Carolina A&T State University has found evidence that bull sperm tend to move closer together forming groups when swimming in viscoelastic fluids. Tung gave a presentation of the group's findings at a recent

meeting of the American Physical Society.

In order for sperm to make it from the vagina to a waiting egg, they must swim inside the vagina where they have been deposited during intercourse, through the cervix, then into the uterus and then to the wall where the egg has attached itself. This is the case for both humans and other mammals. But, the researchers noted, the fluid inside the reproductive tract is not thin like water, it has viscosity, and also in parts is a viscoelastic fluid, which means it is elastic, like silly putty or melted cheese. To learn more about the behavior of sperm as they swim, the researchers obtained bull sperm samples and placed them in various liquids in their lab.

They report that the sperm generally swam independently in all of the fluids tested except for those that were viscoelastic—in those cases, the sperm moved closer to one another, eventually forming into groups. Under the microscope they could see that the groups were also dynamic—members constantly joined as others left the group. They noted a similarity between the sperm grouping and the way some molecules behave when they interface with liquids. They noted also that as team members made the fluid more viscoelastic, by adding more polymers, the groups became tighter. Simply making the fluid thicker, on the other hand, did not cause grouping at all.

The researchers admit they do not know why the sperm group when in viscoelastic fluids, but suggest it must confer some reproductive advantage, adding that they also observed a certain degree of synchronicity of tail movements during grouping. They also noted that further study of sperm grouping might offer clues to help understand group swimming in fish, or flying in birds, because it offers a similar activity in a much simpler model. They also suggested that if grouping is something important to fertilization, it might be introduced as a means for improving IVF procedures.

More information: Abstract: V35.00006 : Collective dynamics of sperm in viscoelastic fluid, meetings.aps.org/Meeting/MAR16/Session/V35.6

Collective dynamics in biology is an interesting subject for physicists, in part because of its close relations to emergent behaviors in condensed matter, such as phase separation and criticality. However, the emergence of order is often less drastic in systems composed of the living cells, sometimes due to the natural variability among individual organisms. Here, using bull sperm as a model system, we demonstrate that the cells migrate collectively in viscoelastic fluids, exhibiting behavior similar to "flocking". This collectiveness is greatly reduced in similarly viscous Newtonian fluids, suggesting that the cell-cell interaction is primarily a result of the elastic property or the memory effect of the fluids, instead of pure hydrodynamic interactions. Unlike bacterial swarming, this collectiveness does not require a change in phenotype of the cells; therefore, it is a better model system for physicists.

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