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Keynotes: Ronald Ericsson, sperm separation, sex chromosomes, sperm cells, sex predetermination

In 1973, Ronald Ericsson developed the Ericsson method, which is a technique used to separate human male sperm cells by their genetic material. Ericsson, a physician and reproduction researcher, developed the method while conducting research on sperm separation in Berlin, Germany, in the early 1970s. He found that the sperm cells that carry male-producing Y chromosomes move through liquid faster than the others, which allows for the separation of the cells based on this characteristic. Therefore, male sperm cells are responsible for determining the sex of an embryo. If the male sperm [7] cell that fertilizes a female egg [9] contains a Y chromosome, the embryo is male. If the sperm [7] cell that fertilizes the egg [11] contains an X chromosome, the embryo is female. The mechanism of sperm [7] or folliculin, or the ability of sperm [7] cells to move through the female reproductive tract to reach and fertilize an egg [10], is seen in their capacity for swimming. A sperm’s swimming ability can indicate how successfully the sperm [7] cell can reach and fertilize an egg [10].

During the late twentieth century, emerging research suggested a difference between X chromosome-bearing sperm [7] cells and Y chromosome-bearing sperm [7] cells. In the 1960s, Landrum B. Shettles, a researcher and physician who specialized in human reproduction, claimed that there were physical differences between the two types of male sperm [7] cells. Shettles’ idea stimulated interest in the field of reproductive health, as the sperm [7] separation technique based on those physical differences had the potential to affect physiological capabilities of sperm [7], such as motility. That research served as a precursor for the development of the Ericsson method.


In his experiment, Ericsson took a sperm [7] sample and placed it on top of a solution of 25 percent liquid albumin in a glass column. The sperm [7] cells would then swim down the column through the albumin over a two-and-a-half hour period at 38 degrees Celsius. Afterward, Ericsson observed the sperm [7] cells at the top of the column because they failed to pass through the albumin medium in that amount of time, and transferred the remaining cells at the bottom of the albumin solution into a new test tube. Under Ericsson’s theory, the sperm [7] cells that remained at the bottom of the column were faster, and therefore more successful at fertilization. Ericsson then separated the sperm [7] cells from the albumin solution by centrifugation, or the process of separating a liquid mixture through rotational force. After removing the albumin, he found that the separated samples contained a high concentration of Y chromosome-bearing sperm [7] cells. To test his ideas further, Ericsson filled glass tubes, or separation columns, with the liquid/albumin medium and observed how sperm [7] cells swam through it. Later that same year, he published his findings in an article titled “Isolation of Fractions Rich in Human Y Sperm” that explained how the albumin columns work to separate sperm [7] cells.

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In Ericsson’s experiment, a sample collected at the bottom of the albumin column had a high concentration of Y chromosome-bearing sperm [7] cells, those sperm [7] cells were more agile and swam faster than X chromosome-bearing sperm [7] cells. The research team published their results in the article “Isolation of Fractions Rich in Human Y Sperm,” after which the process of utilizing albumin to separate sperm [7] became known as the Ericsson method.

In its early development, the Ericsson method’s primary use was not for pre-conception sex selection. In December 1974, Ericsson patented his method and included the objectives of his sperm [7] separation technique, which he listed in order of importance. Ericsson’s primary objective was to provide a process for separating human male sperm [7] samples into samples that have an enriched concentration of sperm [7] cells carrying Y chromosomes. Next, he listed using the enhanced Y chromosome-bearing sperm [7] fraction for artificial insemination for increasing the likelihood of male offspring, and did not provide instructions on how to do so in the patent. However, artificial insemination, the process in which sperm [7] cells are injected directly into a female’s uterus for fertilization, was already a common practice at the time Ericsson patented his method. In order for someone to use the Ericsson method for pre-conception sex selection, couples would need to inject the Y chromosome-bearing sperm [7] cells directly into a female’s uterus with an egg [11] using a syringe after the sperm [7] cells are separated through albumin medium. In his patent, Ericsson briefly mentioned that the method could be used for family planning. He claimed that a strong desire to have a child of a particular sex often causes couples to have many children until their favored sex is achieved, and that utilizing his method of sperm [7] separation for pre-conception sex selection would therefore reduce the society’s chance of possible overpopulation.

Two years after its initial development, a clinical trial tested the Ericsson method for pre-conception sex selection. Prior to that clinical trial, studies had shown that the method was effective for collecting sperm [7] samples with high concentrations of Y chromosome carrying sperm [7] cells. But there was no evidence that those samples successfully created male offspring because they had not yet been tested using artificial insemination, as there were still X chromosomes present in the sample. In 1975, physician Paul Zerwas, who specialized in obstetrics and gynecology and his team of researchers at the University of Chicago, developed a method to test whether the separated samples produced by the Ericsson method affected the sex ratio of human offspring. During that initial clinical trial, physicians successfully impregnated seven women using artificial insemination with sperm [7] samples that were separated by the Ericsson method. Of those seven, five women delivered male infants. The researchers involved in the initial clinical trial determined that when sperm [7] cells are separated using the Ericsson method and artificially inseminated for conception [16], there is an increased chance of producing male offspring.

Since that initial clinical trial, further studies have supported the effectiveness of the Ericsson method. In 1976, Ericsson began a clinical trial in collaboration with Ferdinand Beernink, an obstetrician and gynecologist, in Berkeley and Sausalito, California. Over the course of the first six years of using the Ericsson method of sperm [7] separation and artificial insemination, ninety-one births occurred and sixty-eight of them were males. Those results produced a 75 percent male birth ratio. Beernink and Ericsson continued their clinical trial until 1985. They concluded the clinical trial with a total of 1,348 births after artificial insemination with sperm [7] separated using the Ericsson method, 749 of which were male. Those results produced a 72 percent male birth ratio, only slightly lower than their results eleven years prior. Beernink and Ericsson published their results in the journal Fertility and Sterility for the same year the study concluded. In their article, the authors claimed that to date, the Ericsson method was the only clinical method of pre-conception sex selection favoring males that had been continuously supported by scientific data.

However, other researchers have contested the method’s effectiveness at sexing the ratio in favor of males. In 1994, Ericsson published an article in the journal Human Reproduction, in which he specifically addressed the studies conducted in the twenty years after the development of the method that did not support his results. He claimed that those studies did not duplicate his original methods correctly, and therefore were not able to sufficiently evaluate his work. Ericsson provided examples of how his methods were reproduced incorrectly, including over-staining of the separated sperm [7] cells, failure to remove immotile cells that remained at the top of the albumin column effectively, and increasing the temperature at which the experiment was performed from thirty-five to thirty-seven degrees Celsius. In the article, Ericsson stated that researchers who did not replicate his method accurately essentially conducted experiments that were completely unrelated to his. Therefore, he concluded that those studies did not correctly confirm or contrast the results from his original publication and should thus be dismissed entirely.

In 1997, another study published in Human Reproduction attempted to make definitive conclusions on the effectiveness of the Ericsson method. That study replicated the original methods exactly, and also addressed the alterations made in previous studies that did not confirm Ericsson’s initial results. The experiment was conducted at Taichung Veterans General Hospital’s Department of Obstetrics and Gynecology in Taichung, Taiwan. The researchers examined sperm [7] samples from twenty-one healthy males. Even after following Ericsson’s methods precisely, the researchers failed to show that the Ericsson method of sperm [7] separation produced an enrichment of sperm [7] cells that carried Y chromosomes. In fact, the results produced a slightly increased concentration of X chromosome-bearing sperm [7] cells in the sample collected at the bottom of the albumin column, which contradicted Ericsson’s original finding. The 1997 study did not use the separated sperm [7] samples for artificial insemination to see if the sex ratio was affected. However, the results did not confirm Ericsson’s results from his initial study.

Despite the inconclusive data that both supports and invalidates the Ericsson method, the method is still utilized for sex selection at Genetics Limited. As of 2018, Ericsson is the president of Genetics Limited, a company he created that has exclusive access to his patented method of sperm [7] separation using albumin columns. While the company’s headquarters are in Alzada, Montana, it has licensed laboratories, called Sperm Centers, which offer the Ericsson albumin method both in the US and internationally. According to the Genetics Limited website, thousands of children have been born using the Ericsson method, but the success rates for couples that have achieved their desired sex are not advertised directly. Instead, the website provides twelve citations of scientific papers that discuss the development of the Ericsson method and data from clinical trials that only support the method’s effectiveness. In a memorandum from the company published in October 1987, Genetics Limited claimed their Sperm Centers have demonstrated an 86 percent success rate for producing a male offspring. Since then, there have been no additional memorandums from the company.

Sources
The Ericsson method is a technique developed in the 1970s by Ronald Ericsson to separate human male sperm cells by their genetic material. In 1973, Ericsson developed the method while conducting research on sperm isolation in Berlin, Germany. He found that the sperm cells that carry male-producing Y chromosomes move through liquid faster than the cells that carry female-producing X chromosomes. As a result of his findings, Ericsson suggested suspending a semen sample in a viscous liquid made from albumin protein, and collecting only sperm that quickly pass through the liquid. Shortly after Ericsson described his method, researchers demonstrated that it was effective for sex selection. However, later studies contested those results. Despite that, the Ericsson method is still utilized by couples in 2018 as a means of sex selection and was the first sperm separation technique used in combination with artificial insemination to enable people to select the sex of their children.

Subject
- Sex chromosomes
- Gonosomes
- Sperm
- Male gametes
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- Sex Preselection
- X-Chromosome Bearing Sperm
- Y-Chromosome Bearing Sperm

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