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Editorial

New Perspective Regarding the Sperm

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EDITORIAL

What is life? Several types of atoms are combined to make up DNA and proteins that in turn form cells; do these components automatically begin functioning as part of a living organism? Or do components begin functioning as part of a living organism when they are first inspired with the spark of life or spirit? Some people, be they materialists or dualists, believe that human's life begins at the instant that a sperm fertilizes an ovum. Do you think that the ovum and sperm themselves already contain life? When I observed the movement of sperm and was reminded of a vibrating device with a spring attached to its neck. If that model were actually true, then the rules that do or do not govern sperm motility could be calculated based on theoretical physics. Such calculation yielded the following law [1]:

$1/V = a\,(1/A) + b$

$f = c$

Where V is the forward velocity (curvilinear velocity) of sperm, A is the amplitude of lateral head movement, f is the beat-cross frequency of head movement, and a, b, and c are constants. The validity of this law was proved by treating sperm with Percoll procedure and subjecting them to computer-assisted sperm analysis (CASA).

The radius of curvature, rather than linearity (L, defined as straight-line velocity/curvilinear velocity), should be used to indicate the curvature of the path that a sperm takes. The approximate radius of curvature of the path taken by a sperm was mathematically determined as follows [2]. Sperm were analyzed in several types of chambers with different depths using CASA. Based on measurements of V, A, and L, the radius of curvature and the sperm equation [1] (the equation for the regression line obtained by using 1/V as the vertical axis and 1/A as the horizontal axis) were determined and the resulting error in 1/V was calculated. This calculation revealed that the radius of curvature and the error in 1/V were negatively correlated [2]. Some outside forces must be at work for sperm motility to deviate from the aforementioned law of sperm motility. Those outside forces are presumably gravity and friction generated by the chamber walls. If gravity is ignored, then friction resulting from contacts with the chamber walls makes the sperm path winding and produces an error from the sperm equation. A Makler chamber was one of the several types of chambers used to analyze sperm. Analysis in a Makler chamber yielded the smallest standard error from the sperm equation. Thus, a Makler chamber is currently the best chamber for analyzing sperm using CASA.

Radius of curvature = $1/\mathrm{SQR}\,(12)\times V/\mathrm{SQR}(1-L^2)$

SQR (*) is the square root of *

An experiment based on the equation for the radius of curvature yielded the following law [2]. The relationship between V and A is indicated by the equation for sperm motility, and the relationship between L and V is indicated by the inequality for the radius of curvature. Based on these two relationships, previously reported measurements results of V, A, and L in relation to hyperactivation can all be explained. Thus, the phenomenon known as hyperactivation simply means being a high energy state. Flagellar movement that makes sperm appear to jump is a phenomenon caused by high-energy sperm being trapped against chamber walls.

$L^2 < 1 - kV^2$ k is a constant

In light of these 3formulas, sperm can, prior to fertilizing an ovum, be termed a machine for carrying genetic material (DNA).

A sperm has to penetrate the zona pellucida in order to fertilize it. Sperm around an ovum presumably have to be at a certain concentration or higher so that the sperm and ovum make contact. A sperm presumably has to have a certain level of mechanical energy in order to enter an ovum.

If one considers the distribution of mechanical energy among a group of sperm in a closed system, according to quantum theory a quantum of energy is distributed to each sperm. When analyzing sperm in a Makler counting chamber using CASA, n is assumed to be the sperm count in 1 field and λ is assumed to be the mean of the square of the amplitude of lateral head displacement. Based on theoretical physics, a law for the distribution of mechanical energy among sperm can be determined using the law of sperm motility and quantum theory [3]. The validity of this law was proved based on its agreement with the measured distribution.

Based on this law for the distribution of mechanical energy, an index indicating the mechanical energy of sperm was determined [3]. The sperm energy index (SEI) is an index indicating the total mechanical energy of all sperm in 1 field and is defined

as nKλ/100. The mean sperm energy index (MEI) is an index indicating the average mechanical energy of a single sperm and is defined as Kλ. K value can be calculated from data provided by CASA based on these sperm theory. During sperm analysis using CASA, sperm are continuously measured in a total of 5 fields, i.e. the 4 corners and center, in a Makler chamber, thus avoiding an incidental bias in data due to human error in field selection.

A study examined the sperm of men who had fathered children and the sperm of husbands in infertile couples in which infertility was not attributed to the wife. This study found that a couple had very little potential to conceive naturally when MEI/SEI is 2 or greater. When MEI/SEI is less than 2, a larger SEI indicates a greater potential for conception [3]. When analyzing sperm in a Makler chamber using CASA, MEI/SEI=2 corresponds to a concentration of motile sperm of 20×10^6/ml. SEI is an index indicating the concentration of motile sperm × the average mechanical energy of a single sperm.

The findings of sperm parameters of semen from the same patient vary considerably on different dates. A study of several patients examined ejaculates from the same patient on different dates [3]. This study found that none of the patients with MEI/SEI of 2 or greater had fathered children but that some patients with MEI/SEI of less than 2 were infertile. This means that a patient has sperm with no potential to fertilize an ovum even if the patient's concentration of motile sperm is 20×10^6/ml or higher. A certain level of mechanical energy of sperm is a requirement for fertilization. Other requirements, such as preparations for the acrosome reaction at the head of sperm, must be considered to accurately determine a sperm's potential for fertilization.

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