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ORIGINAL

Negative correlation between presence of reactive oxygen species and Sperm Motility Index in whole semen samples of infertile males

Shinnosuke Kuroda^{a,b}, Yasushi Yumura^{b,*}, Kohei Mori^b, Kengo Yasuda^b,
Tepei Takeshima^b, Takashi Kawahara^c, Yasuhide Miyoshi^c, Hiroji Uemura^c,
Akira Iwasaki^b, Kunitomo Takashima^d, Mario Ikeda^d, Yoshihito Kondo^d

^a Department of Urology, Yokohama Minato Red Cross Hospital, Kanagawa, Japan

^b Department of Urology, Reproductive Center, Yokohama City University Medical Center, Kanagawa, Japan

^c Department of Urology, Yokohama City University Medical Center, Kanagawa, Japan

^d Ebina Ladies' Clinic, Kanagawa, Japan

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KEYWORDS

Male infertility;
Reactive oxygen
species;
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Abstract

Objective: To investigate the relationship between the Sperm Motility Index and the presence of reactive oxygen species in semen.

Methods: We retrospectively analyzed Sperm Motility Index measured by the Sperm Quality Analyzer and reactive oxygen species levels in 92 semen samples of infertile male patients who visited the Ebina Ladies' Clinic between September 2011 and June 2012. Using the same semen samples, we also analyzed 8 sperm parameters measured by computer-assisted semen analysis and validated the relationship with the Sperm Motility Index.

Results: The presence of reactive oxygen species in semen was positive in 19 samples and negative in 73 samples. In the reactive oxygen species-positive group, there was a significant negative correlation between the logarithm of reactive oxygen species level and Sperm Motility Index ($p = 0.039$).

Conclusions: This is the first study to find a significant negative correlation between Sperm Motility Index and reactive oxygen species level. This result indicates that the presence of reactive oxygen species in semen may inhibit the fertilization ability of spermatozoa as measured by the Sperm Motility Index.

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* Corresponding author.

E-mail address: yumura@yokohama-cu.ac.jp (Y. Yumura).

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PALABRAS CLAVE

Esterilidad masculina;
Especies reactivas
del oxígeno;
Índice de movilidad
espermática

Correlación negativa entre la presencia de especies reactivas del oxígeno y el índice de movilidad espermática en muestras completas de semen de varones estériles

Resumen

Objetivo: Investigar la relación entre el índice de movilidad espermática y la presencia de especies reactivas del oxígeno en el semen.

Métodos: Analizamos retrospectivamente el índice de movilidad espermática medido por el analizador de calidad del esperma y los niveles de especies reactivas del oxígeno en 92 muestras de semen de varones estériles que visitaron Ebina Ladies' Clinic entre septiembre de 2011 y junio de 2012. Con las mismas muestras de semen también analizamos 8 parámetros del esperma medidos mediante un análisis de semen asistido por ordenador y validamos la relación con el índice de movilidad espermática.

Resultados: La presencia de especies reactivas del oxígeno en el semen dio positivo en 19 muestras y negativo en 73. En el grupo positivo para especies reactivas del oxígeno hubo una correlación negativa significativa entre el logaritmo de nivel de especies reactivas del oxígeno y el índice de movilidad espermática ($p = 0,039$).

Conclusiones: Este es el primer estudio que encuentra una correlación negativa significativa entre el índice de movilidad espermática y el nivel de especies reactivas del oxígeno. Este resultado indica que la presencia de especies reactivas del oxígeno en el semen podría inhibir la capacidad de fecundación de los espermatozoides según la medición del índice de movilidad espermática.

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Introduction

Recently, the Sperm Quality Analyzer[®] (SQA), a useful instrument to assess sperm quality, has been widely used in the field of male infertility. The Sperm Motility Index (SMI) is a single value obtained via the SQA that reflects the number of sperm, intensity of movement, viability, and concentration of motile sperm in a semen sample. The SMI is a measurement of optical density fluctuations caused by motile cells that has been reported to correlate statistically with motile sperm parameters.¹⁻³ One study reported that the SMI could be used to rule out oligozoospermia and asthenozoospermia by setting a threshold value.⁴ Based on previous studies, the SMI is a simple and useful quantifiable measure of sperm quality and activity.

Reactive oxygen species (ROS) in semen were first reported by Aiken in 1987.⁵ According to the study, immature sperm and leukocytes in semen are considered the origin of ROS. The presence of ROS affects sperm function and fertilizing ability through several mechanisms, such as deterioration of sperm motility, DNA fragmentation, and lipid peroxidation of sperm plasma membranes.⁶⁻⁸ Iwasaki et al. reported that ROS was detected in the semen of 40% of male infertile patients.⁹ Another group suggested that the combination of ROS level and total antioxidant capacity could predict idiopathic male infertility.^{10,11}

Although both SMI and ROS are useful to assess sperm quality and activity, no previous study has examined the relationship between these two parameters. The aim of this study was to examine the relationship between SMI and ROS in infertile males to determine the utility of measuring ROS levels in semen.

Materials and methods

We examined the nonprocessed semen samples of 92 male patients who visited the Ebina Ladies' Clinic between September 2011 and October 2012. Written informed consent was obtained from all patients for their data to be used for research purposes. At the patients' first visits, the SMI of the semen samples was measured using SQA-V[®] (Medical Electronic Systems, Israel). Using the same semen samples, a computer-assisted semen analyzer (CASA) was also used to determine 8 semen parameters: concentration, motility, straight-line velocity (VSL), curvilinear velocity (VCL), linearity, mean amplitude of lateral head displacement (mALH), beat-cross frequency (BCF), and progressive motility.

The ROS production levels in whole semen were measured using a computer-driven LKB Wallac 1251 Luminometer[™]. Chemiluminescence was recorded after the addition of 40 μ L of 4mM luminol (5-amino-2,3-dihydro 1,4-phthalazine-dione) to 500 μ L of whole semen. When the luminescence was equal to or greater than 0.1 mV/s at peak value, ROS production in the sample was considered positive.⁹ The integrated values of ROS were also used to clarify the differences between ROS positive and negative cases. The definite integral level of ROS between 0 and 30 min after the addition of luminol was expressed by the unit mV/30 min/ 10^6 spermatozoa and considered the ROS level of the sample (Fig. 1).

The samples were divided into an ROS-positive group and an ROS-negative group. The SMI, ROS level, and 8 semen parameters were compared between the two groups using univariate analysis. The correlation between SMI and each semen parameter was calculated using the Spearman

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