

Correlation between Sperm Motility and Morphology in the Success Rate of in Vitro Fertilization Procedure

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Abstract

Background: In vitro fertilization (IVF) is one of the assisted reproductive technology that has been used in treating infertility. Unfortunately, not every IVF procedure achieves 100% success in fertilizing the oocyte. It has been studied that the percentage of normal motile sperm and percentage of normal sperm morphology play a key role in this process. This study was conducted to evaluate correlation between sperm motility and morphology in the success rate of IVF.

Methods: This study was an observational analytic involving medical records of infertile couples who were treated by IVF procedure in Dr.Hasan Sadikin General Hospital Bandung in 2009–2014. The variables that were used in this study were percentage of sperm motility, percentage of sperm morphology and fertilization rate. The collected data was analyzed using nonparametric Mann Whitney test and Spearman correlation test.

Result: This study showed that there was a significant difference between the fertilization rate group and sperm motility ($p=0,048$) but there was no significant correlation between motility and the entire fertilization rate ($p=0,319$). This study also indicated that there was no significant difference between fertilization rate group and sperm morphology ($p=0,232$) and there was no significant correlation between sperm morphology and fertilization rate ($p=0,720$).

Conclusions: Motility might has a role in determining the success rate of in vitro fertilization; meanwhile morphology does not have any role in determining the success rate of in vitro fertilization.

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Keywords: Fertilization rate, in vitro fertilization, sperm morphology, sperm motility

Introduction

Infertility is a condition affecting married couples who have failed to achieve conception after 12 months or more of having unprotected sex.¹ Infertility occurs in 10–15% of couples.² The first line therapy for infertility is by treating the cause of infertility.³ Assisted reproductive technologies (ART) is used if other medicines fail to treat the cause of infertility.³ In vitro fertilization (IVF) is one of the ART that is commonly used as it is safer than other assisted reproductive technologies.⁴ Fertilization in IVF is performed outside the female body and helps facilitating sperm to fertilize oocytes. Unfortunately, IVF is not always successful.⁵ A number of factors, from both males and

females, influence the success of IVF.

One of the male factors that affects the success of IVF is the quality of sperm used.^{6,7} Sperm quality can be evaluated using semen analysis parameters. Parameters of semen analysis which are most frequently examined and are affiliated to fertility success are concentration, motility, and morphology.⁸ In vitro fertilization is considered to have a low success rate when sperm parameter results are below the World Health Organization (WHO) reference.⁹

However, it is still debatable whether sperm parameters are directly related to the success of in vitro fertilization.¹⁰ The main objective of this study was to assess correlation between the percentage of sperm morphology and

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motility towards in vitro fertilization success.

Methods

This study used an analytic correlative-comparative method with a cross-sectional study design. The population of this study consisted of medical records of married couples who had used assisted reproductive technology in the form of IVF at Aster Fertility Clinic, Dr. Hasan Sadikin General Hospital Bandung, in the period of 2009–2014. Samples were taken from population using total sampling method. The sample was divided into two types. The first samples (N1) were taken to analyze correlation between sperm motility and fertilization success rate analysis and the other samples (N2) were taken to analyze correlation between sperm morphology and fertilization success rate analysis. The samples was also arbitrarily divided into 2 groups based on available data percentage of their fertilization success rate; high fertilization success rates ($\geq 50\%$) and low fertilization success rates ($< 50\%$).

Medical records were compiled based on the inclusion and exclusion criteria. The inclusion criteria was age of female partner < 35 years old, age of female partner ≥ 35 years old with a Follicle Stimulating Hormone (FSH) rate < 10 mIU/ml on the 3rd day of hormone therapy. The exclusion criteria was an FSH rate ≥ 10 mIU/ml on the third day of hormone therapy as this may cause a decrease in quality

of the ovarian reserve,² and incomplete data in medical records on the percentage of sperm motility, percentage of sperm morphology, number of oocytes collected and the number of successful fertilized oocytes.

Variables in this study were the percentages of sperm motility, sperm morphology, and fertilization success rate. The percentage of sperm motility was defined as the percentage of sperm that moved progressively against the total number of sperm. According to WHO, sperm motility below 40% was considered low. The percentage of sperm morphology was defined as the percentage of sperm with normal morphology as compared to the total number of sperm. According to WHO, sperm morphology below 4% was considered low. Motility and morphology were assessed using computer aided-sperm analysis (CASA). The percentage of fertilization success was determined by comparing the total number of fertilized ovum, defined by formation of 2 pronuclei, with the total number of ovum collected. The percentage of successful fertilization was then categorized into low fertilization success ($< 50\%$) and high fertilization success ($\geq 50\%$).

Data was presented in the form of averages \pm SD if the data was normally distributed; whereas, the data was presented in the form of medians and ranges between minimum-maximum if data was not normally distributed. Nonparametric Mann Whitney Test was used to compare 2 groups of fertilization success

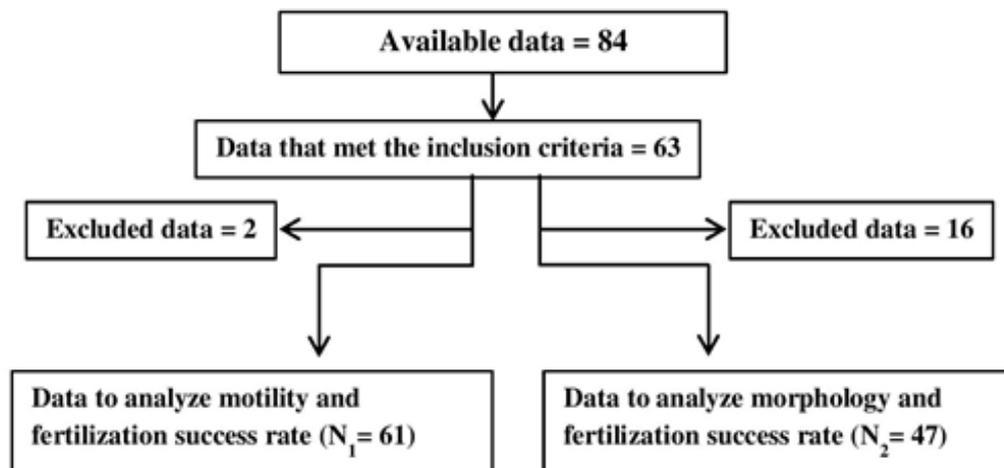


Figure 1 Sample Selection Process

rates. Spearman Correlation Test was used to analyze the correlation between the percentage of sperm morphology and fertilization success rate and the same test was also used to analyze the correlation between the percentage of sperm motility and fertilization success rate.

This study had been approved by the Health Research Ethic Committee Dr. Hasan Sadikin General Hospital Bandung.

Results

Total of 84 medical records obtained, 63 medical records met the inclusion criteria. From 63 which met the inclusion criteria, there were 2 and 16 excluded data for N1 and N2 consecutively (Figure 1). Female partners who did not have data on FSH levels but were below the age of 35 years old were included in this study as female who were younger than 35 usually have FSH rate <10 mIU/ml on the 3rd day of hormone therapy.¹¹

In samples that were used to analyze correlation between motility and fertilization success rate, female factors were the most frequent cause of the infertility. Fallopian tube disorders were the most frequent infertility

disorder followed by endometriosis and asthenozoospermia.

In samples that were used to analyze correlation between morphology and fertilization success rate, female factors were the most frequent cause of the infertility. Fallopian tube disorders were the most frequent infertility disorder followed by asthenozoospermia and endometriosis.

Analysis showed that there was a significant difference ($p=0,048$) between fertilization success rate group and the percentage of sperm motility, but even though the sperm motility was normal (>40%) the fertilization success rate could still be low (<50%) (Table 3). However, there was no significant difference ($p=0,232$) between fertilization success rate group and the percentage of sperm morphology (Table 4).

Based on the correlation test, there was no significant correlation ($p=0,319$) between the percentage of sperm motility and the fertilization success. Based on the correlation test, there was no significant correlation ($p=0,720$) between the percentage of sperm morphology and the fertilization success (Table 4).

Table 1 Sample Characteristics in Correlation between Motility and Fertilization Success Rate

Characteristics	Total
Female age	35(25-44)*
Male age	37+-6**
Total sample	61
Factors affecting infertility	
Female	39
Male	9
Male and Female	6
Unexplained	7
Infertility disorders	
Adenomyosis	3
Endometriosis	9
Fallopian Tube disorders	32
Ovulation disorders	3
Asthenozoospermia	9
Teratozoospermia	6
Unexplained	7

Note: *median and range (minimum-maximum)**average \pm standard deviation

Table 2 Sample Characteristics in Correlation between Morphology and Fertilization Success Rate

Characteristics	Total
Female age	34±4*
Male age	37±6*
Total sample	47
Factors causing infertility	
Female	28
Male	9
Male and Female	6
Unexplained	4
Infertility disorders	
Adenomyosis	3
Endometriosis	7
Fallopian Tube disorders	26
Ovulation disorders	3
Asthenozoospermia	8
Teratozoospermia	6
Unexplained	4

Note: * median and range (minimum–maximum)

Table 3 Comparison between Fertilization Success Rate Groups with Sperm Motility and Morphology Percentage

Sperm Parameters	Fertilization Success Rate		p-value
	<50%	≥50%	
Motility (%)	60 (37–70)***	50(30–96)	p=0,048*
Morphology (%)	13 (2–41)***	17 (2–41)	p=0,232**

Note: *Mann–Whitney u–test, **Independent t–test,***median and range (minimum–maximum)

Discussion

Theoretically, the difference between IVF and the natural fertilization process is the environment where fertilization takes place; however, the ability of sperm to penetrate the ovum is still required.⁶ The results from this study showed that there was a significant difference between the fertilization success

rate group and the percentage of sperm motility (Table 3). This result was similar to a study by Langlois et al.⁸ Low in vitro fertilization success rates can be attributed to the percentage of sperm motility that is below the WHO reference (<40%).^{4,8}

Nonetheless, in this study, low fertilization success rates occurred in males with a sperm motility percentage above 40%, and high

Table 4 Correlation between Sperm Motility and Morphology Percentage with Fertilization Success Rate

Sperm Parameters	Fertilization Success Rate	Correlation Coefficient
Motility (%)	p=0,319*	-0,130
Morphology (%)	p=0,720*	0,054

Note: *Spearman correlation

fertilization success rates can occur in males with a sperm motility percentage below 40% (Table 3). This showed that the number from a parameter analysis was not the only factor that affects fertilization success rates. Aside from a parameter analysis, a deeper evaluation on sperm function should be conducted.^{4,6,7} Other studies also suggested that the total number of motile sperm has more influence as compared to the percentage of motile sperm.^{5,12} Nevertheless, there was no significant correlation between the percentage of sperm motility and fertilization success rate (Table 4) and this result was in contrast to the study by Langlois et al.⁸ This could be due to an uneven distribution of samples and an inadequate sample size in this study.

Based on the analysis results, there was a significant difference between the percentage of sperm morphology and fertilization success rates group (Table 3) and no significant correlation between the percentage of sperm morphology and fertilization success rate (Table 4). Low and high fertilization success rates occurred in males with a sperm morphology percentage of 41% (Table 3).

Low and high fertilization success rates can occur in males having a sperm morphology percentage below the WHO reference (<4%). These results were contradict with studies by Langlois et al.⁸ and van der Westerlaken et al.¹³ which stated that the percentage of sperm morphology influences fertilization success rates in vitro because abnormalities in sperm morphology influences the ability of sperm to penetrate an oocyte.

On the other hand, studies by Lewis,¹⁰ Brita Söderlund and Lundin,¹⁴ and Ghirelli-Filho et al.¹⁵ concluded that sperm morphology did not influence fertilization success rates in IVF. The reason why the results were different could also be because of the cause of the infertility in this study's sample (both female and male factors) and the other studies. This shows that sperm morphology is not an absolute factor in determining fertilization success rates.

In previous studies by Keegan et al.¹⁶ and van der Westerlaken et al.¹³ it was described that in vitro fertilization was still possible with a low percentage in sperm morphology as long as the percentage of sperm motility and the total motile sperm count was within the normal limits.^{13,16} Correlation between morphology and fertilization success rate is still debatable.^{4,10}

Technological advancement in this field of study, especially in the use of media and materials, has provided positive impact

towards fertilization success rates in males with a low sperm morphology percentage.¹⁶ The uncertainty of the influence of the percentage of sperm morphology can be attributed to the difficulty in having an objective evaluation in determining the total percentage of normal sperm morphology during semen analysis which may cause misinterpretation of results.^{14,15}

The conclusion of this study is that the percentage of sperm motility influences the fertilization success rate. However, this study has not yet established relationship between the percentage of sperm motility and fertilization success rate whereas, the percentage of sperm morphology does not influence or has a significant relationship towards fertilization success rate.

This study had a number of limitations. The total number of samples collected did not meet the minimum sample size. Other functional sperm factors, which are rarely examined such as sperm DNA fragmentation, acrosin activity, and sperm chromatin conditions were not controlled and could influence fertilization success. Previous studies reported that these functional factors highly influence the success of sperms to fertilize ovum. It recommended to use a larger sample size and investigate other sperm factors in further study.

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