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Studying the effect of adding autologous platelet rich plasma to the human semen on the sperm motility

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Abstract

Background
Although there is no information on its effect on semen parameters, plasma rich in platelets (PRP) have been utilized for healing processes, maxillary oral surgery, and plastic surgery; nevertheless, there is no information on its usage in andrology.
Aim: To investigate the effect of adding autologous platelet rich plasma to the human semen on sperm parameters.

Material and method: The current experimental trial study has included 100 semen samples. The study was established in the High Institute for Infertility diagnosis and Assisted Reproductive Technologies from November/2020 to February /2021. Ejaculated semen sample were obtained by masturbation. Semen samples after doing semen analysis were divided to two equal portions, the first one without adding autologous platelet rich plasma and the second portion with adding directly autologous platelet rich plasma 2%. Assessment of sperm count, concentration, motility and morphology according to WHO.

Result: There was highly significant rise in total motility, progressive motility grade A + B, progressive motility grade A, progressive motility grade B and non-progressive motility % ($p < 0.001$). There was also highly significant rise in total progressive motile sperm/ concentration and total progressive motile sperm/ejaculate ($p < 0.001$).
Conclusion: Autologous platelet rich plasma (PRP) has been effectively improving the human sperm motility.

Key words: PRP, sperm preparation, ART

1. Introduction

Infertility is defined by the World Health Organization as the inability to conceive after at least 12 months of unprotected intercourse (WHO 2010).

Male factor infertility has been reported to play a role in 30-55 percent of infertile couples (Hamada et al., 2013). Despite developments in andrology diagnostic techniques, a large subset of these sub fertile men is still identified as having unexplained male infertility. Male infertility can be caused by a variety of factors, the most common of which is sperm dysfunction (Hamada

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et al., 2013). Male infertility is traditionally diagnosed by microscopic examination of sperm concentration, motility, and morphology, but the results of this standard semen study are insufficient as a diagnostic tool in male infertility (Chi et al., 2011).

platelet-rich plasma (PRP) is a novel therapeutic alternative that is being used in a variety of medical fields including dermatology, orthopedics, and dentistry (Lubkowska et al., 2012). PRP is defined as an autologous concentration of human platelets that is 3 to 5 times higher than the physiologic concentration of thrombocytes in whole blood (Knezevic et al., 2016). The involvement of various growth factors including transforming growth factor b, fibroblast growth factor, vascular endothelial growth factor, insulin-like growth factor 1, platelet-derived growth factor, zinc, and superoxide dismutase contribute to its potential therapeutic impact (Appel et al., 2002), (Laskaj et al., 2009), (Castillo et al., 2011), (Magalon et al., 2014).

Platelet rich plasma (PRP) is a portion contained in blood plasma that has been researched and used in a variety of medical specialties, but there have been no records of its use in male reproduction until now up to our knowledge.

2. Material and methods

The study was approved by Al-Nahrain University's High Institute for Infertility Diagnosis and Assisted Reproductive Technologies' ethics committee, which collected 100 sperm samples from men who visited an infertility clinic at the High Institute for Infertility Diagnosis and Assisted Reproductive Technologies. Each participant had given informed consent to use the remainder of their sample before being included in the validation trial. The study has started in (November 2020) and has ended on (June 2021).

2.1 Sample collection and processing

Masturbation was performed to collect samples, which were then placed in sterile containers. Only one seminal sample was taken from each patient. Following receipt of the samples, they were immediately placed in a 370°C incubator to complete liquefaction in preparation for semen analysis. After numerous trials and pilot studies with various concentrations of PRP (2%, 5%, and 10%), it was discovered that the 2% was the optimal percentage for PRP preparation and providing substantial effects. Each sperm sample was separated into two portions. The first was treated with 2% PRP, while the second was not. After incubation for 15 min, assessment of semen parameters according to WHO.

3. Statistical Analysis

The statistical package for the social sciences (SPSS version 23) computer software application was used to examine the data. P-values of 0.05 or less were used to determine the degree of significance. P-values equal to or less than 0.01 were judged to be of high significance.

4. Result

Comparison of sperm characteristics before and after adding PRP in all enrolled samples is shown in table 1. There was highly significant rise in total motility, progressive motility grade A + B, progressive motility grade A, progressive motility grade B and non progressive motility % ($p < 0.001$). There was also highly significant reduction in non-motile grade D %

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($p < 0.001$). There was also highly significant rise in total progressive motile sperm/ concentration and total progressive motile sperm/ejaculate ($p < 0.001$).

Table 1: Comparison of sperm motility before and after adding PRP in all enrolled samples

Characteristic	**PRP** ***n*** **= 100**	**Baseline** ***n*** **= 100**	***P***
Total motility %			
Mean ±SD	68.20 ±19.65	54.15 ±19.21	< 0.001 P HS
Progressive motility (A+B) %			
Mean ±SD	39.22 ±20.26	28.17 ±17.31	< 0.001 P HS
Progressive motility (A) %			
Mean ±SD	13.51 ±10.44	6.68 ±7.52	< 0.001 P HS
Progressive motility (B) %			
Mean ±SD	25.71 ±12.72	21.49 ±12.90	< 0.001 P HS
Non Progressive motility (C) %			
Mean ±SD	29.09 ±12.63	25.98 ±13.26	< 0.001 P HS
Immotile sperm (D) %			
Mean ±SD	31.80 ±19.65	45.85 ±19.21	< 0.001 P HS
Total progressive sperm /Concentration m/ml			
Median (IQR)	1.66 (2.33)	1.27 (2.05)	< 0.001 W HS
Total progressive sperm / ejaculate m/ ejaculate			

Median (IQR)	0.67 (0.93)	0.49 (0.79)	< 0.001 W HS

n: number of cases; **SD**: standard deviation; **P**: paired *t*-test; **W**: Wilcoxon test; **HS**: highly significant at $p \leq 0.01$

5. Discussion

Male factor infertility is believed to be responsible for around half of all fertility issues. These issues either inhibit sperm production or affect sperm function after they have been generated. The use of autologous PRP in human reproduction appears to be a safe treatment choice with a range of potentially beneficial results, according to new therapies emerging in the medical filed. (Lubkowska et al., 2012). In this regard, the study's goals were one of very few studies that first examine the effect of PRP on different sperm function characteristics, and then to investigate for they may be first time the possible effect of PRP on human sperm parameters.

Although no previous human studies or articles have been published on this subject, other animal experimental studies have suggested that PRP can help improve sperm quality in terms of progressive motility (Hernandes-Corredor at al., 2020).

The results of this research corroborate those of some experimental studies that have demonstrated the role of PRP in sperm activation, with PRP being superior in increasing the percentage of progressively motile sperm (Hernandes-Corredor et al., 2020), (Bader et al., 2020).

By comparing parameters of nontreated spermatozoa to those treated with 2 percent PRP, the biological function of autologous PRP in male infertility treatment was determined. The latter group, interestingly, showed an increase in activity and motility.

Our finding when Comparison of sperm characteristics before and after adding PRP in all enrolled samples is shown in table 1. There was highly significant rise in total motility and progressive motility. Agree with results from study on the ram semen when suggests that the PRP improves the motility of the ram spermatozoa. (Hernandez-Corredor et al., 2020).

The various bioactive components in PRP are primarily responsible for its beneficial effects. (Appel et al., 2002), (Laskaj et al., 2009), (Castillo et al., 2011), (Magalon et al., 2014). Many of these factors have been tested solely on spermatozoa and have shown to have a substantial positive impact on their quality and function.

Endogenous and exogenous factors influence sperm motility. The appearance of this motility is linked to an increase in intracellular cyclic AMP and protein dependent cyclic AMP kinases, as well as a decrease in Ca++ and calmodulin. A rise in intracellular carnitine in sperm is related to progressive mobility (Vera-Muñoze, 2008). According to the research by (Metcalf et al., 2013) the use of PRP containing serotonin can be beneficial and induces an increase in progressively motile sperm, with values close to those found in a study by (Jiménez-Trejo et al., 2012) in human sperm that used high concentrations of serotonin to improve progressively motile sperm.

Agree with (Saucedo et al., 2008) which studied the expression, functionality, and involvement of FGF2 in human sperm cells and discovered that FGFRs were found in the acrosomal area and flagellum of ejaculated spermatozoa. When spermatozoa were exposed to FGF2, phosphorylation of the flagellar FGFR increased, as did activation of the extracellular signal regulated kinase and protein kinase B signaling pathways, resulting in a substantial increase in total and progressive sperm motility. Seminal TGF was discovered to increase sperm motility and total number and to play an important role in reproductive success through interactions with the female reproductive tract after coitus due to its anti-inflammatory properties (Sharkey et al., 2016).

According to (Miki, 2007) there is growing evidence that glycolysis, which occurs in the main piece, produces ATP, which promotes sperm motility, it has been shown that the frequency of flagella beating is proportional to the rate of ATP hydrolysis by dynein. Serotonin increases glycolytic flux by activating the enzyme 6 phosphofructose-1-kinase, which is formed by modulating the enzyme's binding to the membrane cytoskeleton (Assouline-Cohen et al., 1998). Since serotonin increased the level of tyrosine phosphorylation, suggesting that this indoleamine causes hyperphosphorylation of the dynein, in the intermediate piece, resulting in sperm displacement that is not physiological. (Jiménez-Trejo et al., 2012) found that high levels of serotonin induced rapid sperm head movements, while lower concentrations increased the linearity of sperm displacement. (Bandivdekar et al., 1992), (Stephens and Prior, 1992).

Furthermore, recent research suggests that fibroblast growth factor 2 (FGF2) is widely present in the mouse uterus and oviduct, and that this protein is capable of increasing sperm motility (Saucedo et al., 2008).

During the analysis, the use of autologous platelet concentrates rich in EDTA tube increased sperm motility when compared to fresh sperm (Hernández-Corredor et al., 2020).

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Conflict of Interest

The authors declare no conflict of interest.

Ethical Clearance

The study was approved by the Ethical Approval Committee. High Institute for Infertility Diagnosis and Assisted Reproductive Technologies/ Al-Nahrain University.

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