Estimation of some biophysical parameters in semen of fertile and infertile patients

Dhahir Tahir Ahmad (1)
Suhel Mawlood Alnajar (2)
Tara Nooradden Abdulla (3)
Zhyan Baker Hasan (4)

(1) PhD Biophysics, Hawler Medical University - College of Medicine
(2) PhD MB, ChB-DG) Hawler Medical University - College of Medicine
(3) MSc, Biophysics, Hawler Medical University - College of Medicine
(4) MSc Gynecology and Obstetrics, Hawler Medical University - College of Medicine

Correspondence:
Department of Pharmacology and Biophysics,
Hawler Medical University,
Erbil, Iraq
Mobile: 009647504979445
Email: dr.dhahirtahir@yahoo.com

Abstract

Objective: The objective of this study is to estimate the magnitude of viscosity and density of seminal fluid in various male subjects, collected randomly in Erbil city, and to observe role of density in fertilization.

Materials and Methods: Rotating viscometer was used for assessment of viscosity of semen, while volume method was used to measure the density of semen. Density of semen and vice versa and how it changes with fertile and infertile persons in Erbil city was assessed. These investigations included kinematic, dynamic and relative viscosity of semen at room temperature (25) Centigrade.

Results: The results were based on a total of 56 samples of fresh semen collected from 44 infertile and 12 fertile patients in an industrial laboratory. The data in Table (1) displays that density and kinematic viscosity was not changed significantly between fertile and infertile patients at range $p<0.05$.

Conclusion and Discussion: The project concluded by demonstration of the changes of viscosity of semen; where displayed it explained changes in relative viscosity and kinematic viscosity and their effects on the physiology of the human body, moreover to the disadvantage of increasing and decreasing of semen density with the locality of people.

Summary: This research proved the investigation of the viscosity and density of semen, how it was affected and its prevalence which depends on molecules adhesiveness and its association with fertility of patients in Erbil city.

Key words: measurement, viscosity, density, kinematic viscosity, physical properties of semen.

Introduction

Viscosity is the internal fractional force between molecules. The rheological properties of semen change dramatically after the material coagulates and this material then liquifies. Liquefaction occurs over a period of 5 minutes in vivo, but may take 20-30 minutes in vitro (1, 2).

The biochemical mechanism of this coagulation in liquefaction has been investigated by numerous researchers (3).

The coagulation factors derive from the seminal vesicles, while liquefying factor comes from the prostate (4).
The prevalence of semen hyperviscosity is estimated to be between (12-29%) and can lead to male factor infertility in both vivo and in vitro (5).

Anatomically the seminal fluid is secreted by male accessory glands i.e. seminal vesicle and prostate; any diseases in these organs change the fluid viscosity. These organs are sited near each other, displaying the short prevalence and weak stability of biophysical consistency of the fluid and any change in the semen environment by change of viscosity, will lead to disability of sperm and their motility (5 and 6) .

Basic semen analysis has remained an essential screening test in the assessment of human male fertility and measurement of semen volume is an important parameter (5). The sample graduated cylindrical method is used for measuring weight of coagulate such as semen analysis(6). It is a direct relationship between weight and volume which hinges on the density of the semen.

Only a few studies have examined the effects of electromagnetic fields on semen and reproduction in general. A study by Tateuo et al, 1998, exposed human semen to electromagnetic fields. Current frequency was applied and showed no increases in abnormalities of the structural semen when compared to the control (7).

The sperm electric charge gradually decreases with semen aging and with growing concentration of lactic acid. Diminished electrical charge will decrease sperm motility and leads to formation of the agglutinations. Viscosity is an atypical characteristic of a real fluid. It arises from the shear stress between the layers of the fluid flow (8).

It has been seen that biochemical, enzymatic or genetic factors are possible causes of hyperviscosity of seminal fluid (9).

The issue of the electrical conductivity and dynamic viscosity has been rarely studied (10, 11).
The possible use of semen physical properties as an additional measure in semen evaluation in stallions has been considered.

This can be applied on quantitative and qualitative biophysical parameters in semen of fertile and infertile humans in Erbil city.

Abnormal coagulation, liquefaction, volume, viscosity and PH strongly suggests gland dysfunction (12).

Materials and Methods

This experiment employed (44) infertile and (12) fertile healthy males in Erbil city, through taking their sperm in an industrial laboratory and determining their dynamic viscosity by rotating viscometer and estimating density of semen by volume method. A viscometer is an instrument used to measure the viscosity of fluids.

For liquids with viscosities, which vary with flow conditions; an instrument called a Rheometer is used. Viscometers are only used to measure under flow condition.

Results

The results are based on a total of 56 samples of fresh semen collected from 44 infertile and 12 fertile patients in an industrial laboratory. The data in Table (1) display that; density and kinematic viscosity are not changed significantly between fertile and infertile patients at range $p<0.05$.

In Table (1) the results show that there are significant differences in the viscosity and relative viscosity between fertile and infertile patients.

Table 1: Biophysical parameters of fertile and infertile seminal fluids

Biophysical parameters	Infertile=44 Mean±SD	Fertile=12 Mean±SD	Sign.
Viscosity/Cp	4.85±0.58	4.45±0.23	S
Density/Kg/m3	1.05±0.03	1.04±0.01	NS
Kinematic Viscosity/ cp.m3/kg	4.50±0.57	4.25±0.20	NS
Relative Viscosity	4.83±0.58	4.45±0.23	S

Discussion

The results of this study (in Table 1) by using T-Test shows that , when comparing viscosity between fertile and infertile patients there are significant differences in increases in the viscosity of semen between them. This result agrees with other researchers (13,14,15).

In Table 1 density and kinematic viscosity is not significantly changed between fertile and infertile patients. This investigation disagrees with authors (16,17).

The data in Table1 shows the relative viscosity decreases significantly between fertile and infertile patients at range $p< 0.05$. This finding agrees with authors (18,19).

This study found that increase in density indicated increase in viscosity of semen. This increases the probability that patients will be infertile (and vice versa).

Recommendation

Since not much research has been done in the field of biophysical properties of semen, the comparison of our results with others was somewhat restricted. Our experiment offered an insight into the issue of a possible assessment of semen qualitative and quantitative characteristics, based on the determination of semen biophysical properties. However, the results of this study need to be repeated and that is recommended before any serious implications can be drawn and needs to be reconfirmed so that this alternative examination can be made.

References

1- Montagnon D. Clavert A. Cranz C. Fructose , protein, and coagulation in human seminal plasma , Andrologia, 1982,14, 434-439.
2- Polak B. Daunter B. Seminal plasma biochemistry, IV, Enzymes involved in the liquefaction of human seminal plasma , Int. Androl.1989, 12,.187-194.
3- Phillip L, Matson Kim Myssonski, Steven Yoviich, Linda Morrison , 2010,the density of human semen the validation of weight as an indicator of volume multicenter study,10(2), Journal l of biology reproduction,141-153.
4- Gonzales GF, Kortebani G, Mazzolli AB, 1993, Hyperviscosity and Hypofunction of the seminal vesicles, Arch Androl. 30,63-68.
5- Du Plessis, Gokul S. Agarwal A. 2013- Semen hyperviscosity; causes, consequences and cures, Front Biosci (Elite Ed) jan 1:5:224-231
6- Mandal A. Bhattacharyya AK 2010, Differences in osmolality pH, buffering capacity, superoxide dismutase and maintenance of sperm motility in human ejaculates according to the degree of coagulation , Int. J Androl.
7- Eliasson R-2003, Basic semen analysis In, Current topics in andrology Iwamoto T, Nozawa S, Yoshiike M, Hoshino T, Baba K, Matsushita T, Tanaka SN , Naka M, Skakkebaek NE, Jorgenson N, 2006, Semen quality of 324 fertile Japanese men , human reproduction 21,760-765.
8- Meachan R, Perspectives and editorials ; from andrology, J. Androl.2002 23, 330-331
9- Elia J, Dlfino M et al 2009-Human semen hyperviscosity: prevalence, pathogenesis and therapeutic aspects: Asian J Androl Sep;11(5):609-15.
10- BravoPW, CCALLO, M, Garnisemenca, J, 2000, The effect of enzymes on semen viscosity in llamas and Alpacas , Small Ruminant Res. 38, 91-95.
11- Andrade Rocha FT, 2005 Physical analysis of Ejaculate to evaluate secretory activity of the seminal vesicles and prostate: Clinical Chem Lab Med. Bios, 76,193-203.
12-Andrande Rocha FT 2005: Physical analysis of Ejaculate to evaluate secretory activity of the seminal vesicles and prostate: Clinical Chem Lab Med.43(11):1203-10
13- Chung-Koo, Jong-Choon Kim and Sung-Ho Myung, and Dong-Il Lee, 2003, Developmental toxicity evaluation of ELF magnetic fields in Sprague -Dawley Rats . Bioelectromagnetics. 24,231-240.
14- Chung, Moon -Koo, Jong-Choon Kim and Sung-Ho Myung, 2004, Lack of adverse effects in pregnant lactating female Rats and Their offspring following pre and postnatal exposure to the ELF magnetic fields. Bioelectromagnetics, 25, 236-244.
15 -Forgacs Zsolt, Zoltan Somosy, Gyogyi Kubinyi, Hanna Sinary , Jozsef Bakos. Gyorgy Thurocsy Andras Surjan Aranka Hudak , Ferenc, Olajos, and Peter Lazar, 2006, effects of whole body 50Hz magnetic field exposure on mouse Leyding cells. The scientific word Journal,4,83-90.
16- Elbertieha Ahmed , Mohd -Ali Al-Akhras and Homa Darmani 2002, long term exposure of male and female mice to 50Hz magnetic field; effects on fertility, . Bioelectromagnetics, 23,168-172.
17- Derek H. Owen and David F. Katz, 2005, A review of the physical and chemical properties of human semen and the formulation of a semen simulant, Journal of andrology,26(4),1-25,
18- Adair , Eleanor R, Dennis M, Blick Stewart J, Allen, Kevin S, Mylacraine John M Ziriax and Dennis M, School, 2005, Thermophysiological responses of human Volunteers to whole body RF exposure at220MHZ, . Bioelectromagnetics, 26,448-461.
19 - Silverberg KM , Turner T, 2009, Evaluation of sperm, in text book of assisted reproductive technologies , laboratory and clinical perspectives, 2,39-52.