

Possible Role for Cholesterol in Human Seminal Fluid in Relations to Other Semen Parameters & Fertility

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Abstract

Background: The failure to achieve a clinical pregnancy after 12 months or more of regular unprotected sexual intercourse means a big problem for some married people. The male partner is either the sole or a contributing cause of infertility. Cholesterol is one of the biochemical which may be attributed to sperm function.

Aim of study: The purpose of this study was to investigate the correlation between cholesterol levels & seminal fluid parameters.

Materials & Methods: One Hundred and twenty seminal fluid samples were collected from subfertile Iraqi patients & evaluated according to the standard seminal fluid analysis (WHO 2010) in relation to cholesterol in the semen plasma samples. The results of these investigations were compared with those for 65 semen samples for apparently healthy individuals as a control group.

Results: This study revealed that there was a significant difference between cholesterol concentration and ($P < 0.01$).

Conclusions: In view of the results it could be concluded that there is an association between cholesterol and sperm motility and thereby the fertility of males.

Key words: Subfertility, Sperm, cholesterol, Seminal Fluid Analysis, Semen Plasma Biochemistry.

الخلاصة:

خلفية التجربة: يعتبر عدم حدوث الحمل خلال مدة اثني عشرة سنة من بداية الزواج مشكلة حقيقية تواجه المتزوجين الجدد. وقد وجد بان الزوج هو جزء مهم من هذه المشكلة. و يعتبر محتوى السائل المنوي من الكولسترول أحد الأسباب المساهمة في خفض قدرة الحيمين البشري لأحداث الأخصاب.

الهدف من التجربة: الهدف من اجراء هذه التجربة هو معرفة العلاقة بين محتوى السائل المنوي من الكولسترول و كفاءة و قدرة الحيمين البشري لأحداث الأخصاب.

مواد و طرق العمل: تم جمع مئة و عشرون عينة من السائل المنوي للأشخاص الغير قادرين على الإنجاب و تم قياس جميع التحاليل المتعلقة بالسائل المنوي حسب معايير منظمة الصحة العالمية (WHO) لسنة 2010 و أجريت مقارنة هذه النتائج مع 65 فردا من الأشخاص القادرين على الإنجاب.

النتائج: أوضحت النتائج بوجود علاقة معنوية عكسية عالية ($P < 0.01$) بين تركيز الكولستيرول و كفاءة السائل المنوي و أحيامن لأحداث الحمل. أستنتجات: من خلال النتائج المستقاة من هذه التجربة أصبحت واضحا مدى تأثير كفاءة السائل المنوي لأحداث الحمل وبما يحتويه من تراكيز الكولستيرول، و بذلك نوصى بأن تكون معرفة تركيز هذه المادة من ضمن التحليل الروتينية للمني. الكلمات المفتاحية: النطف ، الكولسترول، السوائل المنوية ، بلازما النطف

Introduction

Fertility is one of the most tragic marital problems. It was estimated that nearly 8-12% of couples were infertile (Barbara, 2003). Despite recent advances in the treatment of infertility, the problem could not be satisfactorily tackled so far for varied reasons (Jadhav *et al.*, 2012). There are several causes leading to male infertility like radiation, cigarette smoking, varicocele, antibacterial drugs, obstructive lesions, therapeutic methods, trauma, genitourinary infection,

environmental agents, oxidative stress and nutritional deficiency of trace elements like selenium and zinc (Olayemi, 2010; Zakarya *et al.*, 2013).

Seminal plasma is very important for fertility. Secretions from all glands are necessary for optimal seminal plasma function. Hypofunction of seminal vesicles and prostate is associated with impaired fertility (Gonzales, 2001).

Cholesterol are present in semen as free or as Prostatosomes which are membranous vesicles present in human semen, they are secreted by the prostate gland and contain large amounts of cholesterol and sphingomyelin (Palmerini *et al.*, 2003). Prostatosomes are also rich in Ca^{+2} , guanosine diphosphate, adenosine diphosphate and adenosine triphosphate (Arienti *et al.*, 2001). Prostatosomes are able to enhance sperm motility; they also play a primary role in the liquefaction of semen and decrease immunological suppression of human sperm (Carlo *et al.*, 2006).

A key feature in the function of the spermatozoa is the lipid composition of seminal plasma and sperm membrane. It was denoted that within all the lipids present in the sperm and seminal plasma, cholesterol has a special relevance, since is the most present lipid in the spermatozoa among all the mammalian species (Cross, 1998).

The relationship of lipids with male fertility has also been studied, and knowing the role of lipids in the phenomena of maturation and capacitation of spermatozoa, subtle modifications on their composition within the plasma membrane will lead to functional defects. Cholesterol/ phospholipids ratios in sperm from patients with unexplained infertility are twice than fertile donors (Vignon *et al.*, 1993). It was noticed that in patients with infection in the urogenital tract a significant reduction in total seminal plasma cholesterol, and this is potentially affecting sperm function (Cerolini *et al.*, 2001)

Moreover, seminal plasma lipid composition is also important due to the ability of sperm cells to take up lipid components or fatty acids from the surrounding environment under determined circumstances (Marcos *et al.*, 2004).

Materials & Methods

1. Samples' Collection & Analysis

One hundred semen samples were collected during the period of September / 2011 to September/ 2012 from subfertile patients (with age range from 20-50 years) suffering from primary or secondary infertility (asthenozoospermia and oligoasthenozoospermia) due to common causes (such as infection, varicocele, hyperprolactinemia and idiopathic causes) who attending Kamal Al-Samarai Hospital / Baghdad.

Patients with other causes for infertility such as undescended testis, evidence of thyroid diseases, inguinal hernia, severe diabetes complications, and other systemic diseases requiring specific therapies were excluded from this study.

All the semen samples were analyzed according to the Standard WHO parameters (WHO, 2010) and cholesterol levels were estimated colorimetrically in all the semen plasma samples (Standbio, Cat. No. 1010- 430, USA).

The results of the above investigations were compared with those for 65 semen specimens for apparently healthy individuals as a control group who match the patients in their age ranges.

2. Statistical Analysis

The results were statistically analyzed by application of t-Test for comparison between patients and healthy control groups in addition to linear of regression analysis followed by analysis of variance (ANOVA) (Daniel, 1999). The statistical analysis was performed using the Statistical Package for Social Science (SPSS: Version 14, Chicago, IL) and MedCalc Software (Ghent, Belgium).

Results

1. Seminal Characteristics

The semen specimens had been analyzed for grade activity, motility and sperm count according to WHO, 2010 parameters. Table 1 showed the semen characteristics among fertile healthy individuals (control group) and subfertile patients' groups. This table revealed that the mean of sperm count was higher among fertile healthy individuals (control group) ($40.5 \pm 1.3 \times 10^6/\text{ml}$) than that of subfertile patients' groups (10.3 ± 1.75 , 44.7 ± 1.4 and $8.8 \pm 1.9 \times 10^6/\text{ml}$ for oligozoospermia, asthenozoospermia and oligoasthenozoospermia respectively).

It is clear from this is table that the sperm concentration was higher among fertile males. However, asthenozoospermia patients recorded the highest concentration; but in spite of that majority of those sperms were non motile or complain of sluggish movement and only 10% were motile. Moreover, among those motile sperms only 2% were of grade A motility. Meanwhile, 30% of motile sperms were of grade A among the fertile semen's sperms. Both of oligozoospermia and oligoasthenozoospermia groups were characterized by lower sperm counts.

Table 1: Semen Characteristics of fertile & subfertile patients included in this study

Semen Parameters	Fertile Control Group	Subfertile Groups		
		Oligozoospermia	Asthenozoospermia	Oligoasthenozoospermia
Sperm Concentration. ($10^6/\text{ml}$) [mean \pm SE]	$40.5 \pm 1.3^*$ (65)	10.3 ± 1.75 (40)	44.7 ± 1.4 (40)	8.8 ± 1.9 (40)
Motility (%):	65%	60%	10%	8%
Grade A	30%	33%	2%	6%
Grade A+B	35%	27%	8%	2%

2. Correlation between Semen Parameters & Cholesterol Level

Determination of cholesterol level showed that the fertile semen plasma characterized by the highly significant lower value (40.3 ± 4.7 mg / dL) in comparison with patients' different groups (46.5 ± 4.9 , 48.8 ± 4.5 and 48.4 ± 4.3 mg / dL for oligozoospermia, asthenozoospermia and oligoasthenozoospermia respectively) ($P < 0.01$). These data are represented in Table 2.

Table 2: Level of cholesterol among the different patients' groups and healthy control group in mg / dL

Groups	Fertile Control Group	Subfertile Groups		
		Oligozoosperm.	Asthenozoo.	Oligoasthen.
cholesterol Level [mg / dL]	40.3 ± 4.7	$46.5 \pm 4.9^*$	$48.8 \pm 4.5^*$	$48.4 \pm 4.35^*$

* P value (< 0.01 Between control and patients groups).

3. Correlation between sperm count & cholesterol Level among the studied groups' samples

Table 3 showed that there was an inverse relationship between the cholesterol level and the sperm counts. Cholesterol level was significantly lower among control group in comparison with patients' groups ($P < 0.01$).

Table 3: Correlation between sperm count & cholesterol Level among the studied groups' samples

The studied Groups	No (%)	Cholesterol Level [mg / dL]	Sperm Count x 10 ⁶ / ml
Fertile Control Group	42%	40.3±4.7	40.5±1.3
Oligozoospermia	33.3%	46.5±4.9*	10.3±1.5**
Asthenozoospermia	33.3%	48.8±4.5*	44.7±1.4
Oligoasthenozoospermia	33.3%	48.4±4.35*	8.8±1.9**

* P value (<0.01 Between control and patients groups).

** P value (<0.01 Between control and Oligozoospermia with Oligoasthenozoospermia patients groups).

4. Correlation between sperm motility percent (%) & cholesterol level among the studied groups' samples

Regarding the correlation between semen's cholesterol level and mean sperm motility percent (%), the current result highlights that there were highly significant inverse relation (P<0.001) between mean of sperm motility percent (%) and mean of cholesterol in human seminal fluid for studied groups [(40.3±4.7, 46.5±4.9, 48.8±4.5, 48.44.35mg / dL) with sperm motility percentages of (65%, 60%, 10% & 8%)] for control, oligozoospermia, asthenozoospermia., and oligoasthenozoospermia respectively (Figure 1).

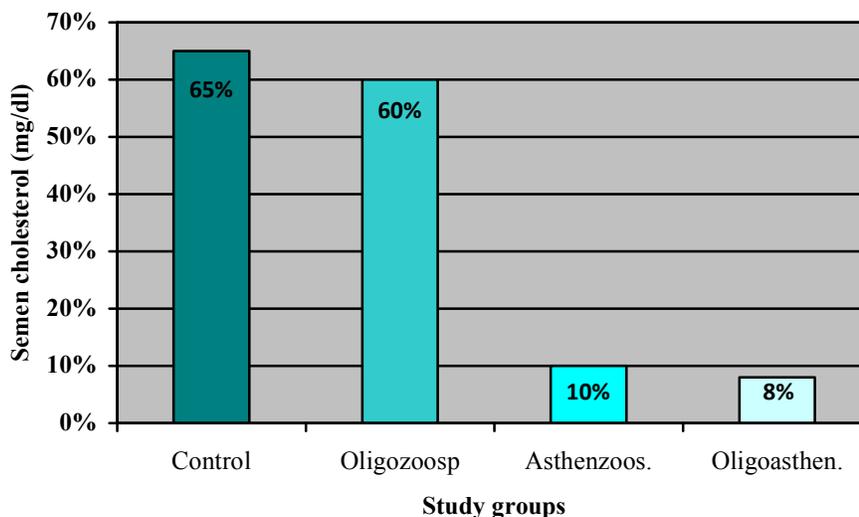


Figure (1): Correlation between sperm motility percent (%) & cholesterol level among the studied groups' samples

Discussion

Seminal lipids play significant roles in the membrane structure of spermatozoa, sperm metabolism, sperm capacitation and fertilization of the female gamete (Demirci *et al.*, 2002).

From the current results it could be concluded that extracellular concentration of Cholesterol in the seminal plasma is important indicators of the sperm quality. These results were comparable to those of Marcos *et al.* (2004), who found that there was a good correlation

between seminal fluid cholesterol level and frequency of motile sperm. The interpretation of these results may be attributed to seminal plasma lipid composition was also important due to sperm ability for taking up the lipid components or fatty acids from the surrounding environment as a source for metabolic energy (Cerolini *et al.*, 2001). Furthermore, there is a significant positive correlation between sperm membrane cholesterol and sperm morphology and subsequently the number of normal sperm will be enhanced so the proportions of Cholesterol in the sperm membrane are too important indicators of the sperm quality (Meseguer *et al.*, 2004). Concerning Cholesterol concentrations undoubtedly this substance is directly linked with sperm metabolism, concretely with hyperactivation process taking place in the oocyte fertilization (Suarez, 1996). Cholesterol proportions in the fresh ejaculate are increased in samples with high percentage of normal forms suggesting that, adequate morphology of non-capacitated sperm is also related with higher proportion of Cholesterol content in the sperm membrane. Possibly this phenomenon is caused by the relation between the proportion of this main component of the membrane with the fluidity of this structure, thus maintaining an adequate shape.

The correlation between cholesterol and sperm concentration it was observed in the present study that there was an inverse relationship between those two factors. These findings were similar to those investigated by Carol, *et al.* (2006); which may be related to more proportion of cholesterol which consumed by sperms [in case of higher count] as a source of energy. Furthermore, there was a significant negative correlation between seminal fluid cholesterol and sperm motility percentage (%), these results agree with results found by (Meseguer *et al.*, 2004).

Considering the patients' ages, it was noticed from this study that while the cholesterol elevated among the semen plasma of patients; most of the semen parameters diminished with progress in human age. These finding was in agreement with Schmid *et al.* (2013) results.

Regarding to this end, new research on specific biochemical markers must be conducted, in order to design concrete and adequate therapeutic tools to improve male fertile potential.

In conclusion, knowing the ability of sperm cells to exchange lipids with external medium an exogenous addition of cholesterol to culture media could improve sperm quality.

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