Status of Total L-Carnitine Level in the Seminal Plasma of Iraqi Infertile and Fertile Men: Correlation Study with Semen Quality

Zainab N.H. Anbar

ABSRACT:

BACKGROUND:

Carnitine is highly concentrated in the epididymis and Spermatozoa, where it may serve as an intramitochondrial vehicle for theAcyl group, a substrate of energy production. This study is aimed to determine any correlation between male infertility and semen quality with Concentration of L- carnitine in human seminal plasma.

OBJECTIVE:

This case-control study performed at the Institute of Embryo Research and Infertility, University of Al-Naharin, Baghdad. Semen samples of 40 infertile men (azoospermia, n=12, oligoasthenozoospermia, n=16, teratozoospermia, n=12) and 12 fertile men controls were collected.

METHODS:

The level of total L- carnitine in seminal plasma was determined by high performance liquid chromatograp and the results correlated with sperm parameters as sperm count, motility and morphology.

RESULTS:

The level of L-carnitine was significantly reduced in infertile male groups; azoospermia, oligoasthenozoospermia and teratozoospermia in comparison with that of fertile male controls ($P< 0.045$, $P< 0.023$ and $P< 0.04$; respectively). There was a borderline significant positive correlation between the seminal L-carnitine and the sperm count in fertile group($r=0.63$, $P< 0.51$).

CONCLUSION:

The results of this study indicated the significance of determination of seminal plasma L-carnitine in evaluation of infertility in men and the importance of recognition of those infertile male who are benefit from administration of carnitine supplement.

***KEY WORDS*:** L-carnitine, seminal plasma, male infertility.

INTRODUCTION:

Carnitine is a quaternary ammonium (3-hydroxyl-4-trimethyl-ammonio-butanoate) compound. In human, carnitine is synthesized primarily in the liver and kidney from the amino acids lysine or methionine. L-carnitine mainly functions in transporting of long-chain acyl groups from cytoplasmic fatty acids into the mitochondrial matrix to be involved in energetic production pathways; β-oxidation and citric acid cycles[1,2].

Free carnitine is taken up from the blood plasma, actively transported into the epididymal plasma, under the regulation of androgen. It is then accumulated in the spermatozoa by passive diffusion. Epididymal sperm use fatty acids oxidation as the main source of energy metabolism. Carnitine is crucial to transport fatty acids into the mitochondrial matrix within spermatozoa for energy production. Carnitine contributes directly to sperm motility and sperm maturation[3]. Low levels of carnitine reduces fatty acid concentrations within the mitochondria, leading to decreased energy production and potential alteration in sperm motility[4]. Together with fructose and lactate, acetylcarnitine is an important fuel source for sperms, supporting motility[5]. Several studies confirmed that patients with idiopathic oligoasthenospermia had low seminal plasma total carnitine level and oral carnitine supplementation improve this type of male infertility[6,7].

In this paper we present an in valuation of the concentration of total carnitine in seminal plasma of different types of idiopathic Iraqi male infertility and to correlate the results with semen quality.

Biochemistry Department , Baghdad College of Pharmacy.

SUBJECTS AND METHODS:

This study was carried out at the Institute of Emberyo Research and Infertility, University of AL-Nahrain, Baghdad, from Febrauary 2009 to August 2009. Forty primary infertile male subjects aged 25-40 years, who had regular unprotected intercourse for at least one year without conception with their partners were included in this study.

A detailed background history and physical examination were done on both husband and wife. Semen specimens from all infertile patients were collected into sterile polystyrene jars after an abstinence period 3 to 5 days. A portion of each semen sample was examined for sperm count, motility and morphologic features. Infertile male patients were then divided into the following three groups according to WHO criteria[8]:

Group I: Azoospermic(sperm count= zero, n=12)

Group II: Oligoasthenozoospermic(sperm count $<20\times10^6$, motility <50%, n=16).

Group III: Teratozoospermic(sperm count $>20\times10^6$/ml, motility >50%, morphology <50%, n=12).

Twelve fertile males whom their partners had conceived within one year and having normal semen quality were included as normospermic control group.

After liquefaction, the seminal sample was centrifuged at 2000 rpm for 15-20 minutes and the supernatant seminal plasma was transferred in fresh tube and stored frozen at -20 °C until the time of assay. The level of L- total carnitine in separated seminal plasma of each infertile patient and fertile control was determined by high performance liquid chromatography(HPLC) technique.

RESULTS:

Table 1 shows the mean(±SEM) value on seminal plasma level of L- total carnitine in the three groups of infertile male patients(azoospermia, oligoasthenozoospermia, teratozoospermia) and fertile controls.A significant reduction in seminal plasma level of L- total carnitine was observed in azoospermic (277.88±33.87 umol/l), oligoasthenozoospermic(270.80±32.97 umol/l), and teratozoospermic(277.96±33.86 umol/l) infertile Iraqi males compared with normospermic controls($P< 0.045$, $P< 0.023$, $P< 0.046$; respectively).

There was a borderline significant positive correlation between seminal plasma L- total carnitine and the sperm count in fertile controls group($r=0.63$, $P< 0.051$). However, there was no significant correlation between seminal plasma L- total carnitine and the parameters of semen quality in the groups of infertile males.

Table 1 : Mean(±SEM) values of L- total carnitine levels in seminal plasma in Azoospermic, Oligoasthenozoospermic, Teratozoospermic infertile Iraqi males and Fertile male controls.

Parameter	Azoospermic (n=12)	Oligoasthenozoospermic(n=16)	Teratozoospermic(n=12)	Normospermic (n=12)
Plasma seminal L-totalcarnitine (umol/l)	277.88± 33.87	270.80± 32.97	277.96± 33.86	362.73± 34.75

DISCUSSION:

Carnitine is necessary for transport of fatty acids into the mitochondria, the main source of spermatozoa´s energy, low levels of carnitine reduce fatty acid concentrations within the mitochondria, leading to decrease energy production and potential alteration in sperm motility[4,9].

The results of the present study confirmed that seminal plasma L-total carnitine level was significantly reduced in Iraqi infertile males compared with fertile males. Moreover, the mean value of L-total carnitine levels was low in oligoasthenazoospermic patients when compared with azoospermic and teratozoospermic infertile groups(Table1). Low carnitine concentrations have been frequently reported in different studies in infertile men[10,11], that may suggest direct correlation of carnitine level with fertility. Furthermore, total carnitine level was low in the asthenospermia group when compared with the group of patients whose total motile sperm was 51%. These authors suggested that the determination of seminal plasma carnitine level may be a useful test in evaluation of male infertility[12].

L-carnitine and acetyl-L-carnitine are highly concentrated in the epididymis and play a crucial role in sperm metabolism and maturation. As the main source of seminal plasma carnitine is the epididymis. When plasma carnitine level increases in pharmacological concentrations, the carnitine concentration in epididymal fluid also increases.

Thus a high carnitine level in epididiymal fluid causes an increase of carnitine concentration in spermatozoa[13]. Carnitine is involved in a variety of metabolic processes playing an important role in maintaining an active oxidative phosphorylation. It has been suggested that the relationship between carnitine secretion, seminal quality and oxidative phosphorylation activities is possible because of a parallel response to the same regulatory events[14].

The results of the present study also showed a borderline significant positive correlation between seminal plasma L-carnitine and sperm count in fertile group. Several studies emphasized the significant positive relationship between seminal plasma L-carnitine and semen quality[13,15]

CONCLUSION:

Estimation of seminal plasma L- total carnitine level might provide the physician with an additional means of evaluating the infertile male. The results of this study encourage the necessity of inclusion of seminal plasma L-carnitine test in Fertility and Infertility Unit for evaluation of, and as a guidance for the clinical treatment of male infertility as well as for the study on the mechanisms of male reproduction.

REFERENCES:

1. Champe P C, Harvey R A,Ferrier D R. Fatty acid and triacylglycerol metabolism: In Lippincott's Illstrated Reviews: Biochemistry. Lippincott Williams& Wilkins; A Wolters kluwer Company: 179-198.
2. Steiber A, Kerner J, Hoppel C. Carnitine: a nutritional, biosynthetic, and functionalperspective. Mol Aspects Med. 2004;25: 455-73.
3. National Center for Complementary and Alternative Medicine: National Institutes of Health, Department of Health and Human Services. www.nccam.nih.gov
4. Sinclair S. Male infertility: Nutritional and environmental considerations.Altern Med Rev. 2000;5: 28-38.
5. Murra RK, Granmer DK, Peter PA, et al. Harper´s biochemistry. New York: McGrow-Hill, 2000:238-48.
6. Matalliotakis I, Koumantaki Y, Evageliou A, et al. L-carnitine levels in the seminal plasma of fertile and infertile men: correlation with sperm quality. Int J Fertil Womens Med. 2000; 45: 236-40.
7. Vitali G, Parente R, Melotti C. Carnitine supplementation in human idiopathic asthenospermia; clinical results. Drugs Experiment Clin Res. 1995;21:157-59.
8. World Health Organization. WHO Laboratory Manual for the Examination of Human Semen and Semen-cervical Mucus Interaction, 3 rd edn. Cambridge Univ. Press, Cambridge, UK. 1992, 6.
9. Lenzi A, Lombardo F, Gandini L, Dondero F. Metabolism and action of L-carnitine: its possible role in sperm tail function. Arch Ital Urol Neefrol Androl. 1992;64:187-96.
10. Xuan W, Lamhonwah AM, Librach C, et al. Characterization of organic cation/carnitine transporter family in human sperm. Biochem Biophys Res Commun. 2003;306: 121-28.
11. Agarwal A, Said TM. Carnitines and male infertility. Repord Biomed online. 2004;8:376-84.
12. Gurbuz B, Yalti S, Ficicioglu C, Zehir K. Relationship between semen quality and seminal plasma total carnitine in infertile men. J Obstet Gynaecol. 2003;23: 653-56.
13. Sheikh N, Goodarzi MT, Bab Al-Havaejee H, et al. L-Carnitine level in seminal plasma of fertile and infertile men. J Res Health Sci. 2007; 7: 43-48.
14. Ruiz-Pesini E, Alvarez E, Enriquez JA, Lopez-Perez MJ. Association between seminal plasma carnitine and sperm mitochondrial enzymatic activities. Int J Androl. 2000;24: 335-40.
15. Tang LF, Jiang H, Shang XJ, et al. Seminal plasma levocarnitine significantly correlated with semen quality. Zhonghua Nan Ke Xue. 2008;14:704-8.