

L-Carnitine Level in Seminal Plasma of Fertile and Infertile Men

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Abstract

Background: To determine any correlation between infertility and semen quality with concentrations of L-carnitine in human seminal plasma.

Methods: This case-control study performed in Fatemeh Hospital in Hamadan, Iran. Seminal plasma of 72 infertile men and 80 men with proved fertility as a control group was investigated and L-carnitine level was determined using UV enzymatic test at 340 nm.

Results: The concentration of L-carnitine was significantly lower in the infertile group compared with control group (80.59±56.43 mg/l versus 108.43±42.26 mg/l; $P= 0.0009$). There was also a statistically significant positive correlation between seminal plasma L-carnitine concentration, total sperm count, and the percentage of motile sperm ($P= 0.0009$, and $P= 0.0000$, respectively).

Conclusion: These finding suggest that the determination of seminal plasma L-carnitine level may be a useful test in evaluation of male infertility.

Keywords: *Sperm motility, Sperm Count, Infertility, Male, Carnitine, Semen*

Introduction

Carnitine, a name derived from the latin Caro or Carnis (flesh), was discovered in muscle extracts in 1905(1). Carnitine is a zwitterionic compound (betaine of gamma trimethylamino-beta-Hydroxy butyric acid). Its role is to carry long-chain fatty acids from the cytosolic compartment to the mitochondrial matrix, where they undergo β -oxidation (2). L-Carnitine (LC) is produced by hepatocytes and concentrated in the blood stream and secreted into the epididymal lumen by the epididymal epithelium of the caput and corpus (3, 4). Carnitine is then taken up partially by the spermatozoa during their pas-

sage through the epididymis and its concentration correlates with sperm count and motility (5-7). Together with fructose and lactate, acetylcarnitine is an important fuel source for sperms, supporting motility (2). Studies confirm that a number of nutritional therapies including carnitine, arginine, zinc, selenium and vitamin B₁₂ may improve sperm count and sperm motility (8).

Tomamichel indicated that there is a significant correlation between the concentration of free seminal carnitine and the anatomic site of the obstruction in patients with obstructive azoospermic (9).

Although diagnosis and treatment of infertility has evolved, management of male infertile patients remains difficult. In several experimen-

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tal and clinical studies, in groups of patients with idiopathic oligoasthenospermia, seminal plasma total carnitine level was found to be low and oral carnitine supplementation improved oligoasthenospermia (5, 6, 10, 11). We aimed to determine any correlation between infertility and semen quality with concentration of LC in human seminal plasma.

Materials and Methods

Participants and sample collection:

Seventy two infertile men aged 42 ± 10 yr were enrolled in the study. All subjects had been referred to the infertility clinic of Fatemiyeh Hospital in Hamadan (west of Iran). Eighty age matched men with proven fertility were enrolled into the study as control group. The spermograms of the fertile men in the control group were normal.

Semen analysis

Semen samples were obtained by masturbation in the laboratory after 3-5 d of sexual abstinence. The samples were analyzed within 1 h after ejaculation for semen volume, pH, sperm count, and sperm motility using the standard methods recommended by the World Health Organization (12).

Evaluation of L-carnitine in seminal plasma

Seminal plasma was obtained by centrifuging semen at 1,000 g for 10 min at room temperature. Supernatant was withdrawn, filtered and stored at -20° C in sterile tubes until L-carnitine measurement within next 15 d. L-carnitine concentration was measured using an enzymatic UV kit (Roche, Germany) for the determination of L-carnitine in samples from serum, urine and seminal plasma and 40-100 mg/l or 250-620 μ mol/l seminal plasma total carnitine concentration was accepted as normal ranges according to the manufacturer's instruction. The test was linear in the range of 5.6-112 μ mol L-carnitine/L test solution.

Statistical analysis

Data were expressed as mean \pm standard deviation. In addition to descriptive statistical meth-

ods (mean, standard deviation), to compare quantitative data student's *t*-test and Pearson correlation coefficient were used. A descriptive level of significance was set at $P \leq 0.05$.

Results

Seventy two infertile men who attended to infertility clinic and 80 age-matched men with proven fertility were enrolled into the study. A significantly reduction of L-carnitine level ($P = 0.0009$) was observed in infertile men compared to fertile subject (Table 1).

There was also a statistically significant positive correlation between seminal plasma L-carnitine concentration, total sperm count, and the percentage of motile sperm ($P = 0.0009$, and $P = 0.0000$, respectively).

The correlation between sperm count and motility in fertile and infertile men was determined which indicated a significant positive correlation in both groups ($r = 0.43$ and $r = 0.25$, respectively).

Furthermore the correlation between carnitine and sperm count in fertile and infertile men was significant in both groups ($r = 0.32$ and $r = 0.22$, respectively) as indicated in Fig. 1. Fig. 2 shows the correlation between motility and carnitine in fertile and infertile men. These data indicated a statistically positive correlation between motility and carnitine level in both studied groups ($r = 0.31$ and $r = 0.29$, respectively).

Table 1: Motility, sperm count and seminal plasma carnitine in fertile and infertile men

Groups	Carnitine (mg/L)	Sperm count No. $\times 10^6$	Motility (%)
Fertile men n =80	108.43 \pm 42.26	66.66 \pm 16.3	50.45 \pm 4.20
Infertile n =72	80.6 \pm 56.43*	52.56 \pm 51.53*	32.31 \pm 9.08**

* *P* value= 0.0009

** *P* value= 0.0000

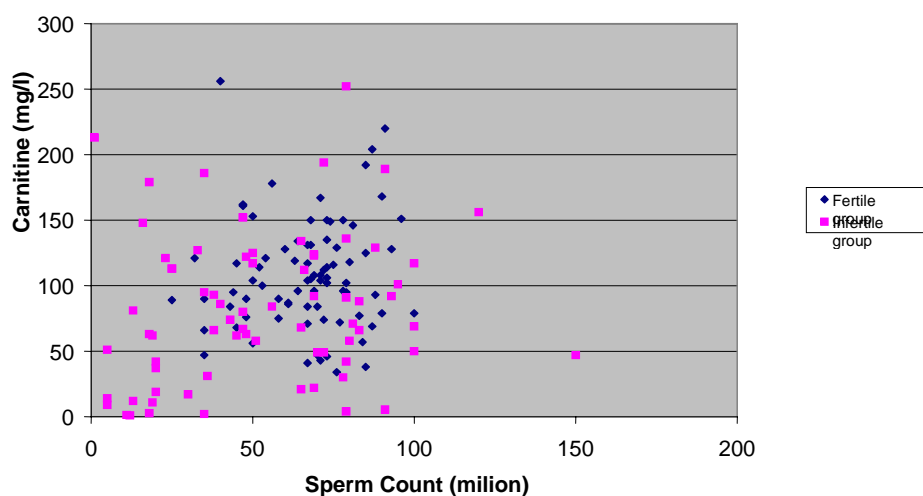


Fig. 1: The correlation between carnitine and sperm count in fertile and infertile men

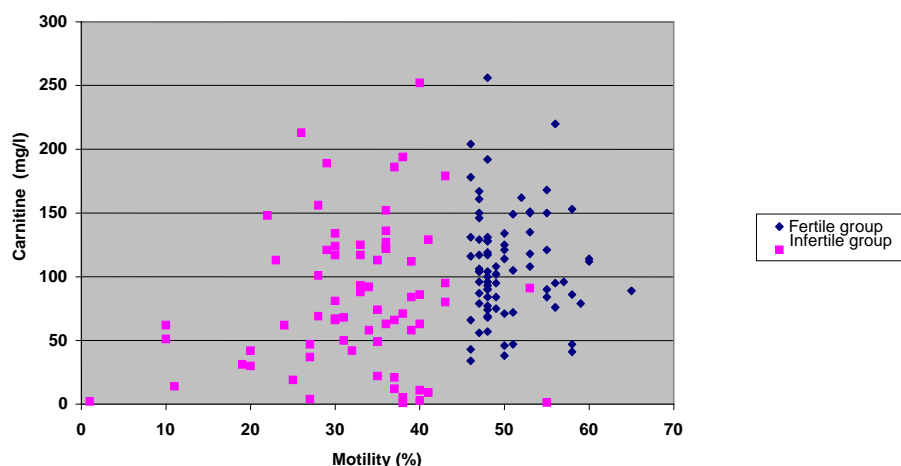


Fig. 2: The correlation between carnitine and sperm motility in fertile and infertile men

Discussion

The main function of carnitine in the epididymis is to provide energy for spermatozoa. Carnitine contributes directly in sperm motility and may involve in successful maturation of sperm (13, 14). This is especially important since epididymal sperm use fatty acid oxidation as main source of energy, and thus tend to concentrate carnitine while in the epididymis. As carnitine is necessary for transport of fatty acids into the mitochondria, low levels of carnitine reduce fatty acid concentra-

tions within the mitochondria, leading to decrease energy production and potential alterations in sperm motility (15). Low carnitine levels have been frequently reported in different studies in infertile men (16-18), that may suggest direct correlation of carnitine level with fertility. However controversial results have also been observed indicating no differences in L-carnitine levels in fertile and infertile men (15). The results of the present study (Table 1), compared the seminal plasma total sperm count in two groups of fertile and infertile men. As

the results showed there was a statistically significant difference in sperm count between two groups ($P= 0.0009$). In addition, there was a statistically significant positive correlation between seminal plasma L-carnitine concentration and total sperm count in fertile and infertile men ($r= 0.43$ and $r= 0.23$). The results obtained here are in line with previous observation reported by Menchini et al., indicating a positive correlation between free L-carnitine and sperm count in patients with various andrologic disease ($r=0.617$, $P< 0.01$) (18). Regarding to Table 1 that we compared the motility of sperm in fertile and infertile men, there was a statistically significant difference in this factor between the two groups ($P= 0.0000$). Gurbuz et al. reported a relationship between semen quality and seminal plasma total carnitine level in infertile men (19). Total carnitine concentration was low in the asthenospermia group when compared with the group of patients whose total motile sperm was 51% ($P< 0.01$). These findings suggest that the determination of seminal carnitine level may be a useful test in evaluation of male infertility (19).

The results of our study also showed a statistically significant positive correlation between seminal plasma L-carnitine concentration and the percentage of motile sperm in fertile and infertile men ($r= 0.31$ and $r= 0.29$) confirming a potential relationship between carnitine and sperm motility.

Lower seminal plasma carnitine concentration was found in infertile men compared to fertile subjects and the difference was statistically significant ($P= 0.0009$).

Matalliotakis et al. showed that L-carnitine level in control subjects significantly differed from those of infertile group ($P< 0.0001$) (6), also there was a statistically significant and positive correlation between L-carnitine and the number of spermatozoa, the percentage of motile spermatozoa, as well as the percentage of normal forms ($P< 0.001$). These findings suggest that determination of seminal car-

nitine values might provide the physician with an additional mean evaluating the infertile male (6).

L-carnitine and acetyl-L-carnitine (ALC) are highly concentrated in the epididymis and play a crucial role in sperm metabolism and maturation. Variety of study support the conclusion that LC and/or ALC at total daily amounts of at least 3 g per day can significantly improve both semen concentration and total sperm counts among men with astheno or oligoastheno-spermia. It seems that additional well designed studies are necessary to further validate the role of canitines in the treatment of patients with male infertility, particularly in men with poor semen quality (17). As the main source of seminal plasma carnitine is the epididymis. When plasma carnitine concentration increases in pharmacological concentrations, the carnitine concentration in epididymal fluid also increases. Thus a high carnitine concentration in epididymal fluid causes an increase of carnitine concentration in spermatozoa. Cellular parameters of the seminogram have been previously shown to correlate with L-carnitine concentration in the seminal fluid. Carnitine is involved in a variety of metabolic processes playing an important role in maintaining an active oxidative phosphorylation (oxphos). Ruiz-Pesini et al. results strongly suggest that relationship between carnitine secretion, seminal quality and oxphos activities is possible because of a parallel response to the same regulatory event (20). Finally, there is growing interest in the use of L-carnitine as a therapeutic tool in same forms of male infertility. In conclusion, our findings suggest that determination of seminal carnitine values might provide the physician with an additional means of evaluating the infertile male.

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