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Original Article

Comparison of L-Carnitine and Vitamin E vs. Coenzyme Q10 (CoQ10) for Asthenozoospermia in Male Infertility

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ABSTRACT

Background: Asthenozoospermia, which is primarily brought on by seminal oxidative stress, is one of the primary reasons of idiopathic male infertility. This study evaluates and compares the efficacy of L-carnitine plus vitamin E against Coenzyme Q10 (CoQ10) supplementation in improving sperm parameters in infertile males with asthenozoospermia. **Methods & Materials:** A quasi-experimental study was conducted over a one-year period at the Reproductive Endocrinology and Infertility unit of Dhaka Medical College Hospital. Sixty infertile men with asthenozoospermia were enrolled and divided equally into two groups. Group A (n=30) received L-carnitine (330 mg) and Vitamin E (200 mg) twice daily, while Group B (n=30) received CoQ10 (100 mg) twice daily for 12 weeks. Semen analyses were performed at baseline, 1 month, and 3 months. Data were analyzed using independent t-tests and repeated measures ANOVA via SPSS version 26. **Results:** Baseline demographic and semen parameters were statistically similar between both cohorts. Following 3 months of treatment, Group A demonstrated significantly higher total sperm motility (42.8 ± 3.0% vs. 41.1 ± 2.5%, $p = 0.018$) and progressive motility (36.9 ± 2.5% vs. 33.8 ± 3.3%, $p < 0.001$) compared to Group B. Furthermore, the total sperm count was significantly higher in Group A (58.7 ± 6.1 million) than in Group B (53.8 ± 6.0 million) ($p = 0.002$). Non-progressive motility also decreased more significantly in Group A (5.9 ± 2.0%) than in Group B (7.2 ± 1.8%, $p = 0.011$). Both groups exhibited highly significant intra-group improvements from their respective baselines ($p < 0.001$). **Conclusion:** Both antioxidant regimens were successful in improving semen parameters; however, in men with asthenozoospermia, the combination of L-carnitine and vitamin E was much more efficient than CoQ10 monotherapy in increasing total sperm motility, progressive motility, and total sperm count.

Keywords: *Asthenozoospermia, Male Infertility, L-Carnitine, Vitamin E, Coenzyme Q10, Antioxidants, Sperm Motility.*

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INTRODUCTION

The World Health Organization (WHO) defines infertility as the inability to conceive after a year of regular, unprotected sexual activity [1]. In this context, the male factor accounts for about 35% to 50% of all cases of infertility [2], with a significant portion of these cases—roughly 30%—being categorized as idiopathic, during which patients exhibit abnormal semen markers without any obvious clinical or genetic etiology [2]. Asthenozoospermia (ASZ), which accounts for nearly 19% to 20% of cases of idiopathic male infertility [3]. The pathophysiology of ASZ is closely associated with oxidative stress [4]. Increased ROS levels cause DNA fragmentation, mitochondrial malfunction, and lipid membrane oxidation, which eventually depletes the intracellular ATP needed for appropriate flagellar movement [4]. In order to increase sperm motility and restore redox equilibrium, antioxidant treatment has received a great deal of clinical attention [5]. Natural antioxidant L-carnitine increases the generation of ATP, which is necessary for sperm motility, by facilitating the transport of fatty acids into mitochondria [6, 7]. While vitamin E offers strong lipid-soluble defense against membrane lipid peroxidation [9], coenzyme Q10 (CoQ10) promotes mitochondrial electron transport and membrane stability [8].

Globally speaking, infertility is a common health problem that affects between 8% to 12% of the population, or between 60 to 80 million couples [1]. Male factor infertility affects up to one in four couples in underdeveloped countries and around one in seven couples in Western countries [1,2]. Up to 30% of couples with male-factor conception problems experience severe male infertility, which often requires sophisticated treatments such intracytoplasmic sperm injection (ICSI) [10]. Male infertility has some of the highest prevalence rates in the world in places like Africa and Central and Eastern Europe [1].

The precise disease burden in Bangladesh is still unknown due to a dearth of thorough national epidemiological data [2]. Bangladesh's infertility prevalence was formerly estimated by the World Fertility Survey to be about 4%; however, more recent regional estimates that reflect broader South Asian trends show that the actual rate may be closer to 15% [2]. Patients in low-resource environments, such as Bangladesh, are often misled by unproven, costly, or ineffective treatments due to a lack of knowledge and restricted access to standardized reproductive care [5]. Therefore, finding pharmaceutical therapies that are highly effective, easily available, and well-tolerated—like oral antioxidant supplementation—is essential to offering the local community evidence-based, economical therapy [9,10].

There is little comparative data assessing the combined effectiveness of these antioxidants in clinical settings, despite their established individual advantages [8]. Therefore, the main goal of this study is to assess and compare the improvements in sperm parameters, particularly sperm motility, before and after giving infertile males with asthenozoospermia a combination of L-carnitine and vitamin E vs CoQ10 monotherapy.

METHODS & MATERIALS

Study Design and Population This quasi-experimental study was conducted in the Reproductive Endocrinology and Infertility unit and IVF Centre at Dhaka Medical College Hospital (DMCH) over a 1-year period. The study population comprised 60 infertile men diagnosed with asthenozoospermia (infertility >1 year),

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selected via convenient sampling based on strict inclusion and exclusion criteria. Patients with endocrine disorders, current genital infections, obstruction, or varicocele/testicular hypotrophy noted on USG or Doppler were excluded. Ethical clearance was obtained from the Ethical Review Committee of DMCH, and written informed consent was secured from all participants.

Interventions and Follow-up Following a comprehensive baseline clinical evaluation and semen analysis, participants were allocated into two groups. Group A (n=30) received Tab. L-carnitine (330 mg twice daily) along with Vitamin E (200 mg capsules twice daily). Group B (n=30) received CoQ10 (100 mg orally twice daily). The treatment duration was 12 weeks. Follow-up semen analyses were performed at 4 weeks (1 month) and 12 weeks (3 months) at the Andrology Lab, IVF Center, DMCH.

Data Analysis Data processing and analysis were conducted using SPSS version 26. Independent sample t-tests were used for continuous variables, and Chi-square tests were utilized for categorical variables. Repeated measures ANOVA (with Bonferroni post-hoc tests) evaluated pre- and post-intervention changes. A p-value of <0.05 was considered statistically significant.

RESULT

Socio-Demographic and Clinical Characteristics:

Table I shows total of 60 infertile men with asthenozoospermia were enrolled in this quasi-experimental study. The participants were equally divided into Group A (treated with Tab. L-carnitine and Vitamin E, n=30) and Group B (treated with CoQ10 supplementation, n=30). In both groups, the majority of the patients were below 40 years of age (66.7% in Group A and 70% in Group B), with a mean age of 33.1 ± 6.0 years and 33.4 ± 5.7 years, respectively. The groups were comparable in terms of educational status, occupation, and socio-economic distribution.

Table I

Socio-demographic factors of the patients (*n*=60).

Variables	Group A (n=30),n(%)	Group B (n=30),n(%)
Age group (years)		
<40	20 (66.7)	21 (70)
≥40	10 (33.3)	9 (30)
Educational status		
Primary Education	10 (33.3)	12 (40)
SSC	15 (50)	13 (43.3)
HSC	5 (16.7)	5 (16.7)
Occupational status		
Service holder	15 (50)	14 (46.6)
Businessman	10 (33.3)	11 (36.7)
Other	5 (16.7)	5 (16.7)
Socio-economic status		
Upper class	6 (20)	5 (16.7)
Middle class	16 (53.3)	14 (46.7)
Lower class	8 (26.7)	11 (36.6)

Group A = Tab. L-carnitine and Vitamin E; Group B = CoQ10 supplementation.

Table II shows regarding personal history, 26.7% of Group A and 23.3% of Group B had a smoking habit. The duration of infertility was between 1 to 5 years for 73.3% of Group A and 80% of Group B. There were no statistically significant differences between the groups regarding smoking habits (p=1.00) or duration of infertility (p=0.542).

Table II

Distribution of the patients according to Personal history (*n*=60).

Personal history	Group A (n=30),n(%)	Group B (n=30),n(%)	p-value*
Smoking habit			
Smoker	8 (26.7)	7 (23.3)	1.00
Non-smoker	22 (73.3)	23 (76.7)	
Duration of infertility			
1 to 5 years	22 (73.3)	24 (80)	0.542
>5 years	8 (26.7)	6 (20)	

*p-value was determined by Chi-square test. Data presented as frequency (%).

Baseline and Post-Intervention Semen Parameters (Inter-Group Comparison) *Table III* shows before treatment, baseline sperm motility parameters (total motility, progressive motility, non-progressive motility, immotile sperm) and total sperm count were statistically similar between Group A and Group B, indicating uniform baseline characteristics across both cohorts.

Table III
Baseline sperm motility among the patients (*n*=60).

Baseline sperm motility	Group A (n=30)	Group B (n=30)	p-value*
Total Motility (%)	30.8 ± 3.0	31.5 ± 2.9	0.362
Progressive Motility (%)	19.6 ± 2.1	20.5 ± 3.2	0.211
Non-Progressive Motility (%)	11.2 ± 2.8	11.0 ± 1.4	0.729
Immotile Sperm (%)	69.2 ± 3.0	68.5 ± 2.9	0.362
Sperm Concentration (million/ml)	14.5 ± 2.1	14.7 ± 2.4	0.733
Total Sperm Count (million)	46.2 ± 5.2	46.4 ± 6.7	0.932
*p-value determined by Independent sample t-test. Data presented as mean ± SD.			

Table IV shows after 1 month of treatment, total sperm motility, progressive motility, and total sperm count were significantly higher in Group A compared to Group B. Additionally, non-progressive motility was significantly lower in Group A than in Group B (7.8 ± 1.1% vs. 9.5 ± 1.5%, p<0.001).

Table IV
Sperm motility among the patients after 1 month of treatment (*n*=60).

After 1 month sperm motility	Group A (n=30)	Group B (n=30)	p-value*
Total Motility (%)	37.2 ± 3.3	35.5 ± 2.9	0.044
Progressive Motility (%)	29.3 ± 3.3	26.0 ± 3.2	<0.001
Non-Progressive Motility (%)	7.8 ± 1.1	9.5 ± 1.5	<0.001
Total Sperm Count (million)	52.2 ± 6.4	48.5 ± 6.8	0.034
*p-value determined by Independent sample t-test. Data presented as mean ± SD.			

Table V shows following 3 months of treatment, the significant advantages observed in Group A over Group B were maintained. Group A exhibited a significantly higher total motility (42.8 ± 3.0% vs. 41.1 ± 2.5%, p=0.018), progressive motility (36.9 ± 2.5% vs. 33.8 ± 3.3%, p<0.001), and total sperm count (58.7 ± 6.1 vs. 53.8 ± 6.0 million, p=0.002).

Table V
Sperm motility among the patients after 3 months of treatment (*n*=60).

After 3 months sperm motility	Group A (n=30)	Group B (n=30)	p-value*
Total Motility (%)	42.8 ± 3.0	41.1 ± 2.5	0.018
Progressive Motility (%)	36.9 ± 2.5	33.8 ± 3.3	<0.001
Non-Progressive Motility (%)	5.9 ± 2.0	7.2 ± 1.8	0.011
Total Sperm Count (million)	58.7 ± 6.1	53.8 ± 6.0	0.002
*p-value determined by Independent sample t-test. Data presented as mean ± SD.			

Table VI shows intra-Group Repeated Measures Analysis Within Group A, there was a gradual and highly significant increase (p<0.001) in total sperm motility, progressive motility, and total sperm count from baseline to 1 month, and extending to 3 months. Conversely, non-progressive motility exhibited a gradual and significant decrease over the same treatment periods.

Table VI
Comparison of sperm motility before and after treatment in Group A (*n*=30).

Sperm motility	Baseline	After 1 month	After 3 months	p-value*
Total Motility (%)	30.8 ± 3.0	37.2 ± 3.3α	42.8 ±3 αβ	<0.001
Progressive Motility (%)	19.6 ± 2.1	29.3 ± 3.3 α	36.9 ± 2.5 αβ	<0.001
Non-Progressive Motility (%)	11.2 ± 2.8	7.8 ± 1.1 α	5.9 ± 2 αβ	<0.001
Total Sperm Count (million)	46.2 ± 5.2	52.2 ± 6.4 α	58.7 ± 6.1 αβ	<0.001

**p-value determined by repeated measures ANOVA test. Data presented as mean ± SD. [α] denotes significant difference between baseline and 1 & 3 months of treatment. [β] denotes significant difference between 1 month and 3 months of treatment.*

Table VII shows similarly, patients in Group B also demonstrated a gradual and statistically significant improvement (p<0.001) across total sperm motility, progressive motility, and total sperm count, paired with a significant progressive decrease in non-progressive motility over the 3-month observation window.

Table VII
Comparison of sperm motility before and after treatment in Group B (*n*=30).

Sperm motility	Baseline	After 1 month	After 3 months	p-value*
Total Motility (%)	31.5 ± 2.9	35.5 ± 2.9 α	41.1 ± 2.5 αβ	<0.001
Progressive Motility (%)	20.5 ± 3.2	26± 3.2 α	33.8 ± 3.3 αβ	<0.001
Non-Progressive Motility (%)	11.0 ± 1.4	9.5 ± 1.5 α	7.2 ± 1.8 αβ	<0.001
Total Sperm Count (million)	46.4 ± 6.7	48.5 ± 6.8 α	53.8 ± 6 αβ	<0.001

**p-value determined by repeated measures ANOVA test. Data presented as mean ± SD. [α] denotes significant difference between baseline and 1 & 3 months of treatment. [β] denotes significant difference between 1 month and 3 months of treatment.*

DISCUSSION

The current study evaluated the comparative efficacy of L-carnitine plus Vitamin E versus CoQ10 in mitigating asthenozoospermia among 60 infertile males. Our findings demonstrate that while both therapeutic regimens successfully enhanced overall sperm parameters over a 3-month period, the combination of L-carnitine and Vitamin E (Group A) yielded significantly superior improvements in total motility, progressive motility, and total sperm count compared to CoQ10 alone (Group B).

The positive impact of CoQ10 observed in Group B is consistent with existing literature affirming its capacity to improve mitochondrial bioenergetics. CoQ10 supplementation is known to increase total antioxidant capacity and superoxide dismutase activity while reducing ROS levels in men with idiopathic oligoasthenospermia, correlating strongly with enhanced sperm motility [11]. Additionally, thorough meta-analyses have confirmed that CoQ10 considerably increases sperm motility and concentration in a variety of clinical populations [12]. Our findings, however, imply that combination treatments that target several oxidative stress pathways at once may be more effective than CoQ10 monotherapy.

The synergistic chemical effects of vitamin E and L-carnitine are responsible for Group A's greater efficacy [6,9]. The production of mitochondrial ATP, which is required for flagellar propulsion, is strongly supported by L-carnitine [7]. On the other hand, the rich polyunsaturated fatty acid matrix of the sperm plasma membrane is shielded against oxidative destruction by vitamin E, which functions as a powerful lipid-soluble defense [13]. Although vitamin E effectively neutralizes free radical activity, its usage as a monotherapy may occasionally result in minor clinical benefits in rigorous conventional parameters, according to prior double-blinded experiments [13]. However, its protective potential is completely achieved when paired with complementing drugs. For example, in idiopathic oligoasthenozoospermia, vitamin E and clomiphene citrate have been demonstrated to dramatically increase sperm concentration and overall motility [14]. These pathways are further supported by animal models, which show that chronic vitamin E treatment directly enhances testicular shape, testosterone levels, and semen quality [15]. Thus, a highly effective, multimodal defense against seminal oxidative stress can be achieved by combining the metabolic boost of L-carnitine with the structural protection of vitamin E.

CONCLUSION

For men with asthenozoospermia, L-carnitine in combination with vitamin E and CoQ10 greatly increased sperm motility and count. However, as compared to CoQ10 alone, the combination of L-carnitine and vitamin E showed more efficacy in improving both total and progressive motility. These results demonstrate that asthenozoospermia in idiopathic male infertility can be effectively managed with targeted, synergistic antioxidant therapy. To confirm these findings and assess their final influence on clinical pregnancy rates, larger, longer-term multi-center investigations are advised.

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