Effect of chronic alcoholism on male fertility hormones and semen quality

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Objective: To evaluate the effects of chronic alcoholism on the male fertility hormones and quality of semen.
Design: Non-probability purposive clinical study.
Setting: Addiction treatment center and an academic research environment.
Patient(s): Sixty-six alcoholics free from smoking and drug abuse who consumed a minimum of 180 mL of alcohol per day (brandy and whisky, both 40%–50% alcohol content) for a minimum of 5 days per week for ≥1 year were included. Thirty nonsmoking nonalcoholics were selected as controls.
Intervention(s): Before starting the addiction treatment for alcoholics, venous blood and semen samples were collected.
Main Outcome Measure(s): Complete blood counts, biochemical parameters, levels of the male fertility hormones FSH, LH, T, PRL, P, and E_2 in blood, and semen parameters.
Result(s): In alcoholics, FSH, LH, and E_2 levels were significantly increased, and T and P levels were significantly decreased. No significant change was noted in PRL levels. Semen volume, sperm count, motility, and number of morphologically normal sperm were significantly decreased.
Conclusion(s): Chronic alcohol consumption has a detrimental effect on male reproductive hormones and on semen quality. (Fertil Steril® 2005;84:919–24. ©2005 by American Society for Reproductive Medicine.)

Key Words: Alcohol, FSH, LH, testosterone, progesterone, estradiol, semen, sperm

Impotence, testicular atrophy, gynecomastia, and loss of sexual interest are often associated with alcoholism in men (1). Sexual disorders have been reported in men who are long-term alcohol users, with the prevalence ranging from 8% to 58% (2). Lemere and Smith (3) reported that 8% of 17,000 patients treated for alcoholism were impotent. The reported prevalence of lack of sexual desire ranged from 31% to 58% in long-term alcohol users (4–6). Fifty-four percent of hospitalized alcoholic men and 24% of healthy controls had erectile impotence (4). In 1984, Jensen (5) reported that 63% of married alcoholic men and 10% of controls had sexual dysfunction, especially lack of sexual desire.

Use of ethanol might cause gonadal disorders, including structural testicular changes and a decrease in testicular and serum levels of T, which might be involved in the hypogonadism and feminization phenotype. Ethanol and its metabolite acetaldehyde cause a reduction in LH binding to Leydig cells, an inhibition of the enzymes responsible for the formation of sex hormones (7, 8).

Van Thiel et al. (9) demonstrated that ethanol acts as a Leydig cell toxin. Moreover, ethanol increases the metabolic clearance rate of T concomitant with an increase in hepatic 5α-reductase activity and increases conversion of androgens into estrogens. Sperm cells might be selectively affected by various substances throughout the process of spermatogenesis to spermiogenesis (10).

Both acute and chronic alcohol intoxication result in dose-dependent suppression of plasma T levels in normal men (11, 12). Alcohol-induced suppression of male T is due to a direct effect on the biosynthetic processes in the testes (13–16). Increased LH levels after alcohol-induced suppression of T in men (11, 12) and male monkeys (17) is consistent with established mechanisms of negative feedback of LH secretory activity.

Alcohol seems to exert a dual effect on the hypothalamic–pituitary–gonadal axis by directly inhibiting testicular steroidogenesis and by blocking the release of LH-releasing hormone/LH from the hypothalamic–pituitary axis (18).

In human semen, ethanol produces a significant decrease in the percentage of motility, straight-line velocity, and curvilinear velocity of sperm. Alcohol causes a significant decrease in the number of spermatozoa with normal morphology and an increase in irreversible tail defects (19).

The sperm of ethanol-consuming animals exhibit alterations in their spermatozoa concentration, abnormal motility and morphology, and a decrease of the fecundation capability (20). It has been reported that ethanol abusers might exhibit sperm alterations, such as changes in the count, morphology, and viability of the spermatozoa (21–23). Alcohol exerts a dose-related toxic effect on testicular function. Spermatogenesis disruption and a primary testicular insuffi-

Received September 30, 2004; revised and accepted April 25, 2005.
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ciency and compensatory increase of FSH and LH secretion have been observed in alcoholics (24, 25).

A reduction in sperm concentration and in the percentage of spermatozoa with normal morphology has been detected in chronic alcoholics and in smokers. The above modifications suggest a synergistic or additive effect of both toxic habits on male reproductive function. Men who wish to procreate should be specifically warned of this matter (26).

Drinking alcohol is considered a common social entertainment. In the present study, reproductive function in chronic alcoholics was assessed to know the effects of alcoholism on reproductive function. The intent of the study was also to help physicians treating alcoholics to have a better idea of these patients' reproductive function.

MATERIALS AND METHODS

Subjects

This study was conducted at the Kasthuriba Gandhi Memorial Deaddiction Center in Coimbatore city, Tamil Nadu, India. We screened a total of 1,300 alcoholics who had reported to the Kasthuriba Gandhi Memorial Deaddiction Center and 300 nonalcoholic nonsmoking volunteers (as controls) from Coimbatore city. The study population consisted of 66 nonsmoking alcoholics, aged 36.6 ± 5.7 years (mean ± SD). Alcoholics consuming drugs like diazepam, pethidine, cannabis, and marijuana along with alcohol were excluded from the study. The control population consisted of 30 normal healthy persons aged 35.0 ± 6.1 years.

All subjects were examined by a physician before inclusion in the study. Personal interviews were conducted with all alcoholic and control subjects to obtain relevant clinical data: age, sex, domicile (urban vs. rural dwelling), marital status, diet, history of alcohol consumption, infertility status, past medical illness and treatment, history of smoking, sexual urgency and frequency, and premarital and extramarital sexual history. Sexual function (e.g., erectile function, libido potency, frequency of ejaculation) was also noted in the questionnaire.

Experimental Design

The study included two subject groups, controls and alcoholics. Subjects in the control group were volunteers who were free from any disease and who had never consumed alcoholic drinks and who had never smoked. Subjects in the alcoholic group were nonsmokers who had consumed a minimum of 180 mL of alcohol (brandy and whisky, both 40%–50% alcohol content) per day for a minimum of 5 days per week in the past year.

Seminal Parameters

Semen samples were collected after at least 48 hours but no more than 7 days of sexual abstinence. The semen sample was collected by masturbation and delivered to the laboratory within ½ hour from the time of collection. After liquefaction, semen appearance, volume, consistency, pH, fructose, and sperm motility, concentration, viability, and morphology were analyzed as per the criteria of the World Health Organization (27). Motility was expressed as percentages of rapid progressively motile, slow or sluggishly motile, nonprogressively motile, and immotile sperm. Sperm viability was expressed as percentages of live and dead sperm, and sperm morphology was expressed as percentages of sperm with normal morphology, head-defective morphology, neck-defective morphology, and tail-defective morphology.

Male Fertility Hormones

Ten milliliters of venous blood was collected, and 5 mL of blood was transferred into a clean conical centrifuge tube with no anticoagulant. Serum was separated and stored at −20°C until use. The remaining 5 mL of blood was added to a Vacutainer tube containing ethylenediaminetetraacetic acid, and the complete hemogram in the blood was analyzed with Cell Dyn 1700 (Abbott Laboratories, Abbott Park, IL).

The routine biochemical parameters were analyzed with Hitachi 912 (Roche Diagnostics, Penzberg, Germany). Serum levels of FSH, T, E_2, P, and PRL were measured by the electro-chemiluminescence immunoassay method (Elecsys 1010; Roche Diagnostics), and LH was analyzed by ELISA (Cobas Core II; Roche Diagnostics). All the results were expressed in conventional units.

The results for both groups are expressed as mean ± SD. The results were analyzed statistically with commercial software (SPSS for Windows 7.5.1; SPSS, Chicago, IL). Student's *t*-test was used to determine the degree of significance for the various mean variables obtained. Semen nonparametric values (liquefaction, appearance, volume, consistency, pH, and fructose) were analyzed with the χ^2 test.

RESULTS

For alcoholics, the mean number of days of alcohol consumption per week was 6.1 ± 1.1, for a mean period of 4.5 ± 2.9 consecutive years. The mean volume of alcohol consumption was 441.1 ± 323.9 mL/day.

No significant differences were found between alcoholics and controls for any of the routine biochemical parameters (blood glucose, creatinine, total cholesterol, high-density lipoprotein cholesterol, low-density lipoprotein cholesterol, very-low-density lipoprotein cholesterol, total bilirubin, total protein, albumin, albumin/globulin ratio, γ glutamyl transferase, alkaline phosphatase, and serum glutamate pyruvate transaminase). Neither were any significant differences found between the two groups for any of the hematologic parameters (hemoglobin, total white blood corpuscle count, differential white blood corpuscle count, platelet count, total red blood corpuscle count, mean corpuscular volume, mean corpuscular hemoglobin, mean corpuscular hemoglobin concentration, and packed cell volume).