Cigarette Smoke: High Risk for Female Reproductive System

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***Abstract*—**Studies show that there is an association between smoking and serum levels of sex steroid hormones. The main aim of this study was to determine the effects of cigarette smoke on serum levels of estradiol and progesterone in female rats. In this laboratory experimental study female Wistar rats were randomly divided into control and cigarette smoke receiving groups of 10 rats in each. To expose the animals to cigarette or smoke, a special apparatus was used and the animals were exposed to cigarette for 100 minutes a day. After 6 weeks, blood samples were collected using cardiac puncture method and following serum collection, levels of estradiol and progesterone were measured by radioimmunoassay method. Data were statistically analyzed and compared between groups using one-way ANOVA. Serum level of estradiol and progesterone significantly decreased in cigarette smoke receving rats compared with control animals ($P<0.001$). Our finding indicates that cigarette smoke is high risk for female reproductive system which can lead to female reproductive failure.

***Keywords*—** Cigarette, Estradiol, Progesterone, Rat.

I. Introduction

ESTROGENS influence several functions in body including female reproductive system function [1]. Estradiol, like other steroids, is derived from cholesterol. Cholesterol is converted to testosterone, which in turn undergoes conversion to estradiol [2]. Progesterone is a C-21 steroid hormone involved in the female menstrual cycle, pregnancy and embryogenesis of humans [2].

In the female, estradiol acts as a growth hormone for tissue of the reproductive organs. Estradiol appears necessary to maintain oocytes in the ovary. During the menstrual cycle, estradiol produced by the growing follicle triggers, via a positive feedback system, the hypothalamic-pituitary events that lead to the luteinizing hormone surge, inducing ovulation. In the luteal phase, estradiol, in conjunction with progesterone, prepares the endometrium for implantation.

During pregnancy, estradiol increases due to placental production [1]. Progesterone has key effects via non-genomic signalling on human sperm as they migrate through the female tract before fertilization occurs, though the receptor(s) as yet remain unidentified [3]. Progesterone converts the endometrium to its secretory stage to prepare the uterus for implantation. During implantation and gestation, progesterone appears to decrease the maternal immune response to allow for the acceptance of the pregnancy. Progesterone decreases contractility of the uterine smooth muscle [2]. Progesterone is sometimes called the "hormone of pregnancy" and it has many roles relating to the development of the fetus:

Cigarette smoke can impair normal function of hormones in the body. Nicotine and thiocyanate are the major ingredients of cigarette smoke which seriously influence hormonal systems [4]-[6]. Nicotine as alkaloid has hazardous effects on body [7]. The studies show that nicotine can directly act on and hypothalamus – hypophysis - gonad axis [8].

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II. Material and Methods

A. Animals

Adult Wistar rats weighting 200±30g were purchased and raised in our colony from an original stock of Pasteur institute (Tehran, Iran).The temperature was at 23±2 ^{0}C and animals kept under a schedule of 12h light:12h darkness (light on at: 08: 00 a.m.) with free access to water and standard laboratory chow. Care was taken to examine the animals for general pathological symptoms. Food was withheld for 12-14h before death.

B. Protocol of Study

Female Wistar rats were randomly divided into control and cigarette smoke receiving groups of 10 rats in each. To expose the animals to cigarette or smoke, a special apparatus was used and the animals were exposed to cigarette for 100 minutes a day. After 6 weeks, blood samples were collected using cardiac puncture method and following serum collection, levels of estradiol and progesterone were measured by radioimmunoassay method. All animal experiments were carried out in accordance with the guidelines of Institutational Animals Ethics Committee.

C. Statistical Analysis

All values are presented as mean ± S.E.M. Statistical significance was evaluated by one-way analysis of variance (ANOVA) using SPSS 19. Differences with $P<0.05$ were considered significant.

III. Results

Table I and figure I shows serum levels of estradiol and progesterone in female rats.

TABLE I
SERUM CONCENTRATIONS ESTRADIOL AND PROGESTERONE IN CONTROL AND RATS EXPOSED TO CIGARETTE SMOKE

Group	Estradiol	P	Progesterone	P
Control	18.3±5.66		9.48±0.57	
Cigarette smoke receving	14.47±2.99	<0.001	8.38±1.01	<0.001

The data are indicated as mean ± SEM . P values are expressed in comparison with control group.

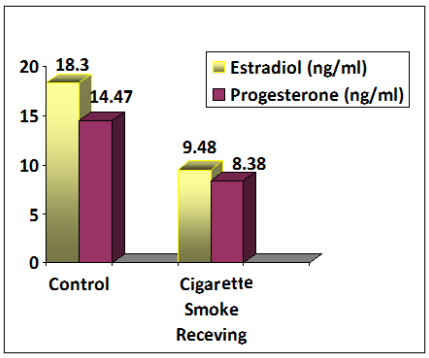

Fig. I. Serum estardiol and progesterone level in control animals and rats exposed to cigarette smoke.

The results of the present study show that serum estradiol and progesterone levels significantly decreased in rats exposed to cigarette smoke compared with control animals (P<0.001).

IV. DISCUSSION

Our study indicated that serum estradiol and progesterone levels significantly decreased in rats exposed to cigarette smoke compared with control rats. In line with our study, there are other research reporting the inhibitory effects of tobacco smoking on reproductive system [9], [10]. The studies also show that nicotine in tobacco smoking has negative effects on female reproductive system function and development [11]-[13]. In contrast to our finding, there are other reports indicating that tobacco smoking do not influence estradiol and progesterone levels in women [14]. The investigations have revealed that tobacco smoke ingredients, in particular nicotine, induce free radicals formation in target tissues by which impair normal function of target organs [15] including female reproductive system leading to disturbances in female gonadal hormones such as estradiol and progesterone.

V. CONCLUSION

Our finding indicates that cigarette smoke is high risk for female reproductive system which can lead to female reproductive failure.

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