Original Article

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Effects of Cigarette Smoking on Adult Male Seminal Fluid: A Retrospective Study

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Abstract

Background: Cigarette smoking is associated with many systemic health problems. Controversial results were found on the effect of cigarette smoking on seminal analysis of infertile males. The aim of the present study is to evaluate the effects of cigarette smoking on seminal fluid examination of adult infertile males.

Materials and Methods: We enroled 329 adult infertile male partners of the couples experiencing infertility. The patients were divided into two groups: Group I (non-smokers, *n* = 211) who ceased smoking >6 months prior to data collection and Group II (smokers, *n* = 118) who smoked within 6-month time frame. However, we further divided Group II into Group IIa (non-heavy smokers, *n* = 57) who smokes <20 cigarettes per day and Group IIb (heavy smokers, *n* = 61) who smokes more than 20 cigarettes per day. Seminal fluid was obtained according to the standard protocol and examined as per WHO guidelines.

Results: Out of 329 males, 211 were observed to be non-smokers and 118 were addicted to cigarette smoking. We observed abnormal morphology (%) in Group I and Group II as 56 ± 6.45 and 72 ± 7.51, respectively (*P* = 0.001). Statistically, significant results were observed on examining forward progressive motility (%) in between the groups (61 ± 8.72 and 44.56 ± 7.61; *P* = 0.001). The concentration of sperms in the seminal fluid and the increase in leukocyte count was significantly greater in non-smokers than smokers (*P* = 0.001).

Conclusion: Smoking causes detrimental and harmful effects on human adult male seminogram.

Key words: Cigarette smoking, Male Infertility, Semen Analysis

INTRODUCTION

Cigarette smoking is a common addiction spreading worldwide and affecting large scale of global population. According to recent World Health Organization (WHO) estimates 8% of the world's population is suffering from infertility and the prevalence of smoking estimated worldwide among young adult males is 46%.[1]

In 40% of the couples visiting infertility clinics, male infertility is also a very common cause.[2] Although various underlying diseases and anatomical abnormalities are the leading causes for male infertility but some of the cases are still undiagnosed regarding the cause of male infertility. Based on this fact, it had led to the researchers to observe other parameters like diet, environmental changes, and occupational hazards for male infertility.[2] Cigarette smoking has proven to be a culprit for male infertility in the recent past. The major constituents that is harmful for the health during cigarette smoking is nicotine and tar in the particulate form and carbon-mono-oxide in gaseous form.[3]

The exact mechanism of compromising male fertility by cigarette smoking is still unknown. Recent researches showed that cigarette smoking decreases the function of sertoli and leydig cells and also causes a negative effect on testicular microcirculation.[4] Extensive medline search revealed studies that cigarette smoking has a negative effect on human sperm. The sperms of smokers are less in number, abnormal morphology, and with poor

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viability. Some studies revealed that cigarette smoking causes decreased the sperm concentration, motility, and morphology.[5-10] Male cigarette smoking causes severe damage to DNA, prevents fertilization of ovum, implantation problems, and poor development of the embryo.[11] A large amount of single/double stranded DNA with decreased fertilizing capacity of sperms was observed in a group of smoking individuals.[12]

Many studies are found comparing the effects of cigarette smoking on human seminal parameters but still in convincing and conflicting results are observed. Based on these facts, we planned to frame a retrospective study comparing the effects of cigarette smoking on human seminogram. Moreover, we also aim to distinguish the seminal parameters of non-heavy smokers and heavy smokers.

MATERIALS AND METHODS

This study was conducted at the Department of Pathology TMMCRC, Moradabad, India. We enroled 329 patients from January to May 2015 and conducted a retrospective study on male partners of the couples experiencing infertility. We excluded the male patients with a history of sexual transmitted diseases, surgery for an inguinal hernia, orchidopexy or any scrotal surgery. Male patients with chronic medical illness (renal, liver, hypertension, diabetes mellitus, etc.) and with abnormal genital examination (hydrocele, varicocele, and ectopic testes) were also excluded from the study.

The patients were divided into two groups: Group I (non-smokers, n = 211) who ceased smoking >6 months prior to data collection and Group II (smokers, n = 118) who smoked within 6-month time frame. However, we further divided Group II into Group IIa (non-heavy smokers, n = 57) who smokes <20 cigarettes per day and Group IIb (heavy smokers, n = 61) who smokes more than 20 cigarettes per day.

Seminal fluid (2-5 ml) was collected in a wide bore sterile container by masturbation after 3 days of abstinence in a separate room near to the laboratory. The sample with volume <1 ml was rejected from the study protocol. All samples were liquefied at 37°C and the samples were analyzed at room temperature by a trained pathologist.

Semen analysis was performed under light microscopy and categorized according to WHO guidelines: sperm concentration ≥20 × 10^6 per ml, semen volume ≥2 ml, sperm count > 40 × 10^6 sperm, sperm motility >50% forward progression and morphology >15% normal.[13]

All the parametric data were analyzed using Student's t-test and non-parametric data using Chi-square or Fisher test whichever is applicable. Data was analyzed using Statistical Package for Social Sciences version 19.0. A P value of < 0.05 was considered statistically significant.

RESULTS

A total of 329 adult males were successfully included in our study. No significant difference in demographic characteristics was observed in between the two groups (Table 1).

Out of 329 males, 211 were observed to be non-smokers and 118 were addicted to cigarette smoking. The volume and pH of seminal fluid ejaculated were found to be insignificant on comparing both the groups (P = 0.76 and P = 0.99, respectively). Table 2 reveals that abnormal morphology (%) in Group I and Group II was 56 ± 6.45 and 72 ± 7.51, respectively (P = 0.001). Statistically significant results were observed on examining forward progressive motility (%) in between the groups (61 ± 8.72 and 44.56 ± 7.61; P = 0.001). The concentration of sperms in the seminal fluid was significantly greater in non-smokers than smokers (P = 0.001). We also observed seminal fluid leukocyte count significantly increased in patients addicted to smoking (P = 0.001) (Table 2 and Figure 1).

We also categorized 118 adult cigarette smoking males into non-heavy smokers and heavy smokers. 57 and 61 males were included in non-heavy smokers and heavy smokers respectively. Statistical insignificant results were observed on comparing volume and pH of the seminal fluid in Group IIa and Group IIb (P = 0.97 and 0.99, respectively) (Table 3 and Figure 2). The patients smoking more than

Table 1: Demographic characteristics (mean±SD)

Demographics	Group I	Group II	*P* value
Age	34.89±6.23	35.51±5.64	0.37
Weight	71.57±7.38	72.25±6.93	0.41
Height	168.85±8.51	167.84±8.19	0.29

SD: Standard deviation

Table 2: Seminal fluid characteristics (mean±SD)

Variables	Group I (*n*=211)	Group II (*n*=118)	*P* value
Volume (mean±SD)	2.96±2.04	2.89±1.98	0.76
Seminal fluid pH	7.64±0.01	7.64±0.01	0.99
Abnormal morphology (%)	56±6.45	72±7.51	0.001*
Forward progressing motility (%)	61±8.72	44.56±7.61	0.001*
Concentration×10^6 (mean±SD)	46.8±22.5	34.4±17.98	0.001*
Seminal fluid leukocyte count increased (%)	41±6.83	55±5.56	0.001*

*P<0.05, SD: Standard deviation

20 cigarettes per day has more abnormal morphology (%) in semen sample (69 ± 4.51) than those smoking <20 cigarettes per day (63 ± 7.68) ($P = 0.001$). The motility (%) of the sperms was observed to be significantly better in Group IIa (48 ± 6.37) than Group IIb (33 ± 5.91) ($P = 0.001$) (Table 3 and Figure 2). The concentration of sperms in Group IIa (37.71 ± 20.02) was found to be significantly greater than Group IIb (29.95 ± 18.26) ($P = 0.001$) (Table 3 and Figure 2).

DISCUSSION

In our study, 118 individuals were smokers out of 329 infertile men. However, most of the adults are between the age group of 32-36 years which is contradicting from the study by Trummer *et al.*[14] who enroled young adults (20-24 years) in their study.

Table 3: Seminal fluid characteristics between non heavy smokers and heavy smokers (mean±SD)

Variables	Group IIa (*n*=57)	Group IIb (*n*=61)	*P* value
Volume (mean±SD)	2.91±1.84	2.90±1.79	0.97
Seminal fluid pH	7.64±±0.01	7.64±0.01	0.99
Abnormal morphology (%)	63±7.68	69±4.51	0.001*
Forward progressing motility (%)	48±6.37	33±5.91	0.001*
Concentration×10^6 (mean±SD)	37.71±20.02	29.95±18.26	0.03*

*P<0.05, SD: Standard deviation

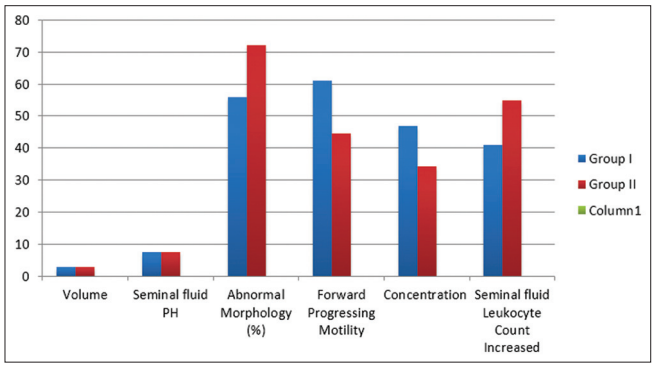

Figure 1: Semen analysis characteristics of non-smokers and smokers

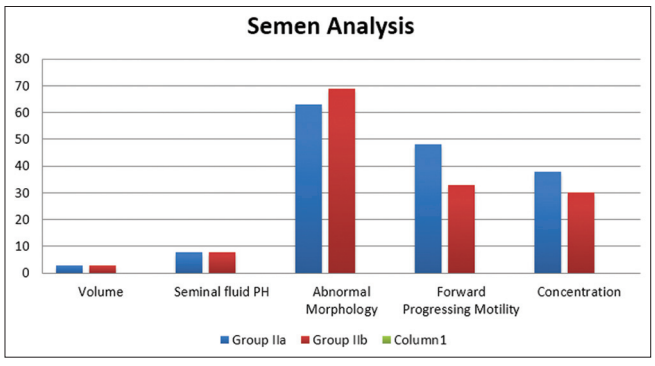

Figure 2: Semen analysis characteristics of non-heavy smokers and heavy smokers

We observed an insignificant difference of volume and pH of seminal fluid between the smokers and non-smokers. These findings were supported by Meri *et al.*[15] who also observed comparable results of volume and pH of seminal fluid among smokers and non-smokers. A larger amount of abnormal morphology sperms was found in a group involved in smoking. Abnormal sperms could be because of the fact that smoking causes increased DNA fragmentation and leads to more number of single/double stranded DNA.[12] Abnormal morphology was also observed by Meri *et al.*[15] in their while comparing smokers with non-smokers. However, Aghamohammadi and Zafari.[16] and Trummer *et al.*[14] did not observed any significant difference in sperm morphology on comparing smokers and non-smokers.

Our study also reveals a significant decrease in sperm motility in smoking individuals. However, Meri *et al.*[15] similarly observed a decrease in Types I and II motility but increase in Type IV motility in smoking candidates. These findings are consistent with other studies.[17-21] Ozgur *et al.*[22] and Collodel *et al.*[23] observed no change in motility of sperms on comparing between smokers and non-smokers. The concentration of sperms was found to be significantly more in non-smoking individuals. Chia *et al.*[24] and Merino *et al.*[25] also observed decrease in concentration of sperms in smoking individuals. However, Aghamohammadi and Zafari[16] did not observed any significant change in concentration of sperms in seminal fluid.

The uniqueness is that we also observed leukocyte count in seminal fluid in our study. Significant increase in leukocyte count was found in smoking individuals as compared to non-smoking males. The increase of leukocyte could be attributed from the fact that tobacco metabolites in cigarettes causes inflammatory reaction and thus leads to the formation of inflammatory mediators, thereby increasing the leukocytes in seminal fluid.[26] Elevated leukocytes are the major source of oxygen free radicals and these reactive oxygen species causes impairment in male fertility.[27] These reactive oxygen species causes oxidative injury to DNA and membrane phospholipids.[27] Our findings were also supported by Meri *et al.*[15] who also reported significant increase in leukocyte count in smoking infertile males.

We also compared seminal parameters of non-heavy smokers with heavy smokers and observed abnormal morphology, decreased sperm concentration and decreased motility of sperms in infertile males smoking more than 20 cigarettes per day. These findings were further supported by

Meri *et al.*[15] also observed similar deranged seminal profile in individuals smoking more than 20 cigarettes per day. However, Collodel *et al.*[23] similarly observed a decrease in seminal concentration in heavy smokers but they did not observed abnormal morphology and decreased motility in their study group. This could be attributed from the fact that the study group by Collodel *et al.*[23] was small compared to our study.

Our study carries a limitation that we should have also measured hormonal levels like testosterone, follicle stimulating hormone, luteinizing hormone, estradiol to make it more impactful as measured by Trummer *et al.*[14] However, due to financial constraints and institutional limitations we could not able to perform thorough hormonal analysis.

CONCLUSION

From our study, we conclude that cigarette smoking has a detrimental effect on seminal fluid parameters in infertile males. Moreover, seminogram of heavy smokers are more deranged as compared to males smoking <20 cigarettes per day. Thus, we conclude that not only omitting cigarette smoking but even decreasing the number of cigarettes per day improves the seminal profile.

REFERENCES

1. Infections, pregnancies, and infertility: Perspectives on prevention. World Health Organization. Fertil Steril 1987;47:964-8.
2. Brugo-Olmedo S, Chillik C, Kopelman S. Definition and causes of infertility. Reprod Biomed Online 2001;2:41-53.
3. Hammond D, Fong GT, Cummings KM, O'Connor RJ, Giovino GA, McNeill A. Cigarette yields and human exposure: A comparison of alternative testing regimens. Cancer Epidemiol Biomarkers Prev 2006;15:1495-501.
4. Collin O, Kilter S, Bergh A. Tobacco smoke disrupts testicular microcirculation in the rat. Int J Androl 1995;18:141-5.
5. Reina Bouvet B, Vicenta Paparella C, Nestor Feldman R. Effect of tobacco consumption on the spermatogenesis in males with idiopathic infertility. Arch Esp Urol 2007;60:273-7.
6. Gaur DS, Talekar M, Pathak VP. Effect of cigarette smoking on semen quality of infertile men. Singapore Med J 2007;48:119-23.
7. Ramlau-Hansen CH, Thulstrup AM, Aggerholm AS, Jensen MS, Toft G, Bonde JP. Is smoking a risk factor for decreased semen quality? A cross-sectional analysis. Hum Reprod 2007;22:188-96.
8. Colagar AH, Jorsaraee GA, Marzony ET. Cigarette smoking and the risk of male infertility. Pak J Biol Sci 2007;10:3870-4.
9. Hassan A, Abo-Azma SM, Fayed SM, Mostafa T. Seminal plasma cotinine and insulin-like growth factor-I in idiopathic oligoasthenoteratozoospermic smokers. BJU Int 2009;103:108-11.
10. Mostafa T. Cigarette smoking and male infertility. J Adv Res 2010;1:179-86.
11. Lähdetie J. Micronucleated spermatids in the seminal fluid of smokers and nonsmokers. Mutat Res 1986;172:255-63.
12. Sokol RZ. Pathophysiology of male infertility. In: Mishell DR, Lobo RA, Sokol RZ, editors. The Year Book of Infertility and Reproductive Endocrinology. Philadelphia: Mosby Elsevier Health Science; 1996. p. 88-101.
13. World Health Organization (WHO). Laboratory Manual for the Examination of Human Semen and Sperm-Cervical Mucus Interaction. 3rd ed. Cambridge, England: Cambridge University Press; 1992.
14. Trummer H, Habermann H, Haas J, Pummer K. The impact of cigarette smoking on human semen parameters and hormones. Hum Reprod 2002;17:1554-9.
15. Meri ZB, Irshid IB, Migdadi M, Irshid AB, Mhanna SA. Does cigarette smoking affect seminal fluid parameters? A comparative study. Oman Med J 2013;28:12-5.
16. Aghamohammadi A, Zafari M. The impact of cigarette smoking on sperm parameters: A cross sectional study. IPCBEE 2011;16:81-4.
17. Vine MF, Tse CK, Hu P, Truong KY. Cigarette smoking and semen quality. Fertil Steril 1996;65:835-42.
18. Zavos PM, Correa JR, Antypas S, Zarmakoupis-Zavos PN, Zarmakoupis CN. Effects of seminal plasma from cigarette smokers on sperm viability and longevity. Fertil Steril 1998;69:425-9.
19. Wong WY, Thomas CM, Merkus HM, Zielhuis GA, Doesburg WH, Steegers-Theunissen RP. Cigarette smoking and the risk of male factor subfertility: Minor association between cotinine in seminal plasma and semen morphology. Fertil Steril 2000;74:930-5.
20. Zhang JP, Meng QY, Wang Q, Zhang LJ, Mao YL, Sun ZX. Effect of smoking on semen quality of infertile men in Shandong, China. Asian J Androl 2000;2:143-6.
21. Wang SL, Wang XR, Chia SE, Shen HM, Song L, Xing HX, *et al.* A study on occupational exposure to petrochemicals and smoking on seminal quality. J Androl 2001;22:73-8.
22. Ozgur K, Isikoglu M, Seleker M, Donmez L. Semen quality of smoking and non-smoking men in infertile couples in a Turkish population. Arch Gynecol Obstet 2005;271:109-12.
23. Collodel G, Capitani S, Pammolli A, Giannerini V, Geminiani M, Moretti E. Semen quality of male idiopathic infertile smokers and nonsmokers: An ultrastructural study. J Androl 2010;31:108-13.
24. Chia SE, Lim ST, Tay SK, Lim ST. Factors associated with male infertility: A case-control study of 218 infertile and 240 fertile men. BJOG 2000;107:55-61.
25. Merino G, Lira SC, Martínez-Chéquer JC. Effects of cigarette smoking on semen characteristics of a population in Mexico. Arch Androl 1998;41:11-5.
26. Comhaire FH, Mahmoud AM, Depuydt CE, Zalata AA, Christophe AB. Mechanisms and effects of male genital tract infection on sperm quality and fertilizing potential: The andrologist's viewpoint. Hum Reprod Update 1999;5:393-8.
27. Shen HM, Chia SE, Ong CN. Evaluation of oxidative DNA damage in human sperm and its association with male infertility. J Androl 1999;20:718-23.

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