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ORIGINAL ARTICLE

Assessment of semen quality in patients with androgenetic alopecia in an infertility clinic

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ABSTRACT

Background: Androgenetic alopecia (AGA) is a common cause of hair loss in men. It is associated with the risk of cardiovascular disease and metabolic syndrome. Additionally, it is suggested that premature AGA could be considered equivalent to that of polycystic ovary syndrome in women.
Objective: The aim of this study was to examine the relation between AGA and the quality of semen.
Methods: The semen specimens were collected from 203 young adult men included in the study. AGA was classified according to the Hamilton baldness scale, modified by Norwood. All participants were classified into two categories: normal to mild AGA (equivalent to Norwood types I–II) as Group I and moderate to severe AGA (equivalent to Norwood types III–VII) as Group II to assess the difference in the quality of sperms between the two groups.
Results: There were no statistically significant differences in the men's age and body mass index scores among the groups. For both Groups I and II, the history of smoking and varicocele was not statistically different ($p = 0.62$ and $p = 0.11$, respectively). All parameters of sperm including volume, density, motility, and morphology were significantly lower in participants with moderate to severe AGA than those with normal to mild AGA ($p < 0.01$, $p < 0.01$, $p < 0.01$, and $p < 0.01$, respectively).
Conclusion: This study showed that young adult men with moderate to severe AGA have poor quality of semen compared with those who have normal to mild AGA.

Introduction

Infertility is reported in 10–15% of couples attempting to conceive during their reproductive life span. A male factor is identified in 40–60% of these couples and is the sole etiology in 20% of all couples seeking assistance for infertility.[1] In a considerable number of men with abnormal semen characteristics, the etiology is unexplained and may involve unknown environmental factors.[2] One of the main laboratory tests for evaluation of infertility is semen analysis (SA).

Androgenetic alopecia (AGA) is a common cause of hair loss in men. Numerous studies in recent decades have associated male AGA with the risk of cardiovascular disease and metabolic syndrome (MS).[3–7] In addition, some studies have inferred that premature baldness prior to the age of 30 in men could be considered equivalent to that of polycystic ovary syndrome (PCOS) in women.[8] Narad et al[9] and Arias-Santiago et al[10] reported decreased levels of sex hormone-binding globulin (SHBG) in men with premature AGA. We expect that if premature AGA is associated with these systemic diseases and changes in the hormone profile, it might also be related to the quality of semen. Hence, the aim of this study was to investigate the relation between AGA and the quality of sperm.

Materials and methods

Participants

The study population consisted of healthy young adult males among the couples visiting the infertility clinic between October 2012 and December 2013. Participants who did not provide a semen sample or those with a history of vasectomy, cryptorchism,

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history of radiation, chemotherapy, infections, sexual dysfunction, and endocrine hypogonadism were excluded from the study. The cigarette smoking status and body mass index (BMI) values of participants were recorded. Those with a history of medications especially of finasteride and dutasteride were excluded from the study. A total of 203 men were included in the study, and semen specimens were collected from these individuals.

Assessment of AGA

AGA was classified according to the Hamilton baldness scale, as modified by Norwood.[11] All participants were classified into two categories—normal to mild AGA (equivalent to Norwood types I–II) as Group I and moderate to severe AGA (equivalent to Norwood types III–VII) as Group II—to assess the difference in the quality of sperm among the two groups.

Approval by the institutional review board was not necessary for this study in our clinic because all the analyses described in this study were part of the routine infertility investigation; in addition, the men were only evaluated for their AGA status with physical examination during the interview with the couples. However, informed consent was obtained from each of the patients with respect to these clinical examinations in this study.

Semen samples were collected by ejaculation into special sterile plastic containers after 2 to 7 days of sexual abstinence. SA was performed within 2 hours of collection of the semen specimens.

SA

SA consisted of determination of sample volume, sperm density, progressive motility, and morphology. Standard clinical SA was performed according to World Health Organization criteria.[12] Ejaculate volumes were estimated by the weight of the specimen, assuming a semen density of 1.0 g/mL. Sperm concentration was evaluated using a hemocytometer (Improved Neubauer; Hauser Scientific, Inc., Horsham, PA, USA). Motility was analyzed using the World Health Organization 1999 criteria and classified as both progressive (A + B) and total (A + B + C). Sperm abnormal forms were examined according to Kruger's strict criteria.[13]

Statistical analysis

The primary outcomes of interest in this study were semen volume, sperm concentration, motility percentage, and normal morphology percentage. Covariates considered in the analysis were age, cigarette use, and BMI.

Average, standard deviation, median, lowest, highest, rate and frequency values were used for the descriptive statistics of the data. Distribution of the variables was analyzed using the Kolmogorov–Smirnov test. Quantitative data were analyzed using the Mann–Whitney *U* test. Qualitative data were analyzed using the chi-square test; when conditions for the chi-square test were not satisfied, Fischer's exact test was used. A value of $p < 0.05$ was considered statistically significant. All statistical analyses were performed using SPSS 22.0 for Windows (SPSS Inc., Chicago, IL, USA).

Results

Table 1 shows some of the demographic characteristics of the participants. No statistically significant difference was found for the men's age and BMI scores within the groups. In Groups I and II, cigarette smoking and varicocele history were not statistically significant ($p < 0.62$ and $p < 0.11$, respectively).

Table 1 Demographic characteristics of Group I (normal–mild AGA) and Group II (moderate–severe AGA).

		Group I ($n = 115$)	Group II ($n = 85$)	p
		Mean	Mean	
Age		31.8 ± 5.6	31.9 ± 5.9	>0.05
BMI		26.0 ± 3.3	25.8 ± 3.1	>0.05
Smoking	+	46 → 36.5%	30 → 40%	>0.05
	–	80 → 63.5%	45 → 60%	>0.05

AGA = androgenetic alopecia; BMI = body mass index.

Figure 1 shows that the participants with moderate to severe AGA had significantly lower sperm counts than those in the normal to mild AGA group ($p < 0.0001$). All sperm parameters were significantly worse in participants with moderate to severe AGA compared with those of the normal to mild AGA group. Sperm volume, density, motility, and morphology were significantly lower or poor in participants with moderate to severe AGA than those in normal to mild AGA group (Table 2) ($p = 0.002$, $p < 0.01$, $p < 0.01$, and $p < 0.01$, respectively).

Figures 2 and 3 illustrate the significantly worse sperm motility and morphology in moderate to severe AGA group ($p < 0.01$ and $p < 0.01$, respectively).

Discussion

Because all of the included participants were from infertile couples, this appears to be a limitation of the study at first glance. However, as the control group (men without AGA or mild AGA) of the study also comprises participants from infertile couples of the same population, we believe that this fact would not have influenced the results of the study. Moreover, as the severity of AGA increases with advancing age, this does not have an influence on the results, because both groups in this study share similar mean ages.

This study showed that young adult men with moderate to severe AGA, according to the Hamilton baldness scale, have poor semen quality compared with those with normal hair status. Previous studies on semen quality showed that decreased levels of

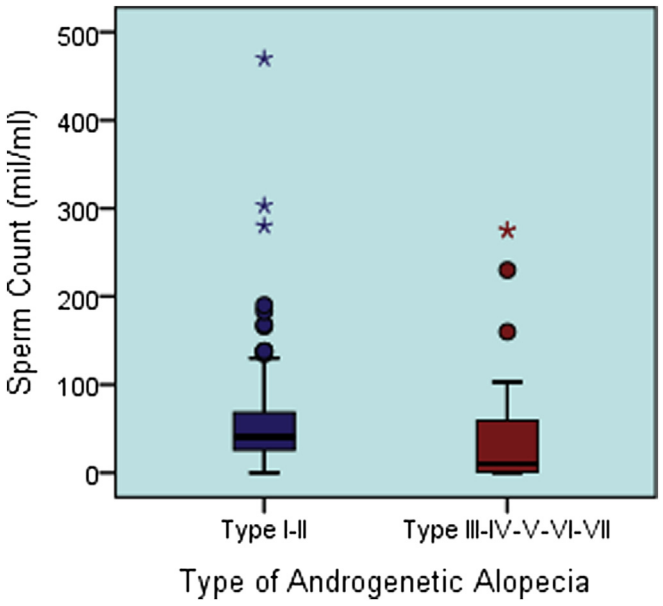

Figure 1 Participants with moderate–severe AGA (Hamilton III–VII) having significantly lower sperm count than normal–mild AGA (Hamilton I–II). AGA = androgenetic alopecia.

Table 2 Sperm parameters of Group I (normal–mild AGA) and Group II (moderate–severe AGA).

	Group I ($n = 115$)		Group II ($n = 88$)		p
	Mean ± SD	Min–max	Mean ± SD	Min–max	
Semen volume (mL)	2.8 ± 1.2	0.5–7.5	2.3 ± 1.5	0.0–8.0	0.002
Sperm count ($\times 0^6$/ml)	59.1 ± 62.3	0–470	36.5 ± 56.8	0–275	<0.01
Rapid progressively motile sperm (%)	40.5 ± 16.6	0–81	23.2 ± 19.3	0–67	<0.01
Slow progressively motile sperm (%)	18.5 ± 11.4	0–57	12.5 ± 10.4	0–40	<0.01
Morphologically normal sperm (%)	8.4 ± 6.7	0–54	4.1 ± 4.2	0–21	<0.01

AGA = androgenetic alopecia; SD = standard deviation.

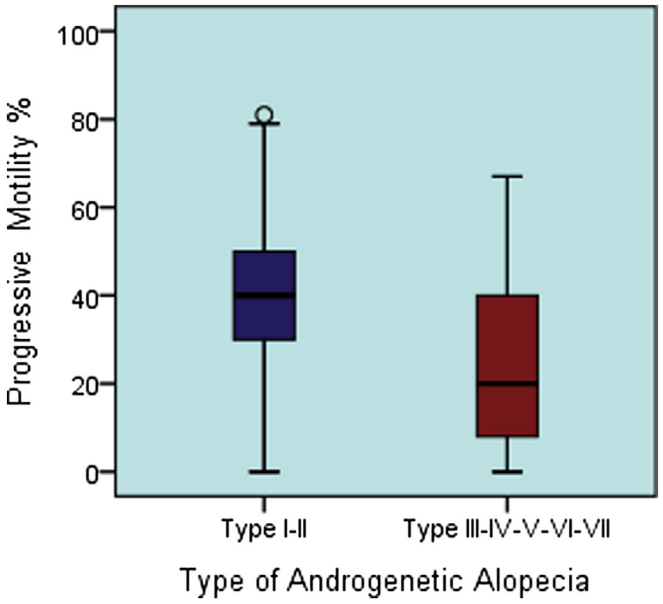

Figure 2 Participants with moderate–severe AGA (Hamilton III–VII) having significantly lower sperm motility than normal–mild AGA (Hamilton I–II). AGA = androgenetic alopecia.

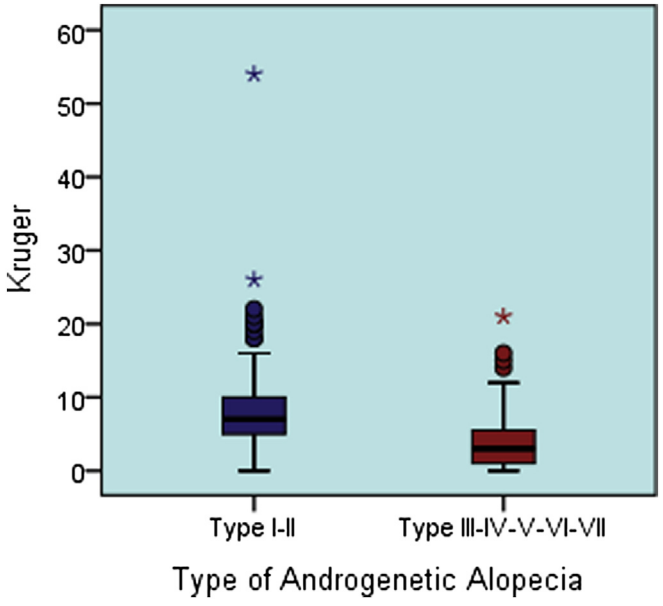

Figure 3 Participants with moderate–severe AGA (Hamilton III–VII) having significantly lower sperm morphology than normal–mild AGA (Hamilton I–II). AGA = androgenetic alopecia.

SHBG are correlated with poor semen quality.[14,15] SHBG is a glycoprotein that binds to the sex hormones, androgen and estrogen. SHBG is produced mostly by the liver and released into the bloodstream. SHBG levels are decreased by androgens, administration of anabolic steroids, PCOS, hypothyroidism, obesity, Cushing's syndrome, and hirsutism. Low SHBG levels increase the probability of type 2 diabetes.[16] In addition, Narad et al[9] reported decreased levels of SHBG in cases with AGA. Arias-Santiago et al[10] showed an association between early onset of AGA, hyperglycemia/diabetes, and low levels of SHBG, and suggested that low levels of SHBG could be a marker of insulin resistance and hyperglycemia/diabetes in patients with AGA.[10] Jensen et al[14] reported that alcohol intake and poor semen quality are associated with reduction in levels of SHBG. Moreover, Duskova et al[17] suggested premature alopecia as one of the signs of male phenotype of PCOS. Patients with PCOS have lower SHBG, lower follicle-stimulating hormone, and elevated free androgen index. It has been shown that overweight men have significantly lower SHBG levels, and their semen parameters are significantly worse.[15] Moreover, Safarinejad et al[18] reported that baseline SHBG levels tended to be lower in infertile men (21.1 ± 7.2 nmol/L) compared with normal fertile men (24.7 ± 7.9 nmol/L). All these systemic hormonal changes may also be true for the patients with AGA, and these changes may also affect spermatogenesis. Therefore, these assumptions may explain our findings on all the sperm parameters including total sperm volume, motility, and morphology.

Similar to these findings, AGA was found to be associated with MS,[3] and several studies reported that MS affects sperm parameters adversely.[19,20] Chakrabarty et al[21] demonstrated that AGA is associated with MS. Bakry et al[22] reported a statistically significant association between AGA and MS ($p = 0.002$). Meanwhile, Leisegang et al[23] reported that patients with MS had significant reductions in sperm concentration, total sperm count, and total motility.

It is hypothesized that a systemic proinflammatory state with oxidative stress is associated with MS, AGA, and worsening of the sperm parameters. Rosety et al[19] reported that sperm concentration and the percentage of sperms with normal motility and morphology were significantly lower in adults with MS, when compared with their healthy normal weight counterparts, and they attributed this to increased seminal oxidative damage. Omu[24] concluded that MS and low SHBG levels adversely affect semen quality. Lotti et al[25] reported that MS is associated with hypogonadism, poor sperm morphology, and testis ultrasound inhomogeneity. Oxidative stress at the level of testicular microenvironment may result in decreased spermatogenesis and sperm damage.[24] Therefore, elucidation of the complex interaction between MS and reproductive functions will have clinical implications in the therapeutic approach of both the entities, and this may also benefit the treatment of AGA.

In conclusion, this study demonstrated that the studied semen parameters were significantly worse in men with moderate to severe AGA than in men with normal to mild AGA ($p < 0.01$). This

study showed that men with AGA had poor semen quality. Patients with AGA have certain hormonal and metabolic changes that affect all systems, and these changes might also have some bad effect on spermiogram parameters.

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