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Body Composition Parameters, Carotid Intima Media Thickness and Epicardial Fat Thickness in Male Patients with Androgenetic Alopecia

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ABSTRACT

Background: Androgenetic alopecia (AGA) is a noncicatricial alopecia that happens under the stimulus of androgens in genetically predisposed individuals. Previous studies have shown that bioelectrical impedance analysis (BIA) is an objective indicator of body composition. Measurement of carotid intima-media thickness (CIMT) and epicardial fat thickness (EFT) indicates the risk of cardiovascular disease and subclinical atherosclerosis. In this study, we aimed to examine body composition parameters, CIMT and EFT values and to correlate these parameters with each other.

Materials and Methods: Sixty-four male patients with AGA who had no history of chronic disease and 67 age-matched healthy men were included as the control group. Subjects were separated into two groups (mild/moderate and severe) based on the Hamilton baldness scale modified by Norwood. BIA and body composition parameters and echocardiographic CIMT and EFT values were evaluated in all individuals included in the study.

Results: BIA; fat percentage, degree of obesity, metabolic age, body mass index (BMI) and visceral fat were higher than the controls. In echocardiographic measurements; LA diameter, interventricular septal thickness and posterior wall thickness averages were statistically significantly higher in the patients than in the controls. In the correlation analysis, a strong positive correlation was tracked between EFT and fat mass, obesity degree, BMI, visceral fat, and CIMT. On the other hand, strong negative correlation was tracked between EFT and fat free mass, muscle mass and body water.

Conclusion: In the study, obesity parameters measured by BIA were higher in patients with AGA compared to the control group, but there was no difference between the groups in terms of CIMT and EFT in echocardiographic measurements.

Keywords: Androgenetic alopecia, Bioelectrical impedance, CIMT, EFT, Visceral fat

Introduction

Androgenetic alopecia (AGA) is a noncicatricial alopecia that happens under the stimulus of androgens in genetically predisposed individuals [1]. In AGA, the anagen phase is shortened, resulting in miniaturization of the follicles. Dark and thick hairs are replaced by thin, short and light colored vellus hairs [2]. Its frequency varies between communities. It usually begins in the 3rd and 4th decades and its incidence raises with age [3,4]. It is the most frequent cause of hair loss in men during their lifetime [5]. In the dermatological examination, thinning of the hair in the vertex and

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bilateral temporal regions and regression of the anterior skin line are observed in men [2]. Although its pathophysiology is not openly reported, androgens, especially dihydrotestosterone (DHT), play a crucial part in the development of AGA. DHT is the main metabolite of testosterone found in the skin and is the most potent androgen in human blood [6].

Muscle tissue, adipose tissue and visceral protein are the three main nutritional parts of body composition [7]. Bioelectrical impedance analysis (BIA) method is one of the most effective methods for evaluating body fat ratio. It is based on the principle of determining body composition by applying electric current at different frequencies (at a very low level) to the human body [7,8]. BIA has recently been used in the evaluation of diseases such as metabolic syndrome, obesity, insulin resistance and nutritional status [9,10]. It is stated that it is more reliable than body mass index (BMI) in the evaluation of obesity [11]. With this assessment, which is based on the difference in lean tissue mass and electrical permeability of fat, various body tissue compositions such as muscle mass, body water content, body fat mass and lean body mass can be examined [7].

Epicardial fat is the visceral fat located between the pericardium and the heart and covers 80% of the heart surface [12]. Lately, measurement of carotid intima-media thickness (CIMT) and epicardial fat thickness (EFT) as practical and noninvasive methods have become popular to point out the risk of subclinical atherosclerosis and cardiovascular disease. Various studies have shown that CIMT and EFT are increased in patients with insulin resistance, metabolic syndrome and major cardiac events [12,13,14,15]. In a recent study, it was shown that CIMT and EFT values measured echocardiographically were higher in patients with advanced stages of AGA [6].

BMI was found to be higher in men with moderate and severe AGA than in men without AGA or with mild AGA [16]. On the other hand, there are also studies reporting that there is no difference in BMI between patients with AGA and the control group [17,18]. As far as we can scan, there is no study investigating body composition parameters in patients with AGA using the BIA method. In this study, it was purposed to examine body composition parameters with BIA and to examine CIMT and EFT values echocardiographically and to correlate these parameters with each other.

Materials and Method

Study Population

The study was conducted in accordance with the Declaration of Helsinki. This study was carried out between February 2020 and January 2022. In this prospective study, male patients who applied to the dermatology outpatient clinic due to hair loss and men without AGA were included as the control group. Previously diagnosed cerebral, peripheral or coronary artery disease; presence of congestive heart failure, chronic kidney disease, diabetes mellitus, hypertension, thyroid, pituitary, or adrenal disorders or left ventricular ejection fraction (LVEF) fewer than 50%; current or previous alopecia and those using drugs like androgens, antiandrogens or glucocorticoids in the last 3 months were not included to the study. All participants were informed and their written consent was obtained. Approval was obtained for the study from Malatya Clinical Research Ethics Committee on 15.01.2020 (decision no: 2020/10).

Assessment of AGA

AGA was categorized according to the Hamilton baldness scale modified by Norwood [19]. The two doctors separately examined each subject’s head from two perspectives (top and side), matching the subject’s hairstyle with consensus with the Hamilton-Norwood scale of baldness. Subjects were then classified into one of two groups for comparison. According to the Hamilton-Norwood scale, AGA stage II-IIa-IIIa-III vertex subjects were group I; AGA stages IV-IVa-V-Va-VI-VII were grouped as group II.

Bioelectrical Impedance Analysis

Body weight was measured using the BIA device with the least possible clothing of the individuals. The Tanta-BC 418 device was used to measure body composition. The diagnostic device works with 8 electrodes, 50 kHz constant current (hand to hand, foot to foot). It is a device that measures fat ratio, muscle mass and lean mass values for five different regions (right and left arm, right and left leg, trunk) with five separate current waves [20]. Measurements were carried out taking into account the working principles of the BIA device.

Echocardiographic Measurements

Echocardiographic examinations were applied according to the AHA and ESC Cardiac Chamber Measurement guidelines [21]. Echocardiographic evaluations of all participants were made by 2 cardiologists who were unaware of their clinical knowledge in each group using the Vivid E95 system (GE Vingmed Ultrasound AS, Horten-Norway) and an M5Sc-D (1.4-4.6 MHz) transducer probe. Two-dimensional, pulsed and continuous wave, color doppler evaluations were performed. LVEF was determined by Simpson method. Epicardial adipose tissue was defined as an anechoic space between the two epicardial layers on 2D echocardiographic images. EFT was calculated in the free wall of the right ventricle at the end of diastole on both parasternal long and short axis views. The mean of three cardiac cycles from each echocardiographic view was defined as EFT [22]. Intraobserver and interobserver variability rates for EFT were not statistically significant.

Carotis Intima Media Thickness Measurements

CIMT was calculated by a trained cardiologist who recorded ultrasonographic images of both the left and right common carotid arteries using the Vivid S6N device and a linear transducer when the participants were in the supine position. The proximal and distal walls of the artery were kept parallel to each other by applying transducer manipulation. Measurements were made 1 cm proximal to the carotid bifurcation. After visualization of the distal and proximal walls of the arteries parallel to each other in the longitudinal axis, the images were frozen. Images have been enlarged for detailed evaluation. Intima media thickness was measured from 4 different points with 1 mm distances and averaged.

Statistical Analysis

Quantitative-data were summarized as mean ± standard deviation and qualitative-data were given as number and percentage. Yates corrected chi-square tests were utilized to compare independent categorical variables. P-value <0.05 was contemplated statistically significant. The data were evaluated by using SPSS Package Statistical-Package-for-Social-Sciences software (SPSS Inc., Chicago, IL, USA, v17.0).

Results

There were 64 participants in the patient group and 67 participants in the control group. The mean age of the patient and control groups was close to each other (30.4±9.7, 28.3±8.6, respectively) and the difference was not statistically significant (p>0.05). Family history of AGA was higher in the patient group than in the controls (p<0.001). Approximately half of the patients were in groups III and IV according to the Hamilton-Norwood scale, and the disease duration in most patients was between 1 and 5 years (Table 1).

In bioimpedance analysis; lean muscle mass, muscle mass, body water percentage and body density were statistically lower in AGA patients than in the controls (p<0.001, p<0.001, p=0.002, p<0.001, respectively). Conversely, fat mass, obesity degree, metabolic age, BMI and visceral fat were higher than the control group (respectively, p<0.001, p=0.01, p=0.002, p=0.006, p=0.001) (Table 2).

In echocardiographic measurements; LA diameter, interventricular septal (IVS) thickness and posterior wall thickness (PWT) mean values were significantly higher in the patient group than in the controls (p=0.006, p=0.037, p=0.043, respectively). At the same time, IVS and PWT were statistically significantly higher in group II patients with higher AGA severity compared to the control group (p=0.010, p=0.045, respectively). No significant difference was observed between the groups in the comparison of other parameters (Table 3).

In the correlation analysis, a strong positive correlation was observed between EFT and FM, obesity degree, BMI, visceral fat, and CIMT (p<0.001, p=0.002, p<0.001, p<0.001, p=0.001, respectively). Conversely, a strong negative correlation was observed between EFT and fat free mass, muscle mass and body water (p<0.001, p<0.001, p<0.001, respectively) (Table 4).

Table 1. Demographic and clinical characteristics of the patient and control groups

		Patients	Controls	p-value
Age, mean ± SD		30.4±9.7	28.3±8.6	0.15
Family history, n (%)	Yes	58 (86.6)	29 (45.3)	<0.001
	No	9 (13.4)	35 (54.7)	
AGA severity, n (%)	II	11 (16.4)	-	-
	IIa	6 (9.0)	-	
	III	1 (1.5)		
	IIIa	8 (11.9)	-	
	III vertex	12 (17.9)	-	
	IV	15 (22.4)	-	
	Va	4 (6)	-	
	V vertex	6 (9)	-	
	VI	4 (6)	-	
	VII	-		
AGA duration, n (%)	0-12 months	5 (7.5)	-	-
	1-3 years	25 (37.3)	-	
	3-5 years	20 (29.9)	-	
	5-10 years	12 (17.9)	-	
	≥10 years	5 (7.5)	-	

AGA: Androgenetic alopecia, SD: Standard deviation

Table 2. Antropometric, BIA, and clinical parameters

	Patients			Controls	p-values*			
	Group I	Group II	All		p^1	p^2	p^3	p^4
+FFM (%)	78.2±5.5	78.3±5.3	78.2±5.4	82.4±4.8	**0.001**	**0.001**	0.99	**<0.001**
+MM (%)	74.3±5.2	74.3±5.0	74.3±5.1	78.3±4.5	**0.001**	**0.001**	0.98	**<0.001**
+FM (%)	21.6±5.5	21.6±5.3	21.6±5.3	17.4±4.8	**0.001**	**0.001**	0.99	**<0.001**
+BW (%)	55.8±3.4	56.0±4.2	55.9±3.8	58.3±3.6	**0.005**	**0.017**	0.87	**0.002**
+Obesity degree	16.7±13.0	12.1±14.3	14.5±13.7	6.9±14.6	**0.006**	0.15	0.23	**0.01**
+Protein	13.3±2.3	13.2±3.1	13.3±2.7	13.3±2.3	0.98	0.85	0.88	0.90
+Mineral	4.5±0.4	4.4±0.6	4.4±0.5	4.3±0.4	0.24	0.59	0.67	0.31
*Metabolic age (years)	25.2±6.0	32.4±9.8	28.7±8.8	24.3±7.7	0.14	**<0.001**	**0.012**	**0.002**
+BMI (kg/m^2)	25.4±2.9	25.1±3.7	25.3±3.3	23.4±3.2	**0.012**	**0.046**	0.78	**0.006**
*Body density	1.0±0.0	1.0±0.0	1.04±0.0	1.2±1.3	**0.001**	**0.002**	0.95	**<0.001**
*Visceral fat	5.1±2.6	6.7±3.5	5.9±3.2	3.9±2.5	**0.043**	**0.001**	0.10	**0.001**

*Mann-Whitney U test, +t-test, BIA: Bioimpedance analysis, FFM: Fat free mass, MM: Muscle mass, FM: Fat mass, BW: Body water, BMI: Body mass index, Group I: Subjects with AGA stages (Hamilton-Norwood scale) II, IIa, IIIa and III vertex, Group II: AGA stages IV, IVa, V, Va, VI and VII, p^1: Group I and controls, p^2: Group II and controls, p^3: Group I and group II, p^4: All patients and controls, AGA: Androgenic alopecia

Table 3. Echocardiographic and ultrasonic datas for the groups

	Patients, mean ± SD			Controls, mean ± SD	p-values*			
	Group I	Group II	All		p^1	p^2	p^3	p^4
EFT (cm)	3.3±1.0	3.4±0.8	3.4±0.9	3.2±1.0	0.75	0.34	0.49	0.46
LVEF (%)	64.6±1.3	64.6±1.2	64.6±1.3	64.4±1.5	0.49	0.44	0.87	0.36
LA (cm)	3.5±0.2	3.5±0.2	3.5±0.2	3.4±0.2	**0.012**	0.05	0.59	**0.006**
LVEDD	4.7±0.3	4.6±0.3	4.7±0.3	4.6±0.2	0.06	0.99	0.10	0.21
LVESD	3.1±0.4	3.0±0.3	3.0±0.3	3.0±0.3	0.10	0.92	0.05	0.29
IVST	0.96±0.0	1.0±0.3	0.99±0.2	0.93±0.0	0.32	**0.010**	0.11	**0.037**
PWT	0.88±0.1	0.91±0.1	0.89±0.1	0.86±0.0	0.16	**0.045**	0.52	**0.043**
sPAP	27.3±5.9	27.2±2.7	27.2±4.8	26.3±2.9	0.90	0.24	0.29	0.47
CIMT (cm)	0.05±0.0	0.04±0.0	0.05±0.0	0.05±0.0	0.78	0.68	0.58	0.63

*Mann-Whitney U test, EFT: Epicardial fat thickness, LVEF: Left ventricular ejection fraction, LA: Left atrium, LVEDD: Left ventricular end-diastolic diameter, LVESD: Left ventricular end-systolic diameter, IVST: Interventricular septal thickness, PWT: Posterior wall thickness, sPAP: Systolic pulmonary artery pressure, CIMT: Carotid intima-media thickness, Group I: Subjects with AGA stages (Hamilton-Norwood scale) II, IIa, IIIa and III vertex, Group II: AGA stages IV, IVa, V, Va, VI and VII, p^1: Group I and controls, p^2: Group II and controls, p^3: Group I and group II, p^4: All patients and controls, AGA: Androgenic alopecia

Discussion

AGA is the most common type of alopecia in the general population [17]. It was first stated by Cotton et al. [23] that male AGA might be a risk factor for cardiovascular disease.

There are various studies investigating the relationship between AGA and CVD, insulin resistance and metabolic syndrome [17]. In a meta-analysis of 50,956 patients, AGA was found to be associated with hyperinsulinemia, insulin resistance, and metabolic syndrome as well as coronary artery disease. The pathological mechanism underlying the relationship between AGA, cardiovascular risk factors and coronary artery disease has not yet been openly determined [24].

In a study conducted in 126 male patients, it was shown that patients with advanced stages of AGA had higher CIMT and EFT values [6]. Although it has been indicated that the increase in CIMT and EFT in AGA patients is associated with coronary artery disease, no such evaluation was made in our study.

In a study of 189 male subjects, higher alopecia severity, higher degree of obesity were associated with higher BMI, particularly in those with early-onset male type AGA [25]. In another study, it was found that the severity of AGA rised with age in 132 male patients, but it was not found to have a statistically significant relationship with BMI [17].

Cardiovascular events such as severe myocardial infarction and fatal ischemic heart disease have been documented with early AGA, but

Table 4. Correlation of BIA parameters with echocardiography and CIMT

		EFT	LVEF	LA	LVEDD	LVESD	IVST	PWT	sPAP	FFM (%)	MM (%)	FM (%)	BW (%)	Obesity degree	BMI	Visceral fat	CIMT
EFT	r	1															
	p																
LVEF	r	-0.363**	1														
	p	0.003															
LA	r	0.392**	-0.266*	1													
	p	0.001	0.030														
LVEDD	r	0.347**	0.390**	0.719**	1												
	p	0.004	0.000	0.000													
LVESD	r	0.009	0.392**	0.347**	0.259*	1											
	p	0.942	0.000	0.004	0.022												
IVST	r	-0.032	0.178	0.095	0.038	0.262*	1										
	p	0.795	0.075	0.445	0.741	0.007											
PWT	r	0.353**	0.518**	0.432**	0.343*	0.727**	0.321*	1									
	p	0.003	0.000	0.000	0.002	0.000	0.001										
sPAP	r	0.094	0.147	-0.073	-0.032	0.093	0.019	-0.058	1								
	p	0.449	0.237	0.558	0.800	0.454	0.876	0.643									
FFM (%)	r	-0.491**	0.215	-0.381**	-0.426**	-0.167	0.256	-0.368**	-0.098	1							
	p	0.000	0.130	0.006	0.002	0.240	0.069	0.008	0.496								
MM (%)	r	-0.485**	0.212	-0.367**	-0.415**	-0.158	0.265	-0.364**	-0.096	0.999**	1						
	p	0.000	0.136	0.008	0.002	0.268	0.061	0.009	0.503	0.000							
FM (%)	r	0.485**	-0.206	0.379**	0.424**	0.170	-0.259	0.373**	0.097	-1.000**	-0.999**	1					
	p	0.000	0.147	0.006	0.002	0.232	0.067	0.007	0.498	0.000	0.000						
BW (%)	r	-0.540**	0.283*	-0.537**	-0.547**	-0.276	0.116	-0.411**	-0.069	0.873**	0.861**	-0.872**	1				
	p	0.000	0.044	0.000	0.000	0.050	0.416	0.003	0.630	0.000	0.000	0.000					
Obesity degree	r	0.420**	-0.264	0.463**	0.571**	0.298*	-0.205	0.326*	0.172	-0.693**	-0.680**	0.687**	-0.786**	1			
	p	0.002	0.061	0.001	0.000	0.034	0.149	0.020	0.228	0.000	0.000	0.000	0.000				
BMI	r	0.502**	-0.231	0.447**	0.488**	0.229	-0.168	0.342*	0.152	-0.666**	-0.654**	0.660**	-0.738**	0.850**	1		
	p	0.000	0.104	0.001	0.000	0.106	0.237	0.014	0.287	0.000	0.000	0.000	0.000	0.000			
Visceral fat	r	0.537**	0.227	0.513**	0.363**	0.122	-0.042	0.429**	0.160	-0.835**	-0.830**	0.834**	-0.768**	0.626**	0.744**	1	
	p	0.000	0.109	0.000	0.009	0.393	0.768	0.002	0.263	0.000	0.000	0.000	0.000	0.000	0.000		
CIMT	r	0.412**	-0.146	0.414**	0.302*	0.068	0.041	0.317**	0.033	-0.357*	-0.355*	0.352*	-0.306*	0.204	0.428**	0.484**	1
	p	0.001	0.240	0.001	0.013	0.585	0.744	0.009	0.793	0.010	0.011	0.011	0.029	0.151	0.002	0.000	

*<0.05, **<0.01; EFT: Epicardial fat thickness, LVEF: Left ventricular ejection fraction, LA: Left atrium, LVEDD: Left ventricular end-diastolic diameter, LVESD: Left ventricular end-systolic diameter, IVST: Interventricular septal thickness, PWT: Posterior wall thickness, sPAP: Systolic pulmonary artery pressure, FFM: Fat free mass, MM: Muscle mass, FM: Fat mass, BW: Body water, CIMT: Carotid intima-media thickness, BW: Body water

the mechanism underlying this relationship is not yet understood [24,26].

In our study, body composition parameters were examined by BIA in patients with AGA and in the controls, and the relationships between cardiovascular disorders and AGA were investigated by making cardiac measurements with echocardiography. Considering the correlation of BIA data with echocardiographic and CIMT data, it was seen there was a powerful and positive correlation between visceral fat, CIMT and EFT values. The relationship between visceral fat ratio and hyperinsulinemia, diabetes mellitus and atherosclerotic heart disease is known [27]. In our study, the visceral fat ratio in BIA analysis was higher in AGA patients compared to the controls, it was significantly higher in group II patients and showed a strong correlation with CIMT and EFT values, which supports this data. In the light of these data, it can be considered as an advantage that visceral fat assessment by BIA method is an easily accessible and non-invasive test, since it may show the development of subclinical atherosclerosis and prediabetes in the early period.

Study Limitation

The limited number of patients included in our study, the fact that our patient profile mostly consists of young individuals, only male patients and the absence of female patients can be expressed as limitations.

Another limitation of our study is that more sensitive methods such as tomography or magnetic resonance imaging (MRI) were not used to measure CIMT and EFT values.

Conclusion

Although it was stated that these values were significantly impaired in studies evaluating CIMT and EFT in patients with AGA, no significance was observed in our study. We believe that this may be because of the few number of patients included in our study and the fact that our patient profile is mostly composed of young individuals. In our study, a two-dimensional transthoracic echocardiography device was used to measure CIMT and EFT values, but using more sensitive methods such as tomography or MRI can provide more meaningful results in the measurement of these values.

Ethics

Ethics Committee Approval: Approval was obtained for the study from Malatya Clinical Research Ethics Committee on 15.01.2020 (decision no: 2020/10).

Informed Consent: All participants were informed and their written consent was obtained.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: D.T., Ş.H., Concept: D.T., Ş.H., N.A., Design: D.T., Ş.H., N.A., Data Collection or Processing: D.T., Ş.H., S.A., M.Y.A., F.B.B., Analysis or Interpretation: D.T., Literature Search: D.T., S.A., Writing: D.T., Ş.H., S.A.

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