Differences of Superoxide Dismutase (SOD) Enzyme Levels Based on the Severity of Androgenetic Alopecia in Men

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Abstract

Introduction: Androgenetic alopecia or male pattern hair loss is a progressive hair loss caused by genetic and androgenic factors in hair follicles with characteristic shortening of the anagen phase, telogen phase elongation, and miniaturization of hair follicles which causes the hair shaft to grow thinner in each cycle. Enzyme Superoxide Dismutase (SOD) is one of the body's antioxidant defense systems. Superoxide Dismutase is important in almost all cells that are exposed to oxygen, decreased levels or their activity can cause oxidative stress status of body cells including hair keratinocytes. The severity of androgenetic alopecia in men is classified on a Hamilton-Norwood scale consisting of types I to VII.

Objective: To analyze differences of SOD enzyme levels based on the severity of androgenetic alopecia in men.

Methods: This study was an observational analytic study with a cross-sectional design involving 30 men with androgenetic alopecia who was treated at Departement of Dermatology and Venereology H. Adam Malik General Hospital Medan. The severity of androgenetic alopecia of each participant was classified into mild, moderate and severe based on Hamilton-Norwood scale and we also performed examination of SOD level.

Results: There was no significant difference in SOD enzyme levels based on the severity of androgenetic alopecia in men.

Conclusion: Androgenetic alopecia is baldness which is influenced by internal factors such as genetic and androgen, and external factors such as microinflammation. SOD levels are strongly related to the characteristics of each individual such as aging and lifestyle.

index term: Alopecia androgenetica, severity, SOD, Hamilton-Norwood scale

I.INTRODUCTION

Androgenetic alopecia or male pattern hair loss is a common progressive hair loss caused by genetic and androgenic factors in hair follicles. Its characteristics are similar in both sexes characterized by shortening of the anagen phase, elongation of the telogen phase, and miniaturization of hair follicles which causes the hair shaft grow thinner in each cycle.[1-3]

The severity of androgenetic alopecia in men is classified with the Hamilton-Norwood scale consist of types I to VII.[1-3]According to Colgecen E et al and Abbasi J et al, the severity can be categorized into mild (I and II), moderate (IIA, III, IIIA and IV), and severe (IVA, V, VA, VI and VII).[4,5]

The pathogenesis of androgenetic alopecia in men influenced by androgen hormon and genetic factors.[1,3] Microinflammation also plays a role in the pathogenesis of androgenetic alopecia in which DHT will increase secretion of interleukin (IL) -6 and also TGF-β1. Later it will influence oxidative stress on dermal papilla cells and inhibits proliferation of hair matrix epithelial. In addition, environmental factors such as nutrition, metabolic syndrome, smoking and ultraviolet (UV) radiation also play a role in the pathogenesis of androgenetic alopecia.[6] These environmental factors influence the occurrence of oxidative stress which in turn causes an increase in free radicals and reactive oxygen compounds in androgenetic alopecia.[6-8] Oxidative stress is a state of imbalance between the production of free radicals or reactive oxygen compounds with antioxidant defense systems in the body.[7]

The body's defense system consist of antioxidant enzymes and non-enzymes. Antioxidant enzymes are Superoxide Dismutase (SOD) contained in the mitochondria and cytosol, Glutathione Peroxidase (GPX), lutathionereductase, and catalase (CAT). Whereas non-enzymatic antioxidant defenses are micronutrient like β-carotene, vitamin C and vitamin E.[7,8] SOD is an antioxidant enzyme that is important in almost all cells exposed to oxygen, decreased levels or activity can cause oxidative stress status of body cells including hair keratinocytes.[9] Study of Roshdy OH et al showed that the mean serum SOD level in patients with androgenetic alopecia was 67.60 ± 12.49 U / g Hb, which decreased compared to control 85.60 ± 6.6 U / g Hb ($p < 0.001$).[10] It was supported by study of Amirnia et al. that examined level of zinc, copper, and SOD, GPX, and malondialdehyde in androgenetic alopecia, it was found that the mean serum SOD level in patients with androgenetic alopecia was 1816.57 ± 98.79 µg / dl which decreased significantly compared to the control of 2296.77 ± 286.89 µg / dl ($p < 0.005$).[9] Prie BE et al in his study of oxidative stress in androgenetic alopecia showed that the mean serum level of SOD enzymes in androgenetic alopecia patients was 441.35 ± 26.83 U / g Hb while control was 546.85 ± 21.99 U / g Hb ($p < 0.01$).

Nowaday, there is only few literature which discusses the differences in SOD enzyme level based on the severity of androgenetic alopecia, so we interested to know about the difference of serum levels of SOD enzymes based on the severity of androgenetic alopecia in men.

II. METHOD

This research was conducted from June 2018 to December 2019. It was an observational analytic study with a cross-sectional design involving 30 men with androgenetic alopecia who came to Departement of Dermatology and Venereology H. Adam Malik General Hospital Medan. Each participant will sign an informed consent and will undergo anamnesis, dermatological examination and blood test for SOD levels. This research was carried out after obtaining permission from the Research Ethics Commission of the Faculty of Medicine, Universitas Sumatera Utara and a research permit from the Directorate of Human Resources and Education of the Research and Development Installation of H. Adam Malik General Hospital Medan.

III.RESULTS

A total of 30 subjects, with majority androgenetic alopecia in the age group of 60-69 years as many as 10 people (33.3%) while at least in the age group> 70 years (3.3%). From the above results it can be seen that there is an increase in the prevalence of androgenetic alopecia with increasing decades of age, except at> 70 years of age. (table 1)

Table 1 Distribution by age group

Age Group (year)	n	%
30-39	5	16,7
40-49	7	23,3
50-59	7	23,3
60-69	10	33,3
>70	1	3,3
Total	30	100

From all the subjects, majority had family history of androgenetic alopecia as much as 21 people (70%). (table 2)

Table 2 Distribution by family history

Family history	n	%
Yes	21	70
None	9	30
Total	30	100

Based on our study, the mean of duration of alopecia was 24 months with a minimum value is 6 months and a maximum value is 72 months. (table 3)

Table 3 Distribution by duration of alopecia

	Median (Min-Max)
Alopecia duration	24 months (6 months-72 months)

Based on table 4, the severity of mild androgenetic alopecia is predominantly found in the 30-39 years and 40-49 years age groups with 50% each, for the moderate severity majority in 50-59 years age group is 60%, and for the severity severe majority in the 60-69 year age group.

Table 4. The severity of androgenetic alopecia by age group

Age group	**severity of androgenetic alopecia**					
	Mild		Moderate		Severe	
	N	%	n	%	n	%
30-39	5	50	0	0	0	0
40-49	5	50	2	20	0	0
50-59	0	0	6	60	1	10
60-69	0	0	2	20	8	80
>70	0	0	0	0	1	10
Total	10	100	10	100	10	100

Based on table 5, participant with family history of alopecia, 90% had a moderate severity androgenetic alopecia, while study subjects who had no family history, 60% had mild androgenetic alopecia.

Table 5. The severity of androgenetic alopecia by family history

Family history	Severity of androgenetic alopecia					
	Mild		Moderate		Severe	
	N	%	n	%	n	%
Yes	4	40	9	90	8	80
None	6	60	1	10	2	20
Total	10	100	10	100	10	100

Based on table 6 it can be seen that the highest SOD enzyme levels are at moderate androgenetic alopecia which is 106.51 (0.01-1054.80) U / L and the lowest level at severe androgenetic alopecia is 24.61 (0.04-595.37) U / L. The results of the kruskal-wallis test showed the value of p> 0.05 so, there was no significant difference in SOD levels based on the severity of androgenetic alopecia in men.

Table 6. The difference of SOD enzyme levels based on the severity of androgenetic alopecia

Severity of androgenetic alopecia	Median (Min-Max) U/L	p*
Mild	35,89 (0,03-401.92)	0,679
Moderate	106,51 (0,01-1054.80)	
Severe	24,61 (0,04-595,37)	

Based on table 7 it can be seen that the highest SOD enzyme levels are in the 50-59 years age group which is 94.06 (0.01-492.07) U / L while the lowest levels in the 40-49 years age group are 9.22 (0 , 05-1054.80) U / L. The results of the kruskal-wallis test p value> 0.05 so there was no significant difference in SOD levels based on the age group of androgenetic alopecia in men.

Table 7. Differences of SOD enzyme levels by age group

Age group (years)	Median (Min-Max) U/L	p*
30-39	62,09 (0,03-113,52)	0,783
40-49	9,22 (0,05-1054,80)	
50-59	94,06 (0,01-492,07)	
60-69	49,82 (0,04-595,37)	
>70	62,09	

Based on table 8 it can be seen that SOD enzyme levels are higher in men with a family history of alopecia that is 73.75 (0.02-1054.80) U / L. The results of the kruskal-wallis test showed p values> 0.05, so there was no significant difference in SOD levels based on a family history of androgenetic alopecia.

Table 8. Differences of SOD enzyme levels based on family history

Family history	Median (Min-Max) U/L	p*
Yes	73,75 (0,02-1054,80)	0,402
None	9,22 (0,01-595,37)	

IV.DISCUSSION

The increasing of androgenetic alopecia prevalence by decades of age shows a connection between the aging and microinflammatory processes in androgenetic alopecia. The accumulation of oxidative stress in aging activates the inflammatory pathway mediated by IL-1α, IL-6, IL-8, which causes cellular damage to the hair's peripherals.[11] Family history of alopecia has an important role in the onset of androgenetic alopecia which genetic factors are considered has role that greatly influences the occurrence of androgenetic alopecia.The duration of androgenetic alopecia varies depending on the onset. The onset of androgenetic alopecia usually begins after puberty and before the age of 40.[3] Study of Lee WS showed there is a link between the history of alopecia in families with early onset other than that the early onset of androgenetic alopecia otherwise the early onset will increases the risk more severe androgenetic alopecia.[12]

Family history of alopecia has an important role in the onset of androgenetic alopecia. Genetic factors are considered as a very influential role in the occurrence of androgenetic alopecia.[12] Polygenic inheritance patterns are considered important in clinical phenotypes and an increased risk of the number of family members affected by alopecia.[13]

According to this study there was no significant difference in SOD levels based on the severity of androgenetic alopecia in men. Roshdy et al's study showed there were differences in SOD levels in androgenetic alopecia patients compared to controls (67.60 ± 12.49 U / L and 85 ± 6.60 U / L (p <0.05)).[10] Armirnia et al also revealed the same, with a value of 1861.57 ± 98.79 U / L for patients with androgenetic alopecia and 2290.77 ± 286.89 U / L for control (p <0.005).[9] However, many studies have revealed differences in SOD levels in each degree of severity of alopecia androgenetics are very limited.

Theoritical, there is no significant differences in SOD levels were found in each of the severity of androgenetic

alopecia, could be influenced by several things, like the presence of oxidative stress factors that can originate from irritants, pollution, and ultraviolet radiation. In addition, individual lifestyles can also affect oxidative stress status such as exercise habits, antioxidant supplementation, and smoking.[14-16] The results of this study can be influenced by several things, especially the presence of oxidative stress factors that came from irritants, pollution, and ultraviolet radiation. However, individual lifestyles can also affect oxidative stress status such as exercise habits, antioxidant supplementation, and smoking.[15-16]

V.CONCLUSIONS

Androgenetic alopecia is baldness which is influenced by internal factors such as genetics and androgens, as well as external factors such as microinflammation. Genetics play an important role in the family's history of androgenetic alopecia. Whereas the SOD level is highly related to the characteristics of each individual such as aging and lifestyle.

VI. SUGGESTION

This research can be done with a larger sample size and age distribution in each group that is similar and has no family history, other than that by minimizing the presence of bias factors such as smoking and the use of antioxidants.

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