ejpmr, 2022,9(10), 279-286

SJIF Impact Factor 6.222

EUROPEAN JOURNAL OF PHARMACEUTICAL AND MEDICAL RESEARCH

www.ejpmr.com

Research Article

ISSN 2394-3211

EJPMR

ASSOCIATION OF METABOLIC SYNDROME AND INSULIN RESISTANCE IN MIDDLE-AGEDMEN WITH ANDROGENIC ALOPECIA

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Article Received on 24/07/2022 **Article Revised on 14/08/2022** **Article Accepted on 04/09/2022**

ABSTRACT

Introduction: Androgenetic alopecia (AGA) is defined as the commonest type of alopecia induced by androgens in genetically predisposed individuals. AGA patients are associated withvarious disorders. **Aim:** To study association of metabolic syndrome (MS) and insulin resistance (IR) in middle aged men with Androgenic alopecia. **Material & Methods:** Sixty male patients attending the Dermatology OPD with AGA between 17-75years were included as cases and 60 age-matched male patients were taken as controls. After obtaining the informed consent, all participants are subjected to detailed history taking, complete physical and clinical examination. Clinical examination including measurement of height, weight, waist circumference, BMI and blood pressure. And measuring blood parameters like the fasting blood sugar, fasting lipid profile and fasting serum insulin was done. **Results:** The mean duration of hair loss was 11.43±8.655 years. The number of participants were more between 30-60 years which was63.3%, focusing mainly middle-aged men. Family history of baldness was present in 75% of cases. History of alcohol consumption and smoking were noted among 56.67% and 46.67% ofcases with AGA respectively. Among 60 cases, 53.33% had metabolic syndrome and 40% had insulin resistance. Among AGA patients with MS, increase in waist circumference was the most common feature (51.67%). **Conclusion:** Increased prevalence of MS and IR was found among the middle-aged men with AGA. Patients with AGA and patients with family history of AGA should be closely monitored lifelong, as they are at risk for coronary artery disease and myocardial infarction in middle- aged men.

KEYWORDS: Androgenetic alopecia, Baldness, Insulin resistance, Metabolic syndrome, AGA, Cardiovascular risk.

INTRODUCTION

Androgenetic alopecia (AGA) is a progressive process that is genetically determined and causes a gradual conversion of terminal hair into vellus hair.[1] Androgenetic alopecia (AGA) is defined as the alopecia induced by androgens in genetically predisposed individuals.[2]

The characteristic "horseshoe" pattern occurs in men, hair loss involving the temporal and vertex regions and sparing of the occipital region.[3] The type of hair loss is different in women,and the prevalence is lower than that in men. The onset of androgenetic alopecia is highly variable and appears to be determined by sufficient circulating androgens and the degree of genetic predisposition.[4] AGA results in progressive miniaturization of the hair follicles leading to vellus transformation of terminal hair.

Androgenic alopecia is the most common type of non-

scarring alopecia.[5] Hamilton proposeda mutual interplay of genetic factors, androgens, age factor as the cause of Androgenic alopecia.[6]

Patients with premature Androgenic alopecia are susceptible to diabetes, hypertension, metabolic syndrome, cardiovascular diseases, and also premature baldness can have a negativeimpact on the self-image and self-esteem.[5] Insulin resistance is the underlying physiopathology of metabolic syndrome (MS), which is characterized by a cluster of conventional and nonconventional cardiovascular risk factors. Insulin resistance and hyperinsulinemia both are known to be independent risk factors for coronary artery disease.[7] Screening of early-onset AGA patients for identification and intervention for metabolic syndrome, insulin resistance and genetic risk factors can prevent the development of cardiovascular disease.

The link between metabolic syndrome, insulin resistance and androgenic alopecia in middle- aged men is not fully understood.[5] Hence this study is done to prevent the early cardiovascular risks by early screening and follow-ups.

MATERIAL AND METHODS

Study design: A hospital-based case-control study.
Study setting: Patients attending Dermatology OPD, AVMC&H, Puducherry.
Sample Size: 120 participants (60 cases and 60 controls)
Duration of study: 2 years.

Statistical tests used

1) CHI-SQUARE TEST – To compare categorical variables.
2) Student's t-test – To compare parametric variables.
3) Multiple Logistic Regression (ODD'S ratio) – To study theassociation.

Sixty male patients with androgenic alopecia with Hamilton-Norwood classification IIIor more and between 18-75years were included as cases. Sixty male participants without androgenic alopecia, matching age group with that of cases were included as controls.

After obtaining the informed consent, all participants are subjected to detailed history taking, complete physical and clinical examination. A detailed history is taken, including duration of baldness, family history, smoking, alcohol consumption, reduced socialization, presence of other systemic illnesses, concomitant intake of medicines for other illnesses and previous treatment and procedures for hair loss.

Clinical examination includes measurement of height, weight, waist circumference, BMI and blood pressure. Measuring blood parameters like the fasting blood sugar, fasting lipid profile and fasting serum insulin. Blood pressure was measured after subjects had been sitting for ten minutes. The waist circumference was measured by placing the measuring tape around the abdomen at the level of the iliac crest. The BMI is calculated using the equation: weight in kg/square of height in meters. According to WHO guidelines, a BMI ($kg/m^{2)}$ of <18.5 is categorized as underweight, BMI between 18.5 - 24.9 is categorized as normal, BMI between 25 to 29.9 is overweight, and BMI >30 is categorized as obese.[8]

The diagnosis of metabolic syndrome is made based on the new International Diabetes Federation criteria.[9] According to the new IDF definition for metabolic syndrome, they must have Central obesity: >94cm for Asian males.

Along with, any two of the following

Raised Triglycerides	>150mg/ dl or any treatment for lipidabnormality
Reduced hdl cholesterol	<40mg/ dl in males <50mg/ dl in females or any treatmentfor lipid abnormality
Raised blood pressure	systolic BP ≥ 130 or diastolic BP ≥ 85mm Hg or treatment of previously diagnosed hypertension
Raised fasting blood sugar	(FPG) ≥ 100 mg/ dl or alreadydiagnosed type 2 diabetes

The diagnosis of insulin resistance is made based on HOMA-IR criteria (As per homeostasis model assessment of insulin resistance) = fasting insulin level (µIU/mL) * Fasting blood sugarlevel (mmol/L) / 22.5) – if the value is above 2.7, it indicates insulin resistance.[10] P-value of <0.05 was considered significant.

Then, finding out the association between androgenic alopecia, metabolic syndrome and insulin resistance in cases as well as controls. To advise the patients with metabolic syndrome and insulin resistance for proper treatment and regular follow-ups to prevent early cardiovascular risks.

Figure 1: Aga patient with Grade V stage of hair loss.

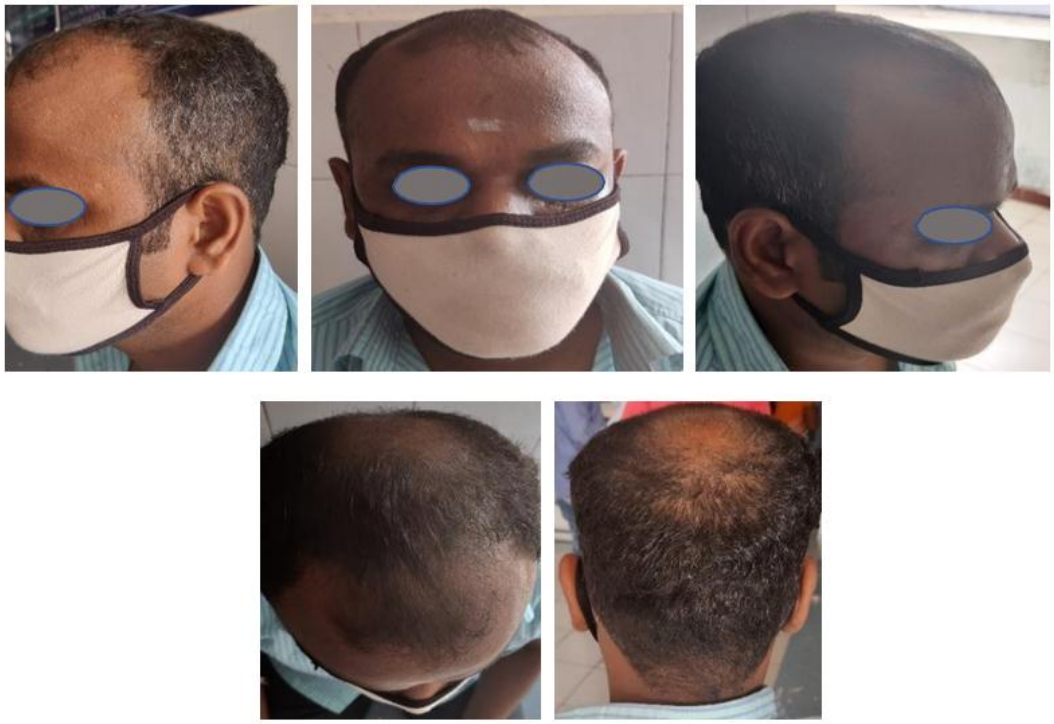

Figure 2: AGA patient with Grade VI stage of hair loss.

RESULTS

The number of cases and controls were equal (60 each), which were age-matched. Andthe mean age of cases and controls were 46.03±15.29 and 45.98±15.31, respectively. Among the participants, the number of cases and controls were more in the middle age group (30-60 years) as our study concentrates on middle-aged men, which was 63.3% (38) each respectively. The participants in cases and controls belonged to different types of occupations.

The duration of hair loss was more between 1-10 years (53.33%), followed by 11-20 years (26.67%), followed by 21-30 years (13.33%), followed by <1 year (5%) and lastly 31-40 years (1.67%) in our study. The mean duration of baldness was 11.43±8.655 years. Family history of AGA was more among the cases (75%) compared to controls (21.67%). AGA and family history of AGA were significantly related to each other denoting the genetic association (p- <0.00001*). Among the participants with positive family history, MS (p-0.0168*) and IR (p-0.01492*) were higher in cases compared to controls.

Among 60 cases, home remedies were used by 58.33% (35) of people. Proper treatment from the dermatologist was taken by only 26.67% (16) of the cases. Alcohol consumption was more in cases (56.67%) compared to controls (30%) showing significance (p- 0.0032*). In patients with H/O alcohol consumption, MS and IR were more among cases (21 and 15 respectively) than controls (3 and 6 respectively). History of smoking was more among the cases (46.67%) than controls (26.67%). 56.67% of cases had reduced socialization among the 60 participants.

According to the Norwood-Hamilton grading, 33.33% of cases belonged to grade IV, followed by 25% of cases in grade V, 16.67% in grade III vertex, 11.67% of cases each in grade III and VI, and 1.67% of cases in grade VII respectively. The mean fasting insulin levels were 9.01±6.67 in cases and 8.10±4.27 in controls. Among 120 people, 53.33%of cases and 13.33% of controls had metabolic syndrome. And 40% of cases and 18.33% of controls had insulin resistance.

Metabolic syndrome in patients with AGA had significantly higher occurrence (p- 0.0001*). In cases, 53.3% of participants had MS, while in controls only 13.3% had MS. This shows the strong association of Metabolic syndrome with AGA. In our study, 40% of participants had IR compared to controls, who were 18.3%. This shows the strong associationbetween IR and participants with AGA(p-0.009*). [TABLE 1]

Table 1: Association between metabolic syndrome, insulinresistance and androgenic alopecia.

		Androgenic alopecia		P value
		Absent	Present	
Metabolic Syndrome	Absent	52 86.7%	28 46.6%	0.0001*
	Present	8 13.3%	32 53.3%	
Total		60 100.0%	60 100.0%	
		Androgenic Alopecia		P value
		Absent	Present	
Insulin resistance	Absent	49 (81.7%)	36(60%)	0.009*
	Present	11 (18.3%)	24(40%)	
Total		60 100.0%	60 100.0%	

*- denotes statistical significance

Among AGA patients with MS, an increase in waist circumference was the most common feature (51.67%), followed by an increase in FBS (46.67%), hypertriglyceridemia (45%), increase in systolic BP (41.67%), increase in diastolic BP (40%) and reduced HDL (25%). There was a statistically significantassociation between the presence of MS and all theindividual components of MS. [TABLE 2]

Table 2: Parameters of Metabolic syndrome.

CASES	MS			
	PRESENT	ABSENT	TOTAL	P-VALUE
WAIST CIRCUMFERENCE >94cms	32	9	41	0.006*
SYSTOLIC BP >130mm Hg	25	5	30	0.008*
DIASTOLIC BP >85mm Hg	24	10	34	0.006*
FBS >100mg/dl	28	9	37	<0.00001*
TGL >150mg/dl	27	9	36	0.002*
HDL <40mg/dl	15	4	19	0.0014*

***-** denotes statistical significance

DISCUSSION

Of the 120 participants studied, 60 were cases, and 60 were controls. The majority of the cases andcontrols belonged to the age group between 30-60 years (63.3%), and 18.3% belonged to the age group <30 years and >60 years, each respectively. The mean age of the cases and controls were 46.03±15.29 years and 45.98±15.31 years, respectively.

Naglaa et al. observed a mean age of 44.16±8.48 years in cases and 44.08±8.54 years in controls, which was similar to our findings.[11] Arias Santiago et al. observed similar mean age in his study where the mean age of cases was 49.2±9.4 years and controls were 47.1±6.3 years, respectively.[12] In a study by Ola Ahmed et al. the mean age of the cases was 40.09±10.57, and that of controls were 37.85±9.48 years.[13] Sadighha et al. observed mean age of 40.6±9.5 years and 39.5±8.7 years in cases and controls, respectively.[14] The last twostudies had age findings more or less similar to our study.

The following studies had less mean age compared to our study because the participants included in these studies had early-onset AGA. Lata Sharma et al. observed mean age of 28.61±3.031 years in cases and 28.45±3.109 years in controls.[15] Rita V Vora et al. observeda mean age of 27.08 years in participants with AGA.[5] Dharam Kumar et al. study had a meanage of 33.56±8.533 years in cases

and 29.75±7.73 years in controls.[16] Mukunda Ranga Swaroop et al. observed mean age of 25.12±2.344 years in cases and 24.18±2.663 years in controls.[5] A study by Acibucu et al. showed a mean age of 36.28±7.74 years in cases and 35.14±6.54 years in controls, respectively.[7]

In a study by Ola Ahmed et al. MS peaked in the age group between 46-55 years, and IR peaked in the age group >55 years.[13] Similarly in our study MS (65.6%) and IR (70.3%) were more among the age group between 30-60 years. The mean duration of hair loss was 11.43±8.655 years in our study. On comparing the mean duration of baldness with the other studies, similar findings were found in the following studies - a study by Hima Gopinath et al. showed 14.8 years of mean duration,[17] a study by S. Arias Santiago et al. observed 17.05 years of mean duration,[12] and a study by Salvador Arias et al. had a mean duration of 18.45 years.[18]

The participants in cases and controls belonged to different types of occupations.

Among the cases, the majority of the participants were businessmen (18.33%). AGA and occupation were not related to each other in our study. Similarly, Lata Sharma et al. found that differences in occupation were not associated with AGA and were insignificant.[15]

Our study showed a positive family history of baldness in 75% of cases and 13% of controls. Among the participants with a family history of baldness, 28 had MS, and 22 had IR, which were statistically significant. (p-0.0168 and p- 0.0149, respectively) Similarly in a study by Salvador Arias et al. had 83.11% of cases and 19.45% of controls with family history of baldness.[18] Jose´ Gerardo et al. showed statistical significance in the family history ($p < 0.001$*), 63.75% of cases had positive family history of baldness.[19] Lata Sharma et al. showed family his of AGA was found in 64% cases, 41% controls, which was significantly high in the cases ($P < 0.002$*).[15]

Family history of AGA was found significantly higher in 26 (52%) cases as compared to 15 (30%) controls (P=0.025*) in a study by Rita V Vora et al.[5] Hima Gopinath et al. observed that family history of androgenic alopecia was significantly higher in 46 (54.1%) cases compared to 25 (29.4%) controls, ($P = 0.002$*).[17] Mukunda Ranga Swaroop et al. showed that 31% among the cases and 14% of the controls had family history of baldness (P=0.001*), which was statistically significant. A study by Naglaa et al. showed no significance, where cases had 68% and controls had 66% of family history of AGA which is contrast to our study findings.[11]

In our study alcohol consumption were more in cases (56.67%) compared to controls (30%). And the p-value was 0.0032*, which was statistically significant that showed that alcohol consumption was more in cases with AGA. Similarly, G. Severi et al, observed that consumption of alcohol was associated with a significant increase in risk of both frontal and vertex AGA but not of full AGA.[20]

But, studies by Salvador Arias et al, and Arias Santiago et al, observed no difference in cases and controls with history of alcohol consumption.[12,18] MS and IR were more among cases (21 and 15 respectively) than controls (3 and 6 respectively) with history of alcohol consumption. There was a statistical significance (0.0019*) found between alcohol consumption and MS.

In our study history of smoking was more among the cases (46.67%) than controls (26.67%), which was statistically significant that proves that in people with smoking there is more prevalence of AGA. MS AND IR were more among cases (17 and 14 respectively) compared to controls (2 and 5 respectively). And there was a statistical significance (p-value – 0.0018) of metabolic syndrome found in participants with AGA. Studies by G. Severi et al, and Arias Santiago et al, showed no association between current smoking status or duration of smoking and AGA.[12,20]

In our study, 56.67% of cases kept themselves away from socialization. This shows that people with AGA have reduced socialization and reduced self-esteem compared to normal people without any hair loss.

In our study, according to the Norwood-Hamilton grading, 33.33% of cases belonged to grade IV, followed by 25% of cases in grade V, 16.67% in grade III vertex, 11.67% of cases each in grade III and VI, and 1.67% of cases in grade VII respectively. Similar findings with majority of participants in Grade IV were found in two studies, Acibucu et al. classified AGA according to the Hamilton -Norwood scale, in which 24 (30%) patients were classified as stage III, 28 (35%) as stage IV, 11 (13.8%) as stage V and 17 (21.3%) as stage VI ; and in another study by Salvador Arias et al. majority of patients belonged to grade IV (47.5%), followed by grade III (27.5%) and then grade V (25%) according to Ebling scale.[18]

But in a study by Naglaa et al. 40% were classified as having mild severity AGA (grade I, II, III), 28% had moderate severity AGA (IV, V), and 32% had severe AGA (IV, VII) according to Norwood- Hamilton grading.[11] Likewise in a study by Lata Sharma et al. Norwood-Hamilton scale of II or III grade was 65% and IV or V was 31%.[15] Rita V Vora et al. observed that Grade III AGA was found to be most common and was seen in 19 (38%) patients followed by Grade IV in 16 (32%), Grade V in 13 (26%), and Grade VI in 2 (4%).[5] Mukunda Ranga Swaroop et al. had 23 (46%) patients under Stage III, 12 (24%) under Stage IV, 10 (20%) under Stage V, and 5 (10%) under Stage VI based on Hamilton–Norwood scale of hair loss.[5]

Waist circumference of >94cms was more 68.33% among cases compared to the controls 31.67%. The p value was 0.006*, that was statistically significant. And the mean waist circumference was 97.41±7.23 in cases and 90.46±4.98 in controls. Our study had similar results when compared to the following studies. Ola Ahmed Bakry et al. observed mean waist circumference(cm) of 98.74±10.02 in cases and 93.19±8.25 in controls (p<0.001) which was statistically significant.[13] In a study by Rita V Vora et al, patients had increased waist circumference of 60% in cases and 38% in controls (p-0.028*) that was statistically significant.[5] Study by Jose Gerard et al. showed significant tendencies in waist to hip ratio.[19]

Dharam Kumar et al. observed mean waist circumference of 95.88±10.355 in cases and 91.86±9.144 in controls with p value of 0.022* in male patients (statistically significant).[16] Hima Gopinath et al. in his study found increased mean waist circumference in cases when compared to controls that was statistically significant(p-0.004*).[17] Mukunda Ranga Swaroop et al. observed significant mean waist circumference if 86.86±9.282 in cases compared to 80.93±5.552 in controls (p<0.0001*)[5] Acibucu et al. observed higher waist circumference in cases compared to controls. (p-0.032*)

In our study most of the participants were overweight and obese compared to the controls. Cases had mean BMI of 26.15±3.43kg/m2 and controls had 24.43±3.65kg/m2. Similar findings were found in the following studies.

Jose Gerardo et al. found that BMI was statistically significant in patients with AGA when compared to controls (p<0.001).(19) Ola Ahmed Bakry et al. observed significant findings of BMI being 28.86±4.67 in cases and 25.51±3.36 among controls (p<0.001).[13] Mukunda Ranga Swaroop et al. observed a significant mean BMI of 25.65±2.752 in cases compared to 24.51±1.756 in controls (p-0.016*).[5] Study by Lata Sharma et al. cases had mean BMI of 23.108±1.589 and controls had 22.597±1.599, Study by Arias Santiago et al. showed BMI of 26.09 and 24.4 kg m^2 in cases and controls ; and Sadighha et al. in his study had cases and controls with following BMI 24.3 ± 2.62 kg/m2 and 24.2 ± 2.3 kg/m2 respectively and all these studies did not show any association of AGA with BMI.[12,14,15]

Comparing both cases and controls in our study, cases had a greater number of participants with systolic blood pressure >130 (p-0.0001*) and diastolic blood pressure >85 (p- 0.005*) (which were statistically significant). Similar findings were observed by Jose Gerardo et al. who found significant increase in both systolic and diastolic BP in cases compared to controls (p<0.001*) and nonobese cases had a higher mean diastolic blood pressure and a more frequent family history of AGA than nonobese controls.[19] Ola Ahmed Bakry et al. in his study showed significant increase in both systolic and diastolic BP (p<0.001*) like our study.[13] Sonali Pechlivanis et al. observed increase in both systolic and diastolic BP in men with any baldness compared to men with no baldness.[21]

Rita V Vora et al. observed significant increase in hypertension in AGA compared to controls (p-0.016*).[5] Arias Santiago et al. in his study found that the mean systolic and diastolic BP were higher in cases (p<0.0001*).[12] The systolic BP was statistically significant in cases (p- 0.003*) in a study by Dharam Kumar et al.[16] Prevalence of hypertension was higher in cases compared to controls in a study by Hima Gopinath et al. but it was insignificant.[16] But contradictory to our study, study by Mukunda Ranga Swaroop et al. observed no significance of systolic (p-0.148) and diastolic blood pressure (p-0.181).[5] Dharam Kumar et al. also found no significance of diastolic BP in cases when compared to controls (p-0.073).[16]

In our study, cases had significantly higher fasting blood sugar levels compared to controls (p<0.00001*). Mean FBS were 120.06±42.96 in cases and 109.1±33.21 in controls. Similar results were observed by the following studies. Ola Ahmed Bakry et al observed an increased mean FBS of 112.03±28.29 in cases compared to 92.58±12.31 in controls (p<0.001*)[13] Rita V Vora et al, observed increased FBS in 29 (58%) of cases and5 (10%) of controls (p-0.001%).[5] Veikko Matilainen et al, also observed significant increase in fasting blood glucose[22] Hima Gopinath et al, found elevated plasma glucose was significantly associated with increased duration of alopecia[17] and Mukunda Ranga Swaroop et al, in his study had mean FBS of 90.18±13.428 in controls and 97.28±20.427 in cases (p- 0.043*). But no significant association was found between AGA and FBS in a study by Lata Sharma et al.[15]

In our study, 60% of the cases has TGL of >150mg/dl that was very high compared to controls (28.33%). This shows the significant association of increase in TGL (p-0.002*) in patients with AGA. Similar findings were observed by Ola Ahmed Bakry et al, where a mean TGL of 160.91±34.0 in cases and 135.62±21.16 in controls was found(p<0.001*).[13] Sadighha et al, also found significant increase in TGL levels in cases than controls (P < 0.01*).(14) In a study by Mukunda Ranga Swaroop et al, there was a mean TGL of 135.06±25.278 in cases and 125.64±19.537 in controls (0.040*).[5] And Acibucu et al, in his study found significant increase in triglyceride level (p-0.048*).[7]

In our study cases had 31.67% of participants with reduced HDL levels compared to controls 26.67%. On comparing, cases had a greater number of participants affected than controls which was statistically significant. (p-0.0014*) Studies by L.H Su et al. (p-0.001*), Ola Ahmed Bakry et al. (p<0.01*), Sonali et al., Lata Sharma et al (p-0.002*), Rita V Vora et al. (p-0.009*), Sadighha

et al. (p-0.09*), Dharam Kumar et al. (p<0.001*), Hima Gopinath et al. (p-0.005*), and Mukunda Ranga Swaroop et al. (p-0.008*), showed statistically significant association of reduced HDL and AGA that were similar to our study.(5,13–17,20)

The mean fasting insulin levels were 9.01±6.67 in cases and 8.10±4.27 in controls. There was a slight increase in mean fasting insulin levels in cases when compared to controls in our study. Similarly in a study by Mukunda Ranga Swaroop et al. the mean fasting insulin levels was increased among cases 4.21±2.285 compared to 3.32±1.341 in controls (p- 0.020*).[5] Acibucu et al. also observed similar findings of mean fasting insulin levels. (10.19±8.92 in cases and 8.13±4.85 in controls) There was no statistical significance but the mean insulin levels were more in cases compared to controls.[7]

There was a significant increase of metabolic syndrome among our cases (53.33%) compared to controls (13.33%). And even individual components of metabolic syndrome were significantly higher in AGA patients. Among the components of MS, increase in waist circumference was the most common feature of MS (51.67%), followed by increase in FBS (46.67%), hypertriglyceridemia (45%), increase in systolic BP (41.67%), increase in diastolic BP (40%) and reduced HDL (25%).

Salvador Arias Santiago et al, observed that Metabolic syndrome was diagnosed in 60% of male patients with AGA.[23] L.H.Su et al. observed that statistically significant association was found between AGA and the presence of metabolic syndrome.(20) Ola Ahmed Bakry et al. found a statistically significant association was found between AGA and MS (P = 0.002).[7] Naglaa et al. found metabolic syndrome was shown to be significantly associated with AGA and its components.[11] Rita V Vora et al. found that metabolic syndrome was significant in patients with AGA.[5] Veikko Matilainen et al. found a strong association in men with early-onset androgenetic alopecia and metabolic syndromes.[22]

Dharam Kumar et al. observed a higher prevalence of MS in androgenic alopecia patients.[16] Mukunda Ranga Swaroop et al. found that MS was associated with patients with early-onset AGA[5] Acibucu et al. observed that the occurrence of MS was significantly higher in the AGA group than in the control group.[7] Study by Hima Gopinath et al. had an association between metabolic syndrome and early-onset androgenic alopecia.[17]

In our study 40% of participants had IR (according to HOMA-IR criteria) compared to controls who were 18.3%. The p-value was 0.009* which was statistically significant. Salvador Arias Santiago et al. observed Aldosterone and insulin levels were significantly higher in the male and female patients with AGA versus their respective control subjects.[12] Jose Gerardo et al. found that the HOMA-IR index was significantly higher in cases than controls.[19] A borderline difference in the HOMA-IR index was found in obese AGA cases vs. obese controls. Ola Ahmed Bakry et al. found a statistically significant association between AGA and IR (P < 0.001).[13] Veikko Matilainen et al. observed that the risk for hyperinsulinaemia was two-fold in men with alopecia.[22] Mukunda Ranga Swaroop et al. in his study observed that male patients with early-onset AGA were not associated with IR and the stage of alopecia was also not associated with IR. Acibucu et al. observed that the prevalence of IR increased in earlyAGA patients.[7]

Samuel M. Lesko et al. found that risk of MI (myocardial infarction) increased, as the degree of vertex baldness increased (P<0.01). Lata Sharma et al. found that patients with AGA appear to be at an increased risk of developing CAD. Rota V Vora et al. concluded that a higher prevalence of cardiovascular risk factors was seen in men with early-onset androgenic alopecia.[5] Sadighha et al. found that the total cholesterol/HDL-cholesterol ratio was higher in men with AGA (P < 0.01), suggesting a greater susceptibility to CHD in these patients. patient with vertex-type AGA showed lower HDL cholesterol level (P < 0.01) and higher triglyceride level (P < 0.01) than the control group, further supporting evidence suggesting a greater susceptibility to CHD in these patients.[14] Study by Hima Gopinath et al. found that MS contribute to the predisposition of patients with androgenic alopecia to develop cardiovascular disease.[17] Similarly in our study, in cases the triglyceride levels (p-0.002*) increased and the HDL levels (p-0.0014*) decreased that correlates with the above studies.

CONCLUSION

In conclusion, the results obtained in our study indicates the association of androgenic alopecia with metabolic syndrome and insulin resistance in middle-aged men. Increased prevalence of MS among the middle-aged men, shows that MS is not only more prevalent in early-onset AGA but all AGA's have high risk of metabolic syndrome. And increasedprevalence of IR, proves that IR is present in elderly, as well as middle-age group.

Patients with AGA and patients with family history of AGA should be closely monitored lifelong, as they are at risk for coronary artery disease and myocardial infarction in middle- aged men. Our study results help to increase the awareness in susceptible individuals with MSand IR to prevent future complications by lifestyle modifications (diet with a low glycemic index, weight control, exercise) and proper follow-ups.

LIMITATIONS

Our study has a sample size of 120. More prospective studies with large number of sample size will give better outcomes. Multicentric studies can help to find out the association of AGA with other disorders in different geographical areas, as this is done in onecentre. As our study is a cross-sectional study, follow-ups should be carried out to check whether the cases develop any future

complications.

Financial support and sponsorship - Nil.
Conflicts of interest - There are no conflicts of interest.

REFERENCES

1. Messenger A. Male androgenetic alopecia. Hair, Hair Growth Hair Disord, 2008; 159–70.
2. Sehgal VN, Kak R, Aggarwal A, Srivastava G, Rajput P. Male pattern androgenetic alopecia in an Indian context: A perspective study. J Eur Acad Dermatology Venereol, 2007; 21(4): 473–9.
3. Lolli F, Pallotti F, Rossi A, Fortuna MC, Caro G, Lenzi A, et al. Androgenetic alopecia: a review. Endocrine [Internet], 2017; 57(1): 9–17. Available from: http://dx.doi.org/10.1007/s12020-017-1280-y
4. Ellis JA, Sinclair R, Harrap SB. Androgenetic alopecia: pathogenesis and potential for therapy. Expert Rev Mol Med, 2002; 2002(November): 1–11.
5. Manchanda Y, Das S, Sarda A, Biswas P. Controversies in the Management of Cutaneous Adverse Drug Reactions Systemic Corticosteroids in the Management ofSJS / TEN : Is it Still. Indian J Dermatol [Internet], 2018; 63(2): 125–30.
6. Vora, Kota RKSK, Singhal RR, Anjaneyan G. Clinical profile of androgenic alopecia and its association with cardiovascular risk factors. Indian J Dermatol [Internet], 2019Jan 1 [cited 2021 Oct 12]; 64(1): 19. Available from: https://www.e-ijd.org/article.asp?issn=0019-154;year=2019;volume=64;issue=1;spage=19;epage=22;aulast=Vora
7. Acibucu F, Kayatas M, Candan F. The association of insulin resistance and metabolic syndrome in early androgenetic alopecia. Singapore Med J., 2010; 51(12): 931–6.
8. Nuttall FQ. Body mass index: Obesity, BMI, and health: A critical review. Nutr Today, 2015; 50(3): 117–28.
9. Ford ES. Prevalence of the Metabolic Syndrome Defined by the InternationalDiabetes. Diabetes Care [Internet], 2005; 28(11): 2745–9. Available from: http://care.diabetesjournals.org/cgi/content/abstract/28/11/2745
10. Gayoso-Diz P, Otero-González A, Rodriguez-Alvarez MX, Gude F, García F, De Francisco A, et al. Insulin resistance (HOMA-IR) cut-off values and the metabolic syndrome in a general adult population: Effect of gender and age: EPIRCE cross- sectional study. BMC Endocr Disord, 2013; 13(Cvd).
11. Agamia NF, Abou Youssif T, El-Hadidy A, El-Abd A. Benign prostatic hyperplasia,metabolic syndrome and androgenic alopecia: Is there a possible relationship? Arab J Urol [Internet], 2016; 14(2): 157–62.
12. Arias-Santiago S, Gutiérrez-Salmerón MT, Buendía-Eisman A, Girón-Prieto MS, Naranjo-Sintes R. Hypertension and aldosterone levels in women with early-onset androgenetic alopecia. Br J Dermatol, 2010; 162(4): 786–9.
13. Bakry O, Shoeib MA, El Shafiee M, Hassan A. Androgenetic alopecia, metabolic syndrome, and insulin resistance: Is there any association? A case-control study. Indian Dermatol Online J., 2014; 5(3): 276.
14. Demitsu T, Kakurai M, Yoneda K, Iida E, Takada M, Hiratsuka Y, et al. Localized pemphigoid (Brunsting-Perry type) with IgG antibody to BP180 NC16a domain resembling lupus erytematosus successfully treated with topical tacrolimus therapy. JEur Acad Dermatology Venereol, 2009; 23(1): 79–80.
15. Sharma L, Agrawal A, Dubey A, Gupta P. Androgenetic alopecia and risk of coronary artery disease. Indian Dermatol Online J., 2013; 4(4): 283.
16. Kumar KCD, Kumar YHK, Neladimmanahally V. Association of androgenetic alopecia with metabolic syndrome: A case-control study on 100 patients in a tertiary care hospital in South India. Indian J Endocrinol Metab, 2018; 22(2): 196–9.
17. Gopinath H, Upadya GM. Metabolic syndrome in androgenic alopecia. Indian J Dermatol Venereol Leprol, 2016; 82(4): 404–8.
18. Arias-Santiago S, Gutiérrez-Salmerón MT, Castellote-Caballero L, Buendía-Eisman A, Naranjo-Sintes R. Androgenetic alopecia and cardiovascular risk factors in men and women: A comparative study. J Am Acad Dermatol, 2010; 63(3): 420–9.
19. González-González JG, Mancillas-Adame LG, Fernández-Reyes M, Gómez-Flores M, Lavalle-González FJ, Ocampo-Candiani J, et al. Androgenetic alopecia and insulin resistance in young men. Clin Endocrinol (Oxf), 2009; 71(4): 494–9.
20. Severi G, Sinclair R, Hopper JL, English DR, Mccredie MRE. Epidemiology and Health Services Research Androgenetic alopecia in men aged 40 – 69 years : prevalence and risk factors. Br J Dermatol, 2003; 149(6): 1207–13.
21. Pechlivanis S, Heilmann-Heimbach S, Erbel R, Mahabadi AA, Hochfeld LM, Jöckel KH, et al. Male-pattern baldness and incident coronary heart disease and risk factors in the Heinz Nixdorf Recall Study. PLoS One., 2019; 14(11): 1–14.
22. Matilainen V, Koskela P, Keinänen-Kiukaanniemi S. Early androgenetic alopecia as a marker of insulin resistance. Lancet, 2000; 356(9236): 1165–6.
23. Arias-Santiago S, Gutiérrez-Salmerón MT, Buendía-Eisman A, Girón-Prieto MS, Naranjo-Sintes R, Mubki T, et al. Association of androgenetic alopecia with metabolic syndrome in men: A community-based survey. J Am Acad Dermatol [Internet], 2010; 14(4): 424–32. Available from: http://dx.doi.org/10.1016/j.aju.2016.01.003.