INTRODUCTION

Androgenetic alopecia (AGA) is a common condition characterized by reduced density of scalp hair with a receding hairline in males occurring due to androgen-mediated conversion of susceptible terminal hair into vellus hair and is largely determined by genetic factors and the peripheral action of androgens. The enzyme 5-alpha reductase converts testosterone to its active form dihydrotestosterone (DHT) and inherited sensitivity of the hair follicles to DHT is one of the etiological factors in AGA. Two types of 5-alpha reductase are seen in humans: Type I and type II. In the scalp, DHT responsible for follicular miniaturization is largely produced by the action of 5-alpha reductase type II on testosterone. In the prostate, DHT derived from testosterone is implicated in the development of benign prostatic hyperplasia (BPH). Inherited deficiency of 5-alpha reductase type II leads to absence of AGA and a small prostate. AGA and BPH are highly prevalent among elderly men but infrequent in those younger than 40 years. Because both entities share a common pathogenesis and AGA manifests before the onset of BPH, there could be an association between AGA and BPH.

AIM

To study the possible association between AGA and the size of prostate.

MATERIALS AND METHODS

Sixty-five consecutive male patients, 35–65 years of age with AGA of Hamilton–Norwood classification Grades 3–7, were included in the study. AGA of Grades 1 and 2 patients on treatment with minoxidil, finasteride, or other treatments for AGA with history of prostate cancer or prostate disease were excluded from the study. Prostate size was measured through transabdominal ultrasonography. Statistical analysis was done with SPSS software.

RESULTS

Of the 65 AGA patients, the mean age was 47.18 years. Grade 4 AGA was the most common grade seen in 19 patients (29.2%), out of which, most (47.4%) were in the 56–65 years age group. 52.3% patients had normal prostate volume, and 47.7% had an enlarged prostate. The percentage of patients with the normal and enlarged prostate in moderate Grade 3 AGA was 68.8% and 31.2%, and in severe Grade 6 AGA, it was 33.3% and 66.7%, respectively. Prostate enlargement was more likely to occur in severe AGA than in moderate AGA (odds ratio 3.311; \( P = 0.025 \), which is significant).

CONCLUSION

This study revealed an increase in prostate size with increasing age, with higher prevalence of Grade 1 prostate enlargement in younger individuals, and with higher prevalence of Grade 3 prostate enlargement in elderly men. The study also found a positive correlation between AGA and prostate size, with higher grades of AGA having higher prostate volume.
are thus both androgen-dependent diseases, in which testosterone and DHT are implicated. Clinically, prostatic development in embryonic life and at puberty is stimulated by androgens, while in eunuchs, the prostate remains underdeveloped. Scalp hair is not androgen-dependent for its development; however, after puberty, its cycle of regeneration is influenced by androgens. Therapy in AGA, benign prostate hyperplasia, and prostate cancer has a common target, minimization of the androgenic effect, and it was carried out via the same pharmaceutical agent, finasteride. BPH occurs in men over 50 years of age and by 60 years, 50% of men have histological evidence of BPH. Because both AGA and BPH share a common pathogenesis and AGA manifests some decades before the onset of BPH, AGA may serve as an early marker of BPH. Hence, this study was conducted to find out the association between AGA and size of the prostate.

The normal volume of the prostate gland in an adult is approximately 20 ml. Prostates having volume more than 40 ml are generally considered enlarged in older men. Previous studies of the relationship between AGA and BPH were all in elderly patients and analyzed the prevalence of alopecia in comparison with a control group; however, many of them did not use ultrasound to reliably rule out the presence of BPH. Although transrectal ultrasound is presently considered a better method of assessing prostatic size, transabdominal ultrasound is also an accepted method and has the added advantage of being easy, noninvasive, and readily acceptable to patients.

**MATERIALS AND METHODS**

This was an observational, single-center, cross-sectional study to establish the relationship between male AGA and prostate size. The study was conducted from October 2012 to March 2014 at the department of dermatology in a tertiary care hospital. Sixty-five consecutive male patients of AGA attending the outpatient clinic of dermatology constituted the study group. Study inclusion criteria were males 35–65 years of age with AGA of Grade 3 and above as per Hamilton–Norwood classification and written informed consent for the study. Exclusion criteria were AGA of Grades 1 and 2, patients who were on treatment with minoxidil or any medication which had an effect on size of prostate or hair growth such as finasteride, patients who had history of hair transplantation, and who were on androgenic supplements, history of prostatic disease, or prostate cancer. The study was approved by the ethics committee of the hospital.

**Clinical assessment**

All patients in the study underwent a detailed history taking, general physical, systemic and dermatologic examination by a single examiner. The grade of AGA was clinically determined using the Hamilton–Norwood classification. To demarcate grades of AGA, Grades 3, 4, and 5 were considered to be moderate AGA, and Grades 6 and 7 considered to be severe AGA. All participants underwent transabdominal ultrasound examination at the radiology department by the same ultrasonologist (who did not know the purpose of the study) to determine the prostate volume. Normal size of the prostate was taken as prostate volume of 20 ml by transabdominal ultrasound, and prostate size was graded as follows: Grade 1 enlargement: 20–40 ml in size; Grade 2 enlargement: 40–60 ml in size; Grade 3 enlargement: 60–80 ml in size; Grade 4 enlargement: More than 80 ml in size.

**Statistical analysis**

Software (SPSS, Version 16.0 for Windows, SPSS Inc., Chicago, IL, USA) was used for stratified analyses of the data. Qualitative variables were analyzed by constructing contingency tables with Pearson Chi-square test. Analysis of variance was used for multiple comparisons of quantitative variables. Correlations among variables were studied using the Pearson coefficient and binary logistic regression models, obtaining adjusted odds ratios with 95% confidence intervals for the association between prostate volume >20 mL and AGA. Differences were considered significant at $P < 0.05$ and marginally significant at $P$ value of 0.05 to 0.1.

**RESULTS**

All 65 patients completed the study. The mean age of the study population was 47.18 years. Most of the study population (40%) belonged to the age group 56–65 years followed by the age group 46–55 years (35.4%) and 36–45 years (24.6%), respectively. Majority were having Grade 4 AGA (29.2%) followed by Grade 3 AGA (24.6%), Grade 5 AGA (20%), Grade 7 AGA (16.9%), and Grade 6 AGA (9.2%). In our study, Grade 3 AGA was seen in 16 patients, more commonly in a younger age group of 36–45 years with a frequency of 43.8% (7/16). Grade 4 AGA was the most common grade in our study seen in 19 patients and was highest in the age group 56–65 years with a frequency of 47.4% (9/19). Grade 5 AGA was seen in 13 patients and it is more common in the 46–55 years’ age group with a frequency of 69.2% (9/13). Grade 6 AGA was the least common in our study seen in six patients.
and found common in both 36–45 and 56–65 years age group in equal distribution 50% (3/6). Grade 7 AGA was seen in 11 patients and it was more common in the most elderly group of 56–65 years with a frequency of 81.8% (9/11) [Table 1].

On further applying Pearson Chi-square test, Pearson Chi-square value was found to be 23.58 with \( P < 0.05 \). Hence, the finding of occurrence of higher percentage of AGA in older age groups is significant.

**Correlation of the prostate size with androgenetic alopecia**

In Grade 3 AGA, 68.8% (11/16) presented with normal prostate volume followed by 31.2% (5/16) with Grade 1 prostate enlargement. There was no Grades 2 or 3 prostate enlargement in Grade 3 AGA patients. In Grade 4 AGA, 63.2% (12/19) had normal prostatic volume followed by 26.3% (5/19) with Grade 1 enlargement and 10.5% (2/19) with Grade 2 enlargement. There was no Grade 3 prostate enlargement in Grade 4 AGA. In Grade 5 AGA, 46.2% (6/13) presented with Grade 1 prostate enlargement followed by normal prostate volume and 7.7% (1/13) each with Grades 2 and 3 prostate enlargement. In Grade 6 AGA, 50% (3/6) had Grade 1 prostate enlargement followed by normal prostate volume in 33.3% (2/6) and 16.7% (1/6) with Grade 3 prostate enlargement. In Grade 7 AGA, which was found to be more common in the elderly age group (56 to 65 years), 45.4% (5/11) presented with Grade 1 prostate enlargement, 36.4% (4/11) with normal prostate size and 18.2% (2/11) with Grade 2 prostate enlargement [Table 2]. Pearson Chi-square test established positive statistical significance between AGA and prostate volume. For the sake of convenience and to demarcate moderate and severe AGA, we considered Grades 3, 4, and 5 AGA as moderate and Grades 6 and 7 AGA as severe. We found that prostate enlargement was 3.311 times more likely to occur in severe AGA than in moderate AGA [Table 3]. This positive association between prostate enlargement and severe AGA was found to be statistically significant.

**DISCUSSION**

AGA is caused by interactions between androgens and hair follicles in genetically predisposed individuals. BPH is common in elderly men, and its prevalence progressively increases above the age of 60 years. The two most important factors implicated in BPH have been patient age and androgenic function. Because both entities share a common pathogenesis and AGA manifests some decades before BPH onset this study attempted to find out the association between AGA and BPH.

In this study, it was found that the prevalence of AGA increases with advancing age which is in accordance with the study done on Korean population.

The most common grade of AGA was Grade 4 (29.2%), and the second most common was Grade 3 AGA (24.6%). The least common was Grade 6 which constituted 9.2% of the study group. This can be explained by the fact that most of our patients were in the younger age group compared to the study on Korean population which predominantly had men in older age group, in which Grade 6 AGA was more prevalent.

| Age group | Androgenetic alopecia grade | Total |
|----------|-----------------------------|-------|
| 36-45 years | Number of patients | 16 (24.6) |
| 46-55 years | Number of patients | 23 (35.4) |
| 56-65 years | Number of patients | 26 (40.0) |

**Table 1: Distribution of grades of androgenetic alopecia with age**

| Grade of prostate enlargement | Androgenetic alopecia grade | Total |
|-------------------------------|-----------------------------|-------|
| Normal prostate size (%) | 16 (24.6) |
| Grade 1 (%) | 19 (29.2) |
| Grade 2 (%) | 23 (35.4) |
| Grade 3 (%) | 65 (100.0) |

**Table 2: Correlation of grades of androgenetic alopecia with grades of prostate enlargement**

| Prostate enlargement | Androgenetic alopecia | OR 95% CI | P |
|----------------------|-----------------------|-----------|---|
| Severe | Moderate | Yes | No | 3.311 | 0.025 |

**Table 3: Odds ratio of prostate enlargement in relation to severity of androgenetic alopecia**

| Prostate enlargement | Androgenetic alopecia | OR 95% CI | P |
|----------------------|-----------------------|-----------|---|
| Severe | Moderate | Yes | No | 3.311 | 0.025 |

OR – Odds ratio; CI – Confidence interval
Prostate enlargement

52.3% of our study group had a normal prostate size. However, the remaining 47.7% showed enlarged prostate, of which, 36.9% had Grade 1 enlargement, 7.7% had Grade 2, and 3.1% had Grade 3 prostate enlargement, respectively. Various other studies have shown prostate enlargement in patients with AGA. The lower prevalence of prostate enlargement may be attributed to the fact that most of the patients in our study belonged to younger age groups with median age of 47.18 years, compared to various other studies.

Correlation of prostate size with androgenetic alopecia

In Grade 3 AGA, 68.8% had normal prostate size and 31.2% had prostate enlargement. In Grade 4 AGA, 63.2% had normal prostate size and 36.8% an enlarged prostate. In Grade 5 AGA, 38.4% had a normal prostate and 61.6% had an enlarged prostate. In Grade 6 AGA, 33.3% had normal prostate and 66.7% had prostate enlargement. In Grade 7 AGA, which was found to be more common in the elderly age group (56 to 65 years), 36.4% had normal prostate size and 63.6% had prostate enlargement. Hence, according to this study, with increase in AGA grade, there is an increase in the size of the prostate. However, a study by Chen et al. elucidated that prostate size did not correlate with AGA severity.

AGA appears to be an independent risk factor for prostate volume >20 mL. These findings in AGA patients suggest the importance of obtaining a good reliable medical history and thorough systemic examination not only in older men but also in younger individuals to pick up early signs of prostate enlargement and its subsequent complications.

The association between baldness and clinical prostate cancer was studied prospectively in a cohort of 4421 United States men 25–75 years old who were followed over 17–21 years. According to this study, the incidence of prostate cancer was greater among men with baldness. A population-based case-control study of 1446 cases of prostate cancer and 1390 controls in Australia showed no association of frontal baldness with prostatic cancer. However, there was a positive association between prostate cancer and vertex baldness. A few other case-control studies did not identify a significant association between AGA and prostate cancer.

On the other hand, in this study, clinical and ultrasound findings did not reveal any signs of prostate malignancy in any of our patients, possibly pointing at the likelihood of more elderly men being more prone to prostate cancers and also the need for a larger sample size to be statistically significant.

The results of this study can be strengthened by case-control studies where age being one of the main confounding factors can be eliminated. Although AGA patients can be screened earlier for BPH, coronary artery disease, and hypertension and despite numerous studies worldwide about AGA, it is still unclear if the early diagnosis and treatment of AGA with 5-alpha reductase inhibitors can reduce the mortality and morbidity of conditions associated with AGA.

Further research in this field is required among various groups of the population across the globe for better understanding of this association and to clarify if treatment of AGA benefits concomitant benign prostatic hypertrophy, presenting early in the course of its natural evolution, all of which may contribute to a better quality of life.

CONCLUSION

In this study, we found an increase in the prevalence of AGA with advancing age.

It was noted that the grade of AGA increased with increase in age, with a higher prevalence of Grades 6 and 7 AGA in older individuals and lower Grades 3 and 4 AGA in younger individuals. This study also revealed an increase in prostate size with increasing age, with higher prevalence of Grade 1 prostate enlargement in younger individuals, and with higher prevalence of Grade 4 prostate enlargement in elderly men.

The study also found a positive correlation between AGA and prostate size, with higher grades of AGA having higher prostate volume, which can be attributed to their common etiopathogenesis: Androgens and the enzyme 5-alpha reductase which is expressed both in the prostate and dermal papillae of scalp hair.

Therefore, finasteride, a 5-alpha reductase type 2 inhibitor used to treat control AGA, may probably be useful in delaying the onset of BPH and its associated symptoms. Further studies are needed to evaluate this hypothesis. In addition, AGA develops much earlier than enlargement of the prostate. Hence, AGA of early onset may be considered as a biomarker for BPH later in life.

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Conflicts of interest

There are no conflicts of interest.
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