INTRODUCTION

Androgenetic alopecia (AGA) is a pattern of hair loss in males and females, characterized by varying degrees of thinning primarily at the frontal area and vertex of the scalp.\(^1\) The Framingham Heart Study revealed an association between the progression of hair loss during adulthood and occurrence of coronary artery disease (CAD) in male individuals, although no direct relationship has been observed with the extent of baldness and CAD.\(^3\) It has been demonstrated that the early onset of AGA in young participants (<30 years) increases the risk of ischemic heart disease (IHD).\(^4\) Premenopausal women are generally protected from the manifestations of IHD because of the protective effects of estrogen; however, the effects get diminished with the development of diabetes mellitus (DM).\(^5\)

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A Study of Correlation of Angiographic Evaluation of Coronary Artery Disease with Androgenetic Alopecia – TricoHeart Study

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ABSTRACT

Background: Research on the association between androgenetic alopecia (AGA) and coronary artery disease (CAD) in women, with a focus on the evaluation of their angiographic association in the form of the severity of disease, has been lacking.

Aim: The study aimed to evaluate the relation between CAD and AGA in women and to study their severity.

Methods: This study, carried out with 438 women within 55 years of age and admitted for coronary angiography, had the case group (participants with CAD; \(n = 219\)) and control group (those without CAD; \(n = 219\)). The clinical and paraclinical data were collected after clinical history, physical examination, and review of the patients’ records (family, past, and personal history of the participants). The coronary risk profiles such as diabetes mellitus, blood pressure, and serum cholesterol level were also noted, and the diagnosis of AGA was performed, and participants were grouped using the Ludwig’s baldness grading system. Statistical analysis was performed by studying association between the variable using the Chi-square test (R\(^{i386.3.5.1}\) software).

Results: In the study group, 74 (33.79%) participants were treadmill test positive, 55 (25.11%) had unstable angina, 40 (18.26%) had ST-segment elevation myocardial infarction (STEMI), and 50 (22.83%) had non-ST-STEMI (NSTEMI). In the case group, Grade II female AGA was evidenced in 38 (43.18%) participants, whereas Grade III was present in 30 (34.09%) participants. Further on, 27 patients with triple vessel disease had Grade III female AGA. Whereas, in the control group, Grade I female AGA was evidenced in 23 (65.71%) participants.

Conclusion: The hypothesis that female pattern baldness is a marker for increased risk of CAD events has been studied and established as part of the present study. Further, extensive studies on the effect of other variables with a larger sample size need to be conducted.

Key words: Alopecia, androgenetic, angiographic, coronary artery disease, myocardial infarction

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Although several studies have reported the association of AGA with CAD, the studies have focused on the male population.[4,5] Reports of their association in women are lacking in the literature; this restricts the development of diagnosis and treatment plans for females. In addition, the limitation of research on detecting the development of the conditions with respect to its severity also affects the timely intervention.[6]

Thus, the present study was conducted to investigate the relationship between AGA and CAD and evaluates the severity of the conditions.

**METHODS**

This cross-sectional study was conducted from January 2016 to July 2019, after receiving the approval from the Institutional Ethics Committee. The study was conducted in the department of cardiology at a tertiary care hospital and research center. A total of 438 women participants were enrolled in the study.

The inclusion criteria included women within <55 years and having documented angiography report. The participants with the presence of chronic telogen effluvium, history of thyroid disorder (hypo/hyper), on chemotherapy drugs, patients with connective tissue disorder, unavailability of first-degree relative, and those who were unwilling to participate were excluded from the study.

The participants were divided into two groups on the basis of their angiography results – case group (participants with CAD; n = 219) and control group (those without CAD; n = 219). The first-degree female relatives (mother, sister, and aunt) of the case participants were assessed for AGA (as AGA has genetic predisposition and has been established to have polygenic mode of inheritance[7]) were categorized in the control group if they did not have demonstrate/report any evidence of CAD (asymptomatic with normal electrocardiogram and echocardiography [ECHO] findings). Coronary angiography data were obtained from the database. Significant lesions were defined as those with ≥70% diameter narrowing of coronary arteries; left main CAD was defined as ≥50% stenosis of the left main coronary artery. Individuals in the control group were evaluated for CAD with electrocardiography and ECHO, and if found symptomatic, then treadmill test (TMT) on an outpatient basis.

The clinical and paraclinical data were collected after clinical history, physical examination, and review of the patients’ records. Family, past, and personal history of the participants, including a family history of CAD, myocardial infarction (MI) and AGA, history of CAD, MI, tobacco chewing, and amenorrhea, were also recorded during the subject’s inclusion in the case group. The coronary risk profiles such as DM, blood pressure, and serum cholesterol level were also noted.

**Diagnosis of androgenetic alopecia**

The dermatologist diagnosed the participants and their relatives for AGA, clinically, and was blinded regarding the categorization of the groups. The participants were blinded to the angiographic results. After the clinical examinations of the participants, they were grouped using the Ludwig’s baldness grading system (Grade I –III) [Figure 1].

**Statistical analysis**

Data analysis was performed using R i386.3.5.1 software. Continuous data were represented in the form of mean ± standard deviation, and the categorical variables were represented by the frequency table. The association between the categorical variable was studied using the Chi-square test.

**RESULTS**

Of the 438 participants, majority of the case group participants were between 41 and 50 years of age, and the control group participants were between 61 and 70 years of age [Table 1].

Upon the diagnosis of the heart condition in the case group, majority of the participants were TMT positive followed by participants with unstable angina [Table 2].

Upon distributing participants based on the detection of AGA, only 40.18% of the case group and 15.98% of the control group were diagnosed with AGA. Majority of case group participants were diagnosed with Grade II AGA, whereas majority of control group participants had Grade I AGA [Table 3].
Patil and Lunge: Relationship of coronary angiography with alopecia

Baseline angiographic characterization of the case group revealed no adverse in-hospital outcome. However, SVD vessels were the most diseased, with the lesion located at LAD, slow/no flow being the most predominant procedure complication, and Type A being the most common lesion [Table 4].

On the other hand, the clinical and laboratory characteristics of the groups indicated age and hypertension as the two predominant factors for CAD [Table 5]. In contrast, no statistical significance was observed in the lipid profiles of the participants in both groups [Table 6]. Interestingly, a statistically significant \( P < 0.0001 \) association was observed between the development of AGA in CAD participants, as represented in Table 7. Furthermore, there was statistical significance found between female AGA and high blood pressure [Table 8].

### DISCUSSION

AGA has been extensively documented in males. However, studies with respect to its cause, association with condition such as CAD and underlying mechanisms in females is yet to be established. An important study on AGA in females was published by Mansori \textit{et al.} in 2005 where they reported an association between AGA and the heart condition-CAD. They also explored the factors such as greying of hairs and MI and their association with AGA. From their findings, they concluded that AGA is associated with CAD in females under the age of 55 years. The present study also attempted to determine the relationship between AGA and CAD in females by investigating various factors such as demographic variables, clinical presentation.

### Table 1: Distribution of participants by age group (\( n = 219 \))

| Age range | Case | Control |
|-----------|------|---------|
| 32-55     | 32-55 | 42-91   |
| 40-50     | 30 (37) | 1 (0.5) |
| 51-60     | 140 (63.93) | 14 (6.39) |
| 61-70     | 0     | 118 (51.6) |
| 71-80     | 0     | 24 (10.96) |
| ≥81       | 0     | 3 (1.37) |

### Table 2: Clinical presentation of coronary artery disease in the case group (\( n = 219 \))

| Case Group | Count (%) |
|------------|-----------|
| TMT positive | 74 (33.79) |
| Unstable angina | 55 (25.11) |
| STEMI | 40 (18.26) |
| NSTEMI | 50 (22.83) |

### Table 3: Distribution of participants by female androgenetic alopecia

| Female androgenetic alopecia | Group (%) |
|-----------------------------|-----------|
| Grade I | 20 (22.72) |
| Grade II | 38 (43.18) |
| Grade III | 30 (34.09) |
| Total | 88 (40.18) |

### Table 4: Baseline angiographic characteristics of the case group

| Variables | Count (%) |
|-----------|-----------|
| Number of diseased vessels | 132 (60) |
| SVD | 48 (22) |
| DVD | 39 (18) |
| Lesion location | 15 (7) |
| LM | 149 (68) |
| LAD | 61 (28) |
| RCA | 110 (50) |
| D1 | 10 (5) |
| OM | 2 (1) |
| Type of lesion | 170 (78) |
| Type A | 39 (18) |
| Type C | 10 (5) |
| Procedure complication | 11 (5) |
| Slow/no flow | 0 |
| Dissection | 0 |
| Perforation | 0 |
| Tamponade | 0 |
| In-hospital outcome | 0 |
| In-hospital MACE | 0 |
| Death | 0 |
| Stent thrombosis | 0 |
| TLR-PCI | 0 |

LM – Left main; LAD – Left anterior descending; LCX – Left circumflex artery; D1 – Diagonal artery; RCA – Right coronary artery; OM – Obtuse marginal; SVD – Single-vessel disease; DVD – Double-vessel disease; TAD – Triple-vessel disease; TLR – Target lesion revascularization; PCI – Percutaneous coronary intervention; MACE – Major adverse cardiovascular event
of CAD and other comorbid conditions, distribution of AGA in females, baseline angiographic characteristics, and lipid profiles.

Similar to the study of Mansouri et al. in 2005, the present study evaluated the frequency of CAD, AGA, and other comorbid conditions among the case and control groups. The frequency of anemia, hypertension, amenorrhea, and female Grade I AGA was higher, similar to the Mansouri et al.’s study. In addition, the mean age of the Mansouri et al.’s study was also similar to the present study, although the population and time of study were different. The present study also supports the study results of Mansouri et al. with respect to the correlation of AGA with CAD and high blood pressure. Mansouri et al. reported a statistically significant relationship between AGA and CAD, and they also reported the association between AGA and high blood pressure as not significant.[10] The results of both the studies also were common in case of lipid profiles of the participants. However, the present study demonstrated the incidence of DM among the participants, in contrast Mansouri et al.[4] Other interesting observations of the present study, which was not previous documented by Mansouri et al., were the baseline angiographic characteristics and the clinical presentation of the case group.

The present study considered the first-degree female relatives as the condition (i.e., AGA) is of genetic predisposition with polygenetic mode of inheritance. The genes for AGA have also been reported to determine the onset, pattern of progression, and severity of AGA in the affected individuals. Besides the genetic predisposition, other factors reported to increase the chances of AGA in individuals include smoking, stress, testosterone, hypertension, minimal physical activity, and diabetes, which are also the factors responsible for the occurrence of heart conditions such as CAD.[3,7,8] Some of these factors have been studied in the present study, and the results are in accordance with Mansouri et al., as mentioned previously.[10]

However, contrasting to Mansouri et al., the present study also revealed about 59.82% of the CAD-diagnosed females...
in the case group with no alopecia. An observation by Price in a review article published in 2003 gives an insight into this fact. Price reported that hair loss in women is generally less as compared to men as the androgen receptors and 5α-reductase (type I and II) were less in women than in men. This may lead to the difference in presentation of AGA clinically, in women, thereby leading to delay in the diagnosis. However, the diagnosis can be expediated by observing thinning of hair, especially in the frontal area of the scalp, along with recognizing other coexisting conditions such as CAD and MI, which have been attempted in the present study. A significant association between AGA and CAD was observed in the present study, indicating CAD as an important diagnostic factor in detecting the origin of AGA in women. In addition, a high percentage of AGA Grade III participants were diagnosed with triple vessel disease (TVD), which can be an indicative marker for the heart condition. These patients had Type A lesions, hence, underwent revascularization in the form of percutaneous treatment option as percutaneous transluminal coronary angioplasty. However, these possibilities need to be explored and established with the higher study population.

To our knowledge, this is the first comparative study among the Indian population to evaluate the association of CAD and its parameters with respect to severity of AGA in women. The present study is also among the few studies evaluating AGA in females and investigating the role of comorbid factors in the development/diagnosis of AGA. Since a high incidence of hirsutism was detected in the case group, an endocrinological opinion was sought for the incidence of PCOS and if detected, then patients were further referred to the endocrinologist for further evaluation and treatment. However, other than exploring the association of heart conditions with AGA, future studies can also determine the relation between other comorbid conditions such as diabetes and AGA, which can also aid in the detection of AGA, in the long run.

CONCLUSION

The hypothesis that female pattern baldness is a marker for increased risk of CAD events has been studied and established as part of the present study. The elevated level of high blood pressure and TVD is predominantly observed in third-grade alopecia patients. However, there are still many questions unanswered such as – does AGA reflect CAD morbidity and mortality whether associated solely with CAD or metabolic syndrome or obesity? We conclude that there is a significant association between female AGA and CAD. However, we plan to study the association of CAD and AGA in the female population who were protected for CAD before menopause.

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Conflicts of interest
There are no conflicts of interest.

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