Clinico-Pathological Correlation in Indian Women Presenting with Cutaneous Features of Hyperandrogenism: A Cross-Sectional Study

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Background: Androgen excess is one of the most common endocrine disorders of reproductive-aged women, which can present in the form of hirsutism, androgenic alopecia, acne, ovulatory dysfunction, and if extreme and prolonged, even virilization. It is important to diagnose the underlying abnormality in young women presenting with cutaneous signs of hyperandrogenism so that appropriate treatment can be offered and long-term consequences of androgen excess in young females such as ovulatory dysfunction and infertility can be avoided besides improving the cosmetic appearance. Aims: The aim of this study was to study the cutaneous manifestations of hyperandrogenism and the various underlying clinicopathological conditions. Settings and Design: The study design was a cross-sectional descriptive study. Materials and Methods: One hundred women patients of reproductive age were studied for clinical manifestations of hyperandrogenism (excess hair growth, seborrhea, acne, alopecia, and/or menstrual disturbances), hormone levels, radioimaging, and underlying endocrinological diagnosis. Statistical Analysis Used: The data were analyzed with CDC EPI Info software computer program (version 7.2) using the appropriate statistical techniques. Results: A majority of 55% of cases were in the third decade. A family history of hirsutism was present in 8% of cases. Menstrual dysfunction was present in 50%. Seborrhea was present in 93%, acne in 71%, hirsutism in 91%, alopecia in 62%, and altogether were present in 39%. Biochemical evidence of hyperandrogenism was present in 75% and correlated with the severity of the grade of hirsutism. Polycystic ovarian syndrome (PCOS) was the most common underlying condition in 72% followed by idiopathic hirsutism in 13%. Conclusions: The present study shows PCOS as the most common underlying cause of cutaneous manifestations of hyperandrogenism. The severity of hirsutism correlates with serum testosterone levels.

Keywords: Hirsutism, hyperandrogenic-insulin-resistant-achanosis nigricans syndrome, hyperandrogenism, idiopathic hirsutism, nonclassical adrenal hyperplasia, polycystic ovarian syndrome

INTRODUCTION

Androgen excess is one of the most common endocrine disorders of reproductive-aged women, affecting approximately 7% of this population.¹ Cutaneous manifestations of androgen excess include hirsutism, seborrhea, acne, and androgenetic alopecia in addition to other accompanying surrogate markers such as acanthosis nigricans, obesity, striae, pelvic mass, features of Cushing’s disease, and virilization.² Orfanos et al. described the combination of seborrhea, acne, hirsutism on the face, trunk, and the extremities and androgenetic alopecia of the scalp as a distinct polyendocrinopathy, the seborrhea, acne, hirsutism, and alopecia (SAHA) syndrome.³
Hyperandrogenism in women occurs from increased production of androgens, which maybe adrenal or ovarian in origin. The ovarian causes being common are polycystic ovarian syndrome (PCOS) and ovarian tumors. Adrenal causes include Cushing’s syndrome, androgen-producing tumors, and congenital adrenal hyperplasia, most commonly due to 21-hydroxylase deficiency. The less common causes include hyperandrogenic-insulin-resistant-achanthisis nigricans (HAIRAN) syndrome, hyperprolactinemia, and androgenic drugs. About 20% of the patients may present with idiopathic hirsutism (IH) with normal androgen levels and ovarian function. The cause of increased hair in these women is thought to be related to disorders in peripheral androgen activity.[4]

There is a paucity of scientific literature on the prevalence of different hyperandrogenic endocrinological disorders which have dermatological manifestations, especially more so in the Indian subcontinent. Hence, 100 women patients presenting with clinical manifestations of hyperandrogenism were studied for associated endocrinological abnormalities and relative prevalence of underlying etiopathological subsets of hyperandrogenism.

**Materials and Methods**

One hundred women patients of reproductive age (14–45 years) attending dermatology outpatient clinics as well as referral cases from obstetrics and gynecology outpatient clinics and endocrinology outpatient clinics were studied over a period from July 2018 to December 2018. Patients evaluated included those presenting with excess hair growth, seborrhea, acne, alopecia, and menstrual disturbances in form of oligo/amenorrhea or with frank virilization. Prepubertal girls, postmenopausal women, pregnant women, and women with chronic liver or renal disease were excluded from the study. The sample size was calculated keeping the prevalence of the disorder in the general population of 5%–10% and accepting 95% confidence intervals for results.

Each patient underwent a detailed history, including presenting complaints, onset, sites of involvement, progression, and reproductive history (menarche, parity). Menstrual history was elicited to record irregularities in the form of oligomenorrhea (>35 days cycle length), polymenorrhea (<26 days cycle length), amenorrhea, and infertility. These patients were considered oligo/anovulatory.[5] A history was taken for recent weight gain, change in voice, treatment with drugs known to cause hirsutism, iatrogenic hypertrichosis, seborrhea, acne, and alopecia. Relevant family history of hirsutism, diabetes mellitus, and thyroid disease was also elicited.

General physical and systemic examination, including height, weight, and age, were recorded prospectively. Clinical measures of obesity in the form of body mass index (BMI) was calculated as kilograms per square meter as per the WHO grading for Asians and classified as normal weight (BMI 18.5–23 kg/m²), overweight (BMI 23–27.5 kg/m²), and obese (BMI >27.5 kg/m²).[6] The waist and hip circumference was measured, and the waist-to-hip ratio (WHR) was calculated as ≤0.8 or >0.8. Dermatological examination included recording of excess male pattern terminal hair growth over nine body sites using the modified Ferriman–Gallwey semiquantitative scoring for hirsutism and classified as mild (8–16), moderate (17–24), and severe (>24).[7] The presence of and severity of the grades of acne vulgaris (Grade I–IV) and female pattern baldness based on Ludwig’s scale (Grade I–III) for androgenetic alopecia were recorded.[8,9] Evidence of seborrhea in the form of greasy skin, oiliness of the scalp and/or seborrhea capitis, and seborrheic dermatitis was recorded. Striae and acanthosis nigricans were also recorded.

Investigations were carried out for each patient, including complete blood counts, liver and renal function tests, and a lipid profile. Sampling for endocrine investigation and sonography abdomen and pelvis for all patients was done in the early follicular phase of the menstrual cycle, including fasting blood sugar and insulin, thyroid profile, serum cortisol, serum gonadotropins, serum prolactin, total serum testosterone, 17-hydroxy progesterone (17-OHP), and dehydroepiandrosterone sulfate (DHEAS) which were performed using standardized radioimmunoassay kits (Beckman Coulter). The sonographic criteria to define polycystic ovaries were the presence of 12 or more follicles in each ovary measuring 2–9 mm in diameter and/or increase in ovarian volume (>10 ml).[10] Insulin resistance syndrome was established based on any three or more of the following: waist circumference >88 cm, triglycerides >150 mg/dL, high-density lipoprotein cholesterol <50 mg/dL, blood pressure >130/85 mm Hg, and fasting glucose >110 mg/dL.[11]

Diagnosis of underlying etiopathological conditions was made on the basis of the following criteria: PCOS was diagnosed with consensus Rotterdam criteria of 2003.[12] Nonclassical adrenal hyperplasia (NCAH) with the pubertal onset of mild degrees of hirsutism, normal physique, normal menses, raised levels of serum androgens as well as raised levels of serum 17-OHP.[1,13] IH was diagnosed when the clinical features of hyperandrogenism were present in conjunction with regular menstrual cycles and normal levels of serum...
testosterone.[14] HAIRAN syndrome was diagnosed on the basis of hyperandrogenism (raised serum testosterone and/or DHEAS), insulin resistance, and acanthosis nigricans.[3,15] Hyperprolactinemia was diagnosed when the clinical features of hyperandrogenism were present with amenorrhea and/or galactorrhea along with elevated serum androgens and prolactin levels. Other endocrinial disorders such as hyper/hypothyroidism and acquired adenocortical disease were diagnosed on the basis of clinical features of hyperandrogenism in conjunction with serum T3, T4, thyroid-stimulating hormone levels in case of hyper/hypothyroidism and raised serum cortisol in case of Cushing’s disease. Iatrogenic causes were diagnosed based on the clinical features with a temporal history of incriminated drugs before the onset of symptoms. The data were analyzed with Epi Info statistical software for epidemiology developed by Centers for Disease Control and Prevention in Atlanta, Georgia, USA (Version 7.2 released Feb 2018) computer program using the appropriate statistical techniques. Ethical approval for the study was obtained from the Institutional Review Board (letter No. IEC S No.: IEC/2018/61 date August 07, 2018)

**RESULTS**

The majority of 55 (55%) cases were in the third decade. A family history of hirsutism was present in 08 (8%) cases, and 21 (21%) cases had a positive family history for diabetes mellitus. Menstrual dysfunction was present in 50 (50%) cases. A history of infertility was present in 09 (9%) cases. A history of incriminating drug intake before the onset of symptoms was present in 04 (4%) cases. Seborrhea was present in 93 (93%) cases. Hirsutism was present in 91 (91%) cases, of which maximum 90 (98.9%) cases were of mild hirsutism (Mod Ferriman Gallwey score 8–15), the mean Mod FG score being 10.67 ± 2.45. Acne was present in 71 (71%) cases, of which maximum 39 (54.2%) cases were of Grade 2 severity. Alopecia was present in 62 (62%) cases, of which maximum 53 (85%) cases were of Grade 1 severity. All four signs of SAHA syndrome were present in 39 (39%) cases. Acanthosis nigricans was present in 35 (35%) cases, whereas striae were present in 50 (50%) cases. Table 1 summarizes the frequency of cutaneous manifestations in the study population. The mean BMI was 22.79 ± 3.67 kg/m². The maximum 52 (52%) cases were of normal weight, 25 (25%) were overweight, while 11 (11%) were obese. Biochemical evidence of hyperandrogenism (raised serum testosterone and/or serum DHEAS) was present in 75 (75%) cases. Serum total testosterone was elevated (>0.65 ng/ml) in 71 cases (71%). Serum DHEAS was elevated (>335 μg/dl) in 26 cases (26%). Both (serum total testosterone and serum DHEAS) were elevated in 22 cases (22%). Twenty-two cases (22%) were found to have normal levels of serum androgens (serum total testosterone and serum DHEAS). The severity of the grade of hirsutism correlated (coefficient of determination “r²” = 0.30) [Figure 1] with serum testosterone in this subset but not so with serum DHEAS (coefficient of determination “r²” = 0.001) [Figure 2]. The severity of acne, alopecia, and clinical measures of obesity (BMI, WHR, and waist circumference) did not correlate with serum androgen levels.

Seven cases were found to have insulin resistance syndrome. The mean Mod FG score (12.71 ± 2.62) and BMI in this subset were higher when compared to the study participants; the prevalence of acanthosis nigricans and striae was also higher, being 42.5% and 100%, respectively. The mean serum testosterone was higher (6.06 ± 9.71 ng/ml) as compared to the study participants (3.40 ± 4.64 ng/ml).

PCOS was diagnosed in 72 cases (72%), IH was diagnosed in 13 cases (13%). NCAH was diagnosed in five cases (5%). Two cases of HAIRAN were diagnosed. Hyperprolactinemia was diagnosed in a single case; three cases were diagnosed with hypothyroid based on the clinical features and thyroid profile. Four cases were attributable to iatrogenic causes.

NCAH patients were younger than other groups (mean age: 22.06 ± 4.44 years). HAIRAN patients had moderate-to-severe grade hirsutism (mean Mod FG core 16.0 ± 2.82), whereas all other groups had mild hirsutism. Menstrual dysfunction was most prevalent in PCOS and HAIRAN subgroup (48.6% and 50%, respectively). HAIRAN patients were most

| Clinical features | Frequency (%) |
|------------------|--------------|
| Seborrhea        | 93 (93.00)   |
| Acne             | 71 (71.00)   |
| Hirsutism        | 91 (91.00)   |
| Alopecia         | 62 (62.00)   |
| Seborrhea + hirsutism | 86 (86.00) |
| Seborrhea + acne | 66 (66.00)   |
| Hirsutism + acne | 65 (65.00)   |
| Seborrhea + alopecia | 58 (58.00) |
| Hirsutism + alopecia | 55 (55.00) |
| Acne + alopecia  | 44 (44.00)   |
| SAHA             | 38 (38.00)   |

SAHA: Seborrhea, acne, hirsutism, and alopecia

Table 1: Frequency of cutaneous manifestations of hyperandrogenism
obese (mean BMI 24.99 ± 2.41 kg/m²), whereas cases of NCAH group were of lean build (mean BMI 21.37 ± 4.10 kg/m²). Serum testosterone was elevated maximally in HAIRAN patients (mean 19.5 ± 7.77 ng/ml) followed by PCOS (mean 3.5 ± 4.7 ng/ml). Serum DHEAS and 17-OHP were elevated maximally in NCAH patients (mean 326 ± 7.77 μg/ml and 1.66 ± 0.55 ng/ml, respectively).

Table 2 summarizes the comparison of clinical and hormonal features by underlying clinicopathological conditions.

### Discussion

In the present study, we have reported our experience of evaluating 100 women patients in the reproductive age group presenting with features of hyperandrogenism. The youngest patient in this study was 14 years, and the oldest was 35 years of age. The mean age of the presentation was 22.36 ± 0.468 years; the majority of 55% of cases were in the third decade, which was in concordance with a reviewed literature[13,16,17].

A family history of hirsutism was present in 8%, which was much lower as compared to 25.7% by Ahmad et al.,[16] 18% in a study by Sharma et al.,[2] and 42.5% by Chhabra et al.[18] Menstrual dysfunction was present in 50% which was in concordance with a study by Carmina et al.,[13] which reported irregular menses in 54.8% cases, while Azziz et al.[1] reported a higher prevalence of menstrual dysfunction in 86.4% as opposed to a lower prevalence in other Indian studies being 36% (2) and 28% (17). Primary infertility was present in 9% which greatly varied from 5.7% (16) to 29.7% (1).

While seborrhea was present in 93% of cases which was universal as per the reviewed literature,[3] acne was present in 71% which was similar to Indian studies 64% (2), 60% (17), and 55% (18), but more than in other studies being 12.6% (13) to 14.2% (1). Hirsutism was present in 91%, which was concordant with other studies ranging from 75.5% (1) to 95% (13). The mean mod FG score was 10.67 ± 2.45 similar to 10.23 ± 2.46 in a study by Sharma et al.[2] and 10.5 ± 4.1 by Azziz et al.[1] Alopecia was present in 62%, which was much higher as compared to 3.2% (13), 16% (2), and 27.5% (18) in other studies. All four features of SAHA were present in 39% as opposed to 20% quoted in the literature.[3] Acanthosis nigricans was present in 35% which was similar to another study by Chhabra et al.[18] Mean BMI was 22.79 ± 3.67 kg/m² when compared to another large study where it was 26.7 ± 9 kg/m².[13] In the present study, 25% were overweight and 11% were obese. This was in contrast to the study by Azziz et al.

| Clinical/biochemical feature (mean±SD) | PCOS | NCAH | IH | HAIRAN syndrome |
|--------------------------------------|------|------|----|----------------|
| Age (years)                          | 22.06±4.44 | 18.4±3.2 | 22.69±6.11 | 19±2.84 |
| Seborrhea (%)                        | 66 (91.7) | 3 (60) | 12 (92.3) | 2 (100) |
| Acne (%)                             | 51 (70.8) | 3 (60) | 7 (53.8) | 1 (50) |
| Hirsutism (Mod FG) score             | 10.83±2.56 | 9.6±1.81 | 9.92±1.75 | 16.0±2.82 |
| Alopecia (%)                         | 44 (61.1) | 5 (100) | 8 (61.5) | 2 (100) |
| Oligo/amenorrhea (%)                 | 35 (48.6) | 1 (20) | 0 (0) | 1 (50) |
| WHR                                  | 0.94±0.84 | 0.84±0.69 | 0.83±0.04 | 0.9 |
| BMI (kg/m²)                          | 22.36±3.27 | 21.37±4.10 | 23.68±4.2 | 24.99±4.2 |
| Serum testosterone (ng/ml)           | 3.5±4.7 | 1.13±0.53 | 0.42±0.21 | 19.5±7.77 |
| Serum DHEAS (µg/dl)                  | 279.48±179.06 | 326.0±226.79 | 208±71.69 | 282.50±325.97 |
| 17-OHP (ng/ml)                       | 1.47±2.0 | 1.66±0.55 | 0.98±0.40 | 1.46±0.98 |

SD: Standard deviation, PCOS: Polycystic ovarian syndrome, NCAH: Nonclassical adrenal hyperplasia, IH: Idiopathic Hirsutism, Hyperandrogenic-insulin-resistant-acanthosis nigricans syndrome, DHEAS: Dehydroepiandrosterone sulfate, 17-OHP: 17-hydroxy progesterone, WHR: Waist-to-hip ratio, BMI: Body mass index, HAIRAN: Hyperandrogenic-insulin-resistant acanthosis nigricans
where 19.4% cases were preobese (BMI 25–29.9 kg/m²) and 58.2% cases were obese (BMI ≥30.0 kg/m²). In other studies, 20.1% (13) and 37.5% (18) were found to be obese with criteria of BMI ≥30.0 kg/m² and BMI >25 kg/m², respectively.

Biochemical evidence of hyperandrogenism (elevated serum testosterone and/or serum DHEAS) was present in 75%, which was concordant to 77.8% (1) in a similar study by Azziz et al.¹¹ Serum total testosterone was elevated in 71% when compared to 70.2% (13) and 37.9% (1) in other studies. Serum DHEAS was elevated in 26% when compared to 44.3% (13) and 40.4% (1) in other studies. Both (serum total testosterone and serum DHEAS) were elevated in 22 cases (22%) as compared to 10% in a study by Azziz et al.¹¹ About 22% were found to have normal levels of serum androgens similar to other studies 17.5% (13) and 22.2% (1). The mean mod FG score was marginally higher in the subset with hyperandrogenemia (11.38 ± 4.95). The severity of grade of hirsutism correlated with serum total testosterone in this subset, but not so with serum DHEAS which was contrary to the findings in studies by Chhabra et al.¹⁸ and Ruutiainen et al.,¹⁹ where they found association between the severity of hirsutism with free testosterone but not with total testosterone or serum DHEAS. The severity of acne, alopecia, and clinical measures of obesity (BMI, WHR, and waist circumference) did not correlate with serum androgens as opposed to other studies by Lucky et al.²⁰ and Schiavone et al.²¹

PCOS based on the revised 2003 Rotterdam criteria was diagnosed in 72%, which was similar to 72.1% by Carmina et al.,¹³ 70% by Chhabra et al.,¹⁸ and 82% by Azziz et al.:¹¹ The luteinizing hormone: follicle-stimulating hormone ratio was >2 in only 15 cases (20.83%), which was suggestive but not diagnostic of PCOS when compared to 78.57% in a study by Chhabra et al.¹⁸ NCAH based on raised serum androgens and 17-OHP was diagnosed in 5% as compared to 2.06% (1), 2.86% (16), 4% (17), and 4.3% (13) in other studies. IH, a diagnosis of exclusion was made in 13% which was similar to 15% in the study by Chhabra et al.,¹⁸ much less when compared with 60% (17) in another Indian study and more when compared with other larger studies, being 7.6% (13) and 4.7% (1). The HAIRAN syndrome was diagnosed in 2% in the present study, while a similar study by Azziz et al.¹¹ have reported a prevalence of 3.78%. Hyperprolactinemia was diagnosed in a single case when compared to 0.3% (1) in another study. Three cases (3%) were diagnosed with hypothyroid based on the clinical features and thyroid profile when compared to 5.70% in a study by Ahmad et al.¹⁶ Four cases (4%) were attributable to iatrogenic hypertrichosis based on a history of drug intake before the onset of symptoms.

The variance in results from those of preceding studies can be explained by several factors. The study by Azziz et al.¹¹ was performed in the obstetrics and gynecology department, which included patients referred because of menstrual disturbances or ovariary dysfunction independently of clinical hyperandrogenism, whereas the Carmina et al.⁴¹ study was performed in the endocrinology department, where study participants were referred for hirsutism only. The studies by Sharma et al.,²¹⁷ Ahmad et al.,¹⁶ and Chhabra et al.,¹⁸ as well as the present study were carried out in the dermatology departments, where additional features of clinical hyperandrogenism, such as seborrhea, acne, and alopecia complemented hirsutism in the referred cases. Definitions and criteria also varied in studies, for example, Mod FG score of >6 was used to define hirsutism in a study by Azziz et al.¹¹ and the definition of obesity being BMI >25 kg/m² by Chhabra et al.¹⁸ Finally, varying sample size and regional study population in the various studies can account for the variation in their results. The limitations of the present study were its small sample size, lack of a control group, inter‑observer subjective variation in recording hirsutism score, grades of acne and alopecia, noninclusion of free testosterone, free androgen index, antimullerian hormone and SHBG in endocrine investigations, and the use of menstrual irregularity as surrogate for oligo/anovulatory cycles.

The study highlights the fact that cutaneous features of hyperandrogenism can often be an opportunity to treat oligo/anovulatory women of reproductive age group presenting to dermatology, gynecology, or endocrinology outpatient departments. Although the present study is a fairly exhaustive attempt, further studies are required to identify more subtle signs and their endocrinal associations.

**Conclusions**

The present study shows PCOS as the most common underlying cause of cutaneous manifestations of hyperandrogenism in Indian women of reproductive age group. The severity of hirsutism correlates with serum testosterone levels.

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**Conflicts of interest**

There are no conflicts of interest.

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