Clinico-investigative Study of Facial Acanthosis Nigricans

Abstract

Background: Facial acanthosis nigricans (FAN) is an underrecognized and undiagnosed entity. The typical presentation of acanthosis nigricans (AN) seen elsewhere on the body like axillae and groins is not seen on the face, making it mimic other pigmented disorders. Moreover, FAN is seldom not accompanied with AN on the classical sites making the diagnosis challenging. The aims of this study were to determine clinical, dermoscopic, and histopathological features of FAN and to estimate the prevalence of obesity and insulin resistance (IR) in FAN. Methods: Forty cases of FAN and forty healthy nonobese individuals with comparable ages and gender were included in the study. Body mass index, waist circumference, hip circumference, waist to hip ratio, and serum fasting lipid levels were used to evaluate obesity, whereas serum fasting insulin and Homeostatic Model of Assessment of Insulin Resistance (HOMA-IR) were used to evaluate IR. Dermoscopy was performed in all cases. Histopathological features of the skin biopsies were reviewed. Results: Out of the 40 cases, 24 were male and 16 were female. The patterns of facial pigmentation in addition to the classic pattern were a hyperpigmented band over forehead (55%), periorbital darkening (25%), perioral (10%), and generalized darkening (10%). Dermoscopy in all cases revealed linear crista cuts, sulcus cuts, and hyperpigmented dots in crista cuts. Biopsy of 20 cases showed mild hyperkeratosis, acanthosis, papillomatosis, and increase in basal melanin. Clinico-dermoscopic-histological correlation showed that milder (light brown) variants of FAN had follicular plugging and subtle sulci pattern with irregular brown globules and perifollicular pigmentation on dermoscopy and mild hyperkeratosis and hypermelanization of the basal layer with minimal acanthosis and papillomatosis on histopathology. On the other hand, chronic variants (dark brown and black) showed prominent sulci, larger brown globules, and perifollicular hyperpigmentation on dermoscopy and moderate hyperkeratosis and hypermelanization of the basal layer with moderate to severe acanthosis and papillomatosis on histopathology. Fasting blood glucose, insulin, HOMA-IR, fasting serum triglyceride, and total cholesterol were statistically significantly high in cases in comparison with controls (P-value < 0.05). Conclusions: Varied clinical presentations of FAN were observed. Dermoscopy and histopathology provide a good aid. FAN may be considered as a cutaneous marker of obesity and IR. Thus, FAN should be suspected in patients presenting with facial melanosis who are obese and have AN over other sites, although FAN can also present de novo.

Keywords: Facial acanthosis nigricans, facial melanosis, insulin resistance, metabolic syndrome, obesity

Introduction

Facial acanthosis nigricans (FAN), also known as metabolic melanosis, is one of the causes of facial melanosis often associated with metabolic derangements. FAN is defined as brown to black macular pigmentation with blurred ill-defined margins and areas having varying degrees of textural changes ranging from mild roughness to obvious velvety appearance. Various differentials include frictional hyperpigmentation, pigmented contact dermatitis, maturation hyperpigmentation (MH), and melanoma. Diagnosing FAN becomes essential due to its association with metabolic derangements, insulin resistance (IR), and obesity.

Aims and objectives

The aims of this study were to determine clinical, dermoscopic, and histopathological features of FAN and to estimate the prevalence of obesity and IR in FAN.

Material and Methods

Inclusion criteria

Cases with classical FAN described as brown to black macular pigmentation with...
blurred ill-defined margins on zygomatic and malar areas or anywhere on face with varying degrees of textural changes were included with or without the presence of similar features on neck, axilla, groin, and other flexural regions. Dermoscopy was done in all cases and wherever there was doubt in diagnosis of FAN with absence of AN at classical sites, a skin biopsy was performed. An age- and sex-matched control group was included consisting of all the patients presenting to the outpatient department of dermatology without a clinical diagnosis of FAN or having lesions of acanthosis nigricans (AN) in any other part of the body. Control group was selected by an independent investigator who was not involved in the study to minimize selection bias.

**Exclusion criteria**

Patients with non-FAN causes of facial melanosis were excluded from the study (melasma, lichen planus pigmentosus (LPP), pigmented contact dermatitis, Riehl’s melanosis, erythema dyschromicum perstans, poikiloderma of civatte, pigmented dermacation lines, postinflammatory pigmentation, topical/systemic drug induced pigmentation, congenital/nevoid, familial causes, etc.). Also, patients with known history of diabetes mellitus were excluded from the study.

**Study design**

This was a case–control study conducted in the outpatient department of dermatology. The study was conducted over a period of 2 years (Dec. 2016–Nov. 2018). Forty patients with a clinical diagnosis of FAN who fulfilled the inclusion criteria and provided consent for use of the clinical photographs were included in the study. Thorough history of all the patients with regards to age, sex, occupation, age of onset of FAN, duration of FAN, history of weight gain, excessive exposure to sunlight, atopy, friction, occupational or personal use of chemicals, and cosmetics and medications applied onto the face, presence of other skin diseases, family history of AN including FAN, diabetes, hypertension, dyslipidemia, history of drug intake was taken. Menstrual and reproductive history was noted in females.

Cutaneous examination of the lesions of FAN was described in terms of color, texture, site of face involved, and laterality. In addition, the presence of AN on other sites of the body was also noted. Other features such as acrochordons, dermatosis papulosa nigra (DPN), excessive fat deposition on cheeks and jaw and acne were also noted. Dermoscopy of all cases using eScope by Oitez (magnification 40×) was performed. Skin biopsy for histopathological examination was done among 22 patients who consented for biopsy.

Blood pressure was measured, and 130/85 mmHg was considered as the normal level. If value was higher than that, the patient was labeled as hypertensive.\[1\]

Body mass index (BMI) was calculated as a ratio of weight in kilograms divided by height in meters squared (kg/m²). BMI was classified as per the consensus statement provided by Misra et al.\[2\] in 2009: normal BMI as 18.0–22.9 kg/m², overweight as 23.0–24.9 kg/m², obesity as ≥25 kg/m², and morbid obesity as ≥30 kg/m².

Waist circumference (WC) and waist hip ratio (WHR) of all patients were calculated. WC was measured using a tape in horizontal position, with the subject standing erect and looking straight forward, just above the iliac crest, at the end of normal expiration. The risk of developing metabolic syndrome (MS) is higher in men with WC ≥36 inches and in females with WC ≥32 inches. Hip circumference was measured as the widest part of the buttocks and WHR was calculated. As per guidelines, WHR was classified as normal: <0.8, overweight: 0.81–0.85, obese: 0.86–0.9, and morbid obese: >0.9.\[2\]

Dysglycemia was labeled when fasting blood sugar level was >100 mg/dL. Fasting serum insulin and homeostatic model assessment-insulin resistance (HOMA2-IR) was also calculated. IR was classified as normal <2, borderline 2–2.2, moderate 2.2–3, and severe >3.\[3\] Deranged lipid profile was defined when level of triglycerides ≥150 mg/dL and high-density lipoprotein (HDL) was <40 mg/dL in males and <50 mg/dL in females.

MS was identified when three out of the following five factors were present as per the consensus statement provided by Misra et al.\[2\]:

1. Abdominal obesity (>40 inches in males and >34.5 inches in females), nonobligatory criterion
2. Fasting blood glucose ≥100 mg/dL
3. Blood pressure ≥130/85 mmHg
4. Triglycerides ≥150 mg/dL
5. HDL (<40 mg/dL in males and <50 mg/dL in females).

Statistical analysis was done using SPSS version 20 (Statistical Package for Social Science SPSS, Inc. Chicago, IL, U.S.A.). Normally distributed continuous variables were expressed as the mean and standard deviation (± SD). Categorical data were reported as numbers and percentages. Comparison of numerical variables between the two groups was done using Student’s unpaired t-test. Intergroup analysis was done using Chi-square test and Fisher’s exact test (two tailed). Odds ratio was calculated for hypertension, deranged lipid profile, dysglycemia, HOMA2-IR, serum fasting insulin, BMI, and WHR. Relative risk of developing FAN in the presence of the risk factor was expressed for each of the variables. P < 0.05 was considered statistically significant.

**Results**

Forty patients of FAN were diagnosed, over a period of 2 years (study duration), and 40 age and sex-matched controls were included in the study. The mean age of cases was 37.10 ± 14.54 years (range: 11–73 years). The mean
The mean age for males was $38.52 \pm 14.52$ years (range: 17–73 years). The mean age for females was $34.15 \pm 15.05$ years (range: 11–56 years). The youngest patient was 11 years old, whereas the eldest one was 73 years old. The male-to-female ratio was 2.08:1 (27 males and 13 females). The mean age of onset was 32.98 years. The mean duration was 4.13 years (range: 1–20 years). History of weight gain was present in 22 patients (55.00%). Eleven (27.50%) patients had a history of being exposed to sunlight >2 h/day. History of dye application was present in nine (22.50%) patients. Four patients (10%) reported the presence of similar disease in the family. Hypertension was present in 10 cases (25.00%) and 2 controls (5.00%).

Cutaneous examination revealed five clinical patterns of FAN. The most common site of face involved was the forehead and temporal region (20 patients, 50%) followed by zygomatic region (19 patients, 47.50%), periorbital (17 patients, 42.50%), perioral (8 patients, 20.00%), and generalized (4 patients, 10.00%) [Figure 1a–e]. The most common color noted was dark brown (25 patients, 62.50%) followed by black (8 patients, 20.00%) and light brown (7 patients, 17.50%) [Figure 2a–c]. Besides the site and color, the degree of pigmentation, velvety thickening, and rugosity of the skin was found to increase in proportion to the severity of the disease. Sharqie’s grading of AN of face depending on texture was done, as shown in Table 1.\(^4\) With respect to Sharqie’s grading of AN of the face, grade II was found in 7 (17.50%) and grade III in 25 (62.50%), while grade IV in 8 (20.00%) patients. AN of other body sites such as neck, axillae, groins, and knuckles was noted in 37 (92.50%) of the cases. Out of these, AN of neck was observed to be highest (30 patients, 75.00%) followed by axillae (29 patients, 72.50%), knuckles (16 patients, 40.00%), and groins (14 patients, 35.00%) [Figure 3a and b]. Acrochordons were present in 77.50% cases as compared to controls. DPN were present in 50.00% of cases and 15.00% of controls. Excessive fat deposition on cheeks and jaw was present in 60.00% of

| Grade   | Thickness       | Color          |
|---------|-----------------|----------------|
| Grade I | 0               | Light brown    |
| Grade II| Mild            | Brown          |
| Grade III| Moderate with velvety | Dark brown |
| Grade IV| Severe with severe velvety | Black         |

Table 1: Sharqie’s grading of acanthosis nigricans of face depending on texture

Figure 1: (a-e) Various patterns of FAN – (a) forehead and temporal, (b) zygomatic, (c) periorbital, (d) perioral, and (e) generalized
cases and 17.50% of controls. Acne with postinflammatory hyperpigmentation was observed in 32.50% cases as compared to 20.00% controls.

Dermoscopy performed in all cases revealed linear crista cutis, sulcus cutis, and hyperpigmented dots in crista cutis [Figure 4a-d]. Skin biopsy performed in 22 patients showed hyperkeratosis and hypermelanization of the basal layer as the most consistent finding with variable degrees of acanthosis and papillomatosis [Figure 5]. Clinico-dermoscopic-histological correlation showing milder (light brown) variants of FAN had follicular plugging and subtle sulci pattern with irregular brown globules and perifollicular pigmentation on dermoscopy and mild hyperkeratosis and hypermelanization of the basal layer with minimal acanthosis and papillomatosis on histopathology. On the other hand, chronic variants (dark brown and black) showed prominent sulci, larger brown globules, and perifollicular hyperpigmentation on dermoscopy and moderate hyperkeratosis and hypermelanization of the basal layer with moderate to severe acanthosis and papillomatosis on histopathology [Figure 6]. Table 2 summarizes dermoscopic and histopathologic correlation of all patients.

BMI of all patients was calculated, and 3 patients (7.5%) were normal, 1 patient (2.50%) was found to be overweight,

| No. of patient | Color | Dermoscopy                                      | Histopathology                                      |
|---------------|-------|------------------------------------------------|----------------------------------------------------|
| 7             | Light brown | Follicular plugging and subtle sulci pattern with irregular brown globules and perifollicular pigmentation | Mild hyperkeratosis and hypermelanization of the basal layer with minimal acanthosis and papillomatosis |
| 25            | Dark brown | Prominent sulci, larger brown globules and perifollicular hyperpigmentation | Moderate hyperkeratosis and hypermelanization of the basal layer with moderate acanthosis and papillomatosis |
| 8             | Black   | Markedly depressed sulci and prominent cristae   | Extensive hyperkeratosis and hypermelanization of the basal layer with severe acanthosis and papillomatosis |

Figure 2: (a-c) Different colors of FAN – (a) light brown, (b) dark brown, and (c) black

Figure 3: (a and b) Acanthosis nigricans of different sites – (a) neck and (b) knuckles
and 36 (90.00%) were obese. The mean BMI for cases was 28.87 ± 4.01 kg/m² (range: 19.80–42.40 kg/m²). Among the controls, 18 (45.00%) were normal, 17 (42.50%) were overweight, and 5 (12.50%) were obese. Intergroup analysis was done using Pearson’s Chi-square test, and the result was statistically significant on overall comparison (P = 0.0007).

The mean WC for males was 38.48 inches and for females was 37.46 inches. WC more than 36 inches was observed in 92.6% male cases as compared to 3.7% of control males. WC more than 32 inches was noted in 100% of male cases as compared to 7.6% female controls. Intergroup analysis done using Pearson’s Chi-square test showed statistically significant difference among cases and controls (P < 0.0001). For the WHR, 1 patient (2.50%) was overweight, 13 patients (32.50%) were obese, and 26 (65.00%) were found to have morbid obesity. When compared with controls, 12 patients (30.00%) were overweight, 24 patients (60.00%) were obese, and 4 patients (10.00%) had morbid obesity. Mean WHR for cases was 0.92 ± 0.028 (range: 0.84–0.97) and for controls was 0.87 ± 0.022 (range: 0.83–0.91). When compared with WHR between more than 0.86 and less than 0.86, statistically significant difference was seen between cases and controls (P value = 0.0085).

Dysglycemia was noted in 13 cases (32.5%) and 4 controls (10.00%). Serum fasting insulin was elevated in 22 cases (55.00%) and 3 controls (7.50%). Intergroup analysis was done using Fisher’s exact test (two tailed), and the result was statistically significant (P < 0.005). The mean HOMA2-IR level for cases was 2.71 ± 2.93 (range: 0.47–18.50). The mean HOMA2-IR level for males was 2.84 ± 2.93 (range: 0.47–18.50) and for females was 2.44 ± 3.10 (range: 0.52–5.47). Six (15.00%) and thirteen (32.50%) of the patients had moderate and severe IR, respectively, as per the HOMA2-IR levels. When compared with HOMA2-IR between more than 2.2 and less than 2.2, statistically significant difference was seen between cases and controls (P value <0.001).

Dyslipidemia was noted in 15 cases (37.50%) and 3 controls (7.50%). Intergroup analysis was done using Fisher’s exact test (two tailed) and the result was statistically significant (P = 0.0058). Our results show that male sex, increased WC, increased WHR, increased BMI, and increased HOMA2-IR were found to be most significantly related to FAN.

**Discussion**

Skin is a window to the internal systems of the human body. Many cutaneous conditions have an associated underlying systemic association. FAN should commonly be considered in obese patients or those having MS. It is commonly seen over zygomatic region over face and is often associated with AN of neck, axillae, groins, and knuckles. Very few studies are there from India describing the clinicodermoscopic and histopathological characteristics of FAN and its correlation with IR and other metabolic markers.

Various studies carried out of clinico-investigative correlation with FAN have been compared in Table 3.[1,4,5] Mean age of patients was 38 years in males and 34 years in females, which was similar to Panda et al.,[1] Sharique et al.[5] and Verma et al.[5] Mean age of onset was 32.98 years comparable to Panda et al.[1] FAN was more commonly seen in males as compared to females as appreciated in Table 3. History of being exposed to sunlight for more than 2 h per day was present in 27.50% similar to Verma et al. (21.50%).[5] The most common pattern observed in this study was classic pattern seen over zygomatic region followed by forehead and similar to Verma et al. AN of...
other sites was seen in 92.50% patients parallel to Panda et al. (81.30%) and Verma et al. (86.27%). Obesity was seen in 90% patients comparable to Verma et al. (87% in males and 100% in females). IR was seen in 55% patients as compared to Panda et al. (62.60%) and Verma et al. (82.34%). Increased WC, increased WHR, increased BMI, dyslipidemia, and increased HOMA2-IR were found to be most significantly related to cases as compared to controls.

Dermoscopy of acanthosis nigricans (FAN) usually reveals linear crista cutis and sulcus cutis with scattered black or dark brown dots and globules.[6] In chronic lesions with thickened skin, exophytic papillary structures are seen.[7] The background color is alternating darker brown or grayish-brown in the crista cutis region and white (hypopigmented) in sulci cutis.[6] Dots or globules vary in size and take the diverse shapes according to their orientation of pigment in the papillary structures. Cristae and sulci are better appreciated in nonpolarized mode, and pigmented dots and globules (specific clues for FAN) are better seen in polarized mode.[8] In histopathological correlation, linear crista cutis represents uplifted and pigmented epidermis by papillomatous projections of the dermis, while sulcus cutis represents equally pigmented surrounding epidermis.[9] The white color of sulci cutis is due to the basket weave stratum corneum filled in the valley of downwardly progressed epidermis.[9] In chronic lesions with thickened skin, exophytic papillary structures are seen due to extreme papillomatosis.[7] Darker brown

---

**Table 3: Comparison of characteristics in various studies**

| Various parameters          | Present study | Panda et al. (2017)[3] | Sharquie et al. (2015)[4] | Verma et al. (2016)[5] |
|-----------------------------|---------------|------------------------|---------------------------|------------------------|
| Sample size                 | 40 cases, 40 controls | 123 cases, 123 controls | 27 cases, 27 controls     | 102 cases              |
| Mean age (years)            | 38.5 (M), 34 (F) | 38.83                  | 39                        | 37.57 (M), 31 (F)      |
| Duration                    | 1-20 years (4)  | -                      | 1 years-8 years (3.4)     | 7 months-8 years       |
| Mean age of onset           | 32.98          | 30.93                  | -                         | -                      |
| M:F                         | 2.08:1         | 4.35:1                 | 27:1                      | 2.9:1                  |
| History of being exposed to sunlight >2 h/day (%) | 27.50         | 74.80                  | -                         | 21.50                  |
| Most common pattern         | Classical      | Forehead and temporal  | Forehead                  | Classical              |
| M/C color                   | Dark brown     | Brown-black            | -                         | -                      |
| AN of other sites (%)       | 92.50          | 81.30                  | -                         | 86.27                  |
| BMI (%) >25                 | 90.00          | 22.00                  | -                         | 87 (M), 100 (F)        |
| WC (%)                      | 95.00          | -                      | 83.30                     | 85.29                  |
| WHR (%)                     | 97.50          | 40.00                  | 53.50                     | 100                    |
| Hypertension (%)            | 25             | 6.50                   | -                         | 49.10                  |
| Dysglycemia (%)             | 32.50          | 54.47                  | -                         | -                      |
| Hypertriglyceridemia (%)    | 37.50          | 39.20                  | -                         | 50.98                  |
| Insulin resistance (%)      | 55.00          | 62.60                  | -                         | 82.34                  |

---

**Figure 6:** (a-c) Dermoscopy of FAN – (a) mild: follicular plugging and subtle sulci pattern (red asterisk) with irregular brown globules (green asterisk) and perifollicular pigmentation. (b) Moderate: prominent sulci, larger brown globules (yellow circle) and perifollicular hyperpigmentation (white circle), and (c) severe: markedly depressed sulci (black arrow) and prominent cristae (yellow asterisk)
Facial acanthosis nigricans (FAN) needs to be differentiated from other causes of facial pigmentation like MH, melasma, and lichen planus pigmentosus (LPP). MH is a recently described entity by Dr. A. Melvin Alexander in seven black individuals. MH is associated with MS. Sonthalia et al. have reported 35 cases of MH in India, out of which MS was present in 60% patients. FAN is differentiated from MH on the following parameters: a) clinically the texture of FAN is rough and that of MH lesions being smoother than FAN, b) presence of AN lesions at typical sites like neck, axillae, groin which are lacking MH patients, c) histopathology of FAN shows marked hyperkeratosis with varying degrees of papillomatosis and basal layer hypermelanization as compared to MH revealing minimal to nil hyperkeratosis and papillomatosis and moderate to dense basal layer hypermelanization, and d) dermoscopy of FAN shows multiple cristae and sulci with hyperpigmented dots in cristae, whereas dermoscopy of MH reveals a peculiar pattern of periocular rings of hyperpigmentation. Due to these subtle differences, some authors consider FAN and MH as different poles of the same spectrum. Table 4 helps us in differentiating the mimickers of FAN.

**Limitations**

We could not do AN severity index in our patients and its association with metabolic markers. We were unable to perform skin biopsies in all patients. Thus, more studies are required to find out whether histological finding has a correlation with the severity of FAN and the underlying systemic diseases.

**Table 4: Differential diagnosis of FAN**

| Characteristics | Facial acanthosis nigricans (FAN) | Maturational hyperpigmentation (MH) | Melasma | Exogenous ochronosis | Lichen planus pigmentosus |
|-----------------|-----------------------------------|--------------------------------------|---------|----------------------|--------------------------|
| Clinical features | Brown to black macular pigmentation with blurred ill-defined margins areas having varying degrees of textural changes | The texture of MH smoother than FAN | Symmetric progressive hyperpigmentation of the facial skin that has a predilection for darker skin phenotypes | Deposition of microscopic, ochre-colored pigment in the dermis, giving rise to a blue-black hue in the skin | Focal or diffuse gray-blue or dark brown macules on exposed areas |
| Dermoscopy | Multiple cristae and sulci with hyperpigmented dots in cristae cutis | Perifollicular rings of hyperpigmentation | Light brown-to-dark brown pigmentation, dark brown-colored globules/dots/blotches, pseudoreticular pigmentation with diffuse dark brown-to-grayish pigmentation with sparing of follicular openings | Dark hyperpigmentation, blue-gray dots and globules with a caviar-like appearance, obliteration of follicular opening | Blue-gray pigmentation, slate gray dots with regular distribution of pigment seen, hem-like pattern in a typical case, especially in nonfacial lesions |
| Histopathology | Hyperkeratosis and hypermelanization of the basal layer with variable degrees of acanthosis and papillomatosis | Minimal to nil hyperkeratosis and papillomatosis and moderate to dense basal layer hypermelanization | Solar elastosis, increased melanin concentration, epidermal flattening, and dermal lymphomononuclear inflammation | Pigment incontinence, solar elastosis, ochre pigment, “banana-shaped” fibers in papillary dermis, and eventually degeneration of the collagen; colloid milium and/or granulomas | Atrophy of the dermis with loss of rete pattern, focal basal cell vacuolization, and sparse dermal infiltrate |
Conclusions
FAN was commonly seen male patients; those with increased BMI, increased WHR, and elevated HOMA2-IR level have a significantly higher probability of developing FAN. Dermoscopy acted as a guide for patients where skin biopsy was not done. This study highlighted a higher incidence of obesity and IR in patients with various patterns of FAN. FAN, thus, aids as an early clinical indicator of IR, MS, and diabetes mellitus. Hence, a detailed biochemical workup in the form of serum fasting lipid levels, fasting blood sugar, fasting insulin, and HOMA-IR2 is required to rule out systemic associations of FAN. It is important so that other measures like dietary modifications and physical exercises are taken to prevent progression of FAN. At present, the most common biochemical investigations used to assess glucose metabolism are fasting blood sugar levels and 2 h postmeal sugar levels that only help in detecting diabetes mellitus or prediabetes (impaired glucose tolerance). This is potentially misleading because the tests do not specifically detect IR which can be detected by serum fasting insulin levels and HOMA2-IR. Thus, a patient of FAN should be thoroughly evaluated for underlying systemic diseases like obesity, diabetes mellitus, and MS, even if there are no signs and symptoms suggestive of cardiovascular disease and MS.

Declaration of patient consent
The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

References
1. Panda S, Das A, Lahiri K, Chatterjee M, Padhi T, Rathi S, et al. Facial acanthosis nigricans: A morphological marker of metabolic syndrome. Indian J Dermatol 2017;62:483-9.
2. Misra A, Chowbey P, Makkar BM, Vikram NK, Wasir JS, Chadha D, et al. Consensus statement for diagnosis of obesity, abdominal obesity and the metabolic syndrome for Asian Indians and recommendations for physical activity, medical and surgical management. J Assoc Physicians India 2009;57:163-70.
3. Schwartz B, Jacobs DR Jr, Moran A, Steinberger J, Hong CP, Sinaiko AR, et al. Measurement of insulin sensitivity in children: Comparison between the euglycemic-hyperinsulinemlc clamp and surrogate measures. Diabetes Care 2008;31:783-8.
4. Sharquie KE, Al-Ogaily SM. Acanthosis nigricans as a cause of facial melanosis (Clinical and histopathological study). IOSR J Dent Med Sci 2015;1:84-90.
5. Verma S, Vasani R, Joshi R, Phiske M, Punjabi P, Toprani T, et al. A descriptive study of facial acanthosis nigricans and its association with body mass index, waist circumference and insulin resistance using HOMA2 IR. Indian Dermatol Online J 2016;7:498-503.
6. Uchida S, Oiso N, Suzuki T, Kawada A. Dermoscopic features of hyperpigmented dots in crista cutis in two siblings in a Japanese family with inherited acanthosis nigricans. J Cosmetics Dermatol Sci Appl 2012;2:252-3.
7. Sonthalia S, Gupta A, Jha AK, Sarkar R. Hyperpigmented disorders (disorders of pigmentation). In: Lallas A, Errichetti E, Ioannides D, editors. Dermoscopy in General Dermatology. London: CRC Press; 2019. p. 257-69.
8. Vinay K, Ankad BS. Dermatoscopic features of pigmentary diseases in ethnic skin. Indian Dermatol Online J 2021;12:24-33.
9. Maize JC, Ralston JS. Metabolic diseases of the skin. In: Elder DE, Eleniatis R, Rosenbach M, Murphy GF, Rubin AI, Xu X, editors. Lever’s Histopathology of the Skin. Philadelphia: Wolters Kluwer; 2015. p. 502-44.
10. Nirmal B. Dermatoscopy image characteristics and differences among commonly used standard dermatoscopes. Indian Dermatol Online J 2017;8:233-4.
11. Ankad BS, Drago NR, Koti VR, Nikam BP. Dermoscopic approach to hyperpigmented lesions in skin of color. Clin Dermatol Rev 2020;4:84-91.
12. Khopkar US, Bharti AH. Dermoscopy, trichoscopy & onychoscopy. In: Diseases of the Pigmented Skin: An Atlas and Short Text. 2nd ed. New Delhi: Jaypee Brothers Medical Publishers; 2020. p. 100-5.
13. Alexander M. Investigating unusual facial hyperpigmentation in darker skin 2006. Dermatology Times. Available from: https://www.dermatologytimes.com/view/investigating-unusual-facial-hyperpigmentation-darker-skin.
14. Sonthalia S, Sarkar R. Maturational hyperpigmentation. In: Lahiri K, Chatterjee M, Sarkar R, editors. Pigmentary Disorders: A Comprehensive Compendium. 1st ed. Philadelphia: Jaypee Brothers Medical Publishers; 2014. p. 430-3.
15. Sonthalia S. Maturational hyperpigmentation- A novel cutaneous marker of metabolic syndrome. J Cosmo Trichol 2017;3:c106.
16. Sonthalia S, Sarkar R, Neema S. Maturational hyperpigmentation: Clinico-dermoscopic and histopathological profile of a new cutaneous marker of metabolic syndrome. Pigment Int 2018;5:54-6.
17. Dharman BK, Sridhar S. Diffuse facial melanosis – An overview of etiology and dermoscopic findings. J Skin Sex Transm Dis 2020;2:86-93.