INTRODUCTION

Central centrifugal cicatricial alopecia (CCCA) is the most common cause of scarring alopecia among African–American women resulting in permanent hair loss. The etiology has been hypothesized to involve hairstyling practices and genetic predisposition for autosomal dominant inheritance.\(^1,2\) A recent publication demonstrated the upregulation of specific fibroproliferative genes in these women and another identified a common mutation in the \(PADI3\) gene of hair-shaft formation.\(^3,4\)

An epidemiologic study found a significant association with an odds ratio (OR) of 4.68, \(P < 0.001\) between CCCA and uterine leiomyomas.\(^5\) Given these associations, we hypothesized that hormones may play a role in the development of CCCA.

MATERIALS AND METHODS

The study was approved by the university institutional review board as a retrospective chart review and a telephone survey. Records of all African–American patients older than 18 years of age and seen by one of the authors were queried. These records were then screened for female pregnancy.
sex and the diagnosis of CCCA and all records identified under that category between January 1, 2013, and January 1, 2018, were reviewed. Exclusion criteria consisted of patients who were male, females under the age of 18 years, and who had diagnoses of “possible/rule out diagnosis” of CCCA in the chart. The diagnosis had been established by clinical presentation, history, physical examination including trichoscopy in all, and histopathology in most (66%). African–American patients without the diagnosis of CCCA but diagnosed with other hair loss conditions, as shown in Table 1, served as controls and were matched for sex, race, and age.

Two independent investigators conducted the retrospective chart review to collect data on demographics, medications, comorbidities, and altered hormonal states such as previous pregnancies. Data were also collected on the use of chemical relaxers and traumatic hairstyles. History of traumatic hairstyles included the use of tight braids, sewn-in weaves, and extensions. A telephone survey for the CCCA patients was subsequently performed by one of the investigators. Questions included number of pregnancies, history of lactation, diagnosis of fibroids, hysterectomy, and hormonal replacement therapy. In addition, more specific questions pertaining to hair care routines were asked such as hair products, salon visit frequency, emotional effect of the diagnosis, and monthly budget spent on hair products and therapies.

R Statistical software and R-studio were used to analyze the chart review data. Data from both cases and controls were analyzed using a logistic regression model to obtain the OR in the presence of more than one variable. ORs were calculated with 95% confidence intervals and \( P < 0.05 \) was considered significant. Data from this survey were summarized using standard descriptive summaries. For further details, see Figure 1.

### RESULTS

#### Chart review

A total of 187 records were initially retrieved and upon screening, 74 were identified as African–American women diagnosed with CCCA by one of the authors at the university dermatology outpatient clinic during the 5-year time period fulfilling the inclusion criteria. All patients included in this study were African–American women. The demographic and clinical features are summarized in Table 1.

According to the central scalp alopecia global photographic scale, the severity of CCCA in our patients ranged from IIA to VB. Concomitant hair loss conditions present in CCCA patients were noted to include either androgenetic alopecia, traction alopecia, frontal fibrosing alopecia, or Lichen planopilaris.

#### Table 1: Demographic and clinical features of our study population

| Features                     | Cases (74)** | Controls (96) |
|------------------------------|--------------|---------------|
| Mean age                     | 46.9         | 47.4          |
| BMI                          | 28.9         | 27.9          |
| Fibroids                     | 14 (18.9)    | 7 (7.3)       |
| Chemical relaxer use         | 64 (86.5)*   | 38 (39.6)     |
| Past traumatic hairstyles    | 49 (66.2)    | 42 (43.8)     |
| Comorbidities                | 44 (59.5)    | 59 (61.5)     |
| Oral contraceptive use       | 4 (5.4)      | 10 (10.4)     |
| Prior pregnancies            | 23 (31.1)*   | 5 (5.2)       |
| Other hair loss              | 23 (31.1)    | 9 (9.4)       |
| Biopsy performed             | 49 (66.2)    | 45 (46.9)     |

*Two independent investigators collected data from the electronic medical record on demographics, clinical presentation, comorbidities, and medications. **Logistic regression was used to calculate the odds ratio. *Statistically significant association with CCCA \( P<0.001 \)
Statistically significant associations were found between patients with CCCA and previous pregnancies and use of chemical relaxers. There were 23 patients (31%) with a history of at least one pregnancy at the moment of diagnosis versus only five (5%) in the control group ($P < 0.001$, OR 11.71). There were 63 patients with CCCA (85%) that had used and/or were currently using chemical relaxers as opposed to 39 patients in the control group ($P < 0.001$; OR: 12.37).

The most common systemic comorbidities in the CCCA group were diabetes mellitus (23%) and hypertension (61%) compared to diabetes mellitus (22%) and hypertension (56%) in the control group ($P > 0.05$).

**Telephone survey**

Of the 74 patients with CCCA, 29 (39%) agreed to participate in the telephone survey and answered questions, some of which are shown in Table 2. Fifteen (51.7%) women said that they actually spent more than $50 a month on hair care, while six (20.7%) women recounted spending more than $100 a month. Hair loss was the primary complaint in 20 (69%) patients and itch in seven (24%). Addressing the severity of interference of CCCA on their lives, 17 (59%) patients strongly agreed to styling their hair differently to cover their hair loss and three (10%) identified their diagnosis as severely interfering with their social lives. With regard to the emotional impact of CCCA, nine (31%) strongly agreed feeling embarrassed as a result of their hair condition, while ten (34.5%) agreed with that sentiment, and a total of 21 patients (72%) reported being frustrated with their diagnosis. In fact, six (21%) would have liked to have psychological support.

**DISCUSSION**

CCCA was first described in the 1950s as a “hot comb alopecia” since the continuous use of hot combs for hairstyling was considered the etiologic cause of it. Fifty years later was renamed by the North American Hair Research Society as CCCA.[6,7] It typically presents smooth and shiny on the central scalp and then spreads centrifugally.[8] Trichoscopy is characterized by loss of follicular openings, peripilar white-gray halo, brown patches, and occasionally, peripilar scaling.[9] Histology is the ultimate tool for the diagnosis: CCCA is classified as a lymphocytic cicatricial alopecia and is characterized by follicular drop out with compound follicular “goggle-like” structures surrounded by fibrosis and usually mild lichenoid inflammation.[10,11] Premature desquamation of the inner root sheath has also been considered common in CCCA.[12] Examples of histopathology are shown in Figures 2 and 3.

CCCA has been found to almost exclusively affect African–American women. According to the 2018 Census, 17.9% of Miami’s population consists of African–American people rendering significance to further investigation of a common entity such as CCCA.[13] Given the nature of CCCA being a permanent hair loss condition without cure or established therapeutic guidelines, there is a large potential for it to impact various aspects of patients’ lives. Our retrospective chart review along with a telephone survey adds to the literature data from 74 cases of CCCA compared to race-, age-, and sex-matched controls regarding comorbidities, hormonal factors, and lifestyle implications. We identified two statistically significant associations of CCCA with previous pregnancies and the use of chemical relaxers.

**Pregnancy**

There is a major change in hormone levels during pregnancy, with increases in estrogen, progesterone, and beta-human
Narasimman, et al.: Prior pregnancy and chemical relaxer use in CCCA

While the increased association of CCCA with previous pregnancies is a novel, previously unreported finding, the results from Aguh’s study also indirectly point to a hormonal link due to the increased prevalence of uterine leiomyomas. Uterine fibroids are benign tumors of the myometrium which have been found to be hormonally linked to estrogen: estrogen causes upregulation of progesterone receptor expression which then results in fibroid proliferation. In general, the prevalence of fibroids ranges from 4.5% to 68.6% depending on diagnostic methodology, and women are usually diagnosed with fibroids around the age of 50 years. Of note, our study did not find a significant increase in the prevalence of uterine fibroids (leiomyomas). The discrepancy in this finding could be due to the interinstitutional difference in sample size and inclusion criteria; in our study, the use of trichoscopy (100%) and dermoscopy-guided scalp biopsy (66%) allowed to confirm the diagnosis of CCCA prior to recruitment including patients with early-stage presentations and patients of younger average age (46.9 years).

We did not find a significant association between the use of oral contraceptives and CCCA, but this could be due to patients seeking primary care or gynecological outside of our institution resulting in our lack of access to these records.

Relaxers

There was a significant association between chemical relaxers and CCCA in our study ($P < 0.001$). Using chemical relaxers can break down the chemical bonds in hair shafts and weaken the hair follicle structure, thus allowing for inflammation and trauma to render negative follicular effects. Compared to Caucasians, African descendants have 30,000 less hair follicles to begin with and as such may see more scalp exposure upon use of chemical relaxers. The absence of inner root sheaths may also contribute to the follicular susceptibility for destruction. While most studies have shown no statistically associated risk between CCCA and chemical relaxers, majority have been based on surveys or recruitment screenings lacking trichoscopy and scalp biopsies. The comparative data are summarized in Table 2. A retrospective survey of hair grooming practices in 118 African–American women with CCCA over the span of 7 years showed no significant correlation between the use of chemical relaxers and CCCA ($P = 0.99$). In this study, a unique survey tool collecting demographic information, family and hair grooming history, and duration of hair grooming practices was used. Surveys were sent out to the 118 women identified with CCCA in the study and 51 responses were received to be compared to the 50 responses from the 312 controls who did not have CCCA. Similar results were revealed by a cross-sectional survey in Cleveland, Ohio of 326 African–American women investigating medical and environmental risk factors for CCCA. This study utilized a questionnaire given out to 326 African American women at a church and subsequently performed a scalp examination to grade the hair loss and presence of CCCA which was then correlated with the use of chemical relaxers. In contrast, a study done in Nigeria produced the results aligning with ours; a significant association between the increased use of chemical relaxers and CCCA was found. Thirty-nine women seen over the span of 12 months were enrolled in this study and their response to chemical relaxer use was analyzed. Of these women, it was found that those who had prolonged and more frequent use of chemical relaxers more commonly had scarred alopecia than those who did not use chemical relaxers ($P < 0.0001$). These varying

**Figure 2: Central centrifugal cicatricial alopecia on horizontal sections: there is altered follicular architecture with follicular dropout and only focally preserved sebaceous lobules and fragmented hair shafts (H and E, ×2)**

**Figure 3: On high power, there are compound follicles with perifollicular concentric fibrosis and lichenoid lymphocytic infiltrate (H and E, ×10)**
conclusions regarding the same factor could indicate the need for a larger, multicenter study to better clarify such an association.

**Other associated findings**

Diabetes has been previously associated with CCCA as in our study, although we did not find it statistically significant.[8,21]

Although based on a small sample, our study brought to light more specific information regarding the emotional effects of CCCA. We found the presence of frustration, embarrassment, interference of social lives, and the need for psychosocial support all as a result of CCCA. Of note, while 65.5% of the interviewed reported feeling embarrassed due to their hair loss, only 20.7% would have liked some level of psychological support in dealing with it. Another interesting result was that 27.5% of those surveyed did not agree with the belief that their hair loss was permanent. This begs the question of how well do our CCCA patients truly understand their hair loss condition. A study performed at Northwestern University found that 82% of the 34 black women with CCCA they surveyed felt embarrassed, frustrated, or self-conscious as a result of their hair loss. Although these results were not significant, they did indicate an effect on self-esteem and quality of life by CCCA.[24] Another study conducted by Haskin et al. used an open-ended individual interview process with 10 patients with scarring alopecia that elucidated a significant emotional and psychological impact from their diagnosis.[25]

Potential limitations of this study include its retrospective design and smaller sample size as well as the loss to follow-up in many of our CCCA patients, patients seeking care outside of our hospital system which further demonstrates the demotivation and frustration associated with this diagnosis. The paucity of physician experience with African–American hair has been noted to be a remarkable barrier to women with CCCA seeking health care.[24]

To solidify the possible hormonal factor in CCCA based on our results, a multicenter prospective study should examine the association between prior pregnancies and CCCA, lactation history, oral contraceptive pills use, hormone replacement therapy, and association with androgen-dependent conditions such as polycystic ovarian syndrome (PCOS), acne, and hirsutism.[26]

**CONCLUSION**

We identified an association between previous pregnancies and use of chemical relaxers in patients diagnosed with central centrifugal cicatricial alopecia when compared to controls. These findings may help to plan prospective studies aimed at establishing a more concrete link between hormones and CCCA.

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**Conflicts of interest**

There are no conflicts of interest.

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