The Effect of Menstrual Cycle on Laser Induced Hyperpigmentation

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Background and Objective: Laser induced post inflammatory hyperpigmentation PIH, is a complication seen mostly in dark skinned patients, it is not known whether giving the laser treatment at specific menstrual period days, may predispose to PIH.
Methods: Seven volunteers underwent fixed fractionated CO_2 laser treatments at four predetermined days spanning the menstrual cycle.
Results: Two volunteers developed hypopigmentation while the rest had hyperpigmentation. In those who developed PIH, the pigmentation was most severe when done just before or after menstruation.
Conclusions: Laser induced PIH risk may be influenced by the menstrual cycle.

Post inflammatory hyperpigmentation PIH, remains a major hurdle in treating a variety of conditions in skin of color, it is a complication seen in many procedures, such as cutaneous lasers and chemical peels.[1] This is especially true with ablative resurfacing lasers, with rates reaching up to 32%.[2] The mechanism behind it is unclear, but it is well known that patients with darker skin are at risk. Other risk factors such as sun exposure and certain laser parameters have been recognized.[3]

Despite precautions, PIH is still unpredictable and may arise after a couple of laser treatments, even when using the same laser parameters. This forces many to lower laser fluencies, for safety concerns which may ultimately reduce the overall efficacy or even have paradoxical results as the case with paradoxical hypertrichosis secondary to laser hair removal.[4]

Hormones are linked to the physiology and pathology of skin pigmentation. The skin's physical properties change dramatically in relation to different phases of the menstrual cycle.[5] Such factors may modify the skin's response to the laser treatment. For example, Melasma is a chronic pigmentary disorder, is known to be precipitated by pregnancy and oral contraceptive pills.[6] It is unknown whether having laser treatments at specific menstrual cycle days, corresponding to different hormonal levels, may increase the risk of developing PIH, therefore would be better deferred to "safer days" where higher fluences can be given with confidence. For those reasons an experimental study is undertaken to study the outcome of fractionated CO_2 laser treatments given at four predetermined days of the menstrual cycle to seven volunteers.

Materials and Methods

Laser treatment were given at four different days spanning their menstrual cycle to their right inner arms in one month duration. Volunteers who are having menses with skin type III or more are recruited. Exclusion criteria included pregnancy, those who are taking oral contraceptive pills, keloid prone patients and those who had isotretinoin within the last year. The purpose and the nature of the study were explained to the volunteers and the study was approved by the ethical committee.

Treatment days were predetermined by a method used in natural family planning,[7] calculating the next anticipated day of menstruation, NADM by adding the cycle length to the date of the first day of the last menstrual period. Four specific days are chosen because they represent important hormonal milestones in the menstrual cycle and span the whole month. All patients started their first laser treatment midway into the follicular phase of the menstrual cycle. This is calculated by subtracting

21 days from the NADM. Second treatment coincides with maximal estrogen secretion and it is calculated by subtracting 15 days from the NADM. The third treatment is calculated by subtracting 7 days from NADM and coincides with maximal progesterone secretion. Finally the last and fourth treatment is done just prior to menses by subtracting

1 day from NADM. A CO_2 fractionated laser device (Lutronic CO_2™) was used using a 1000 micrometer tip, with a spot size of 5 mm, a fluency of 160 mJ and a density of 20%. Photographs were taken at 2 and 3 months to grade for dyspigmentation. Photos were graded with a seven grade visual pigmentation scale, with grade 1 being the mildest pigmentation and grade 5 being the darkest. Grade 0 denotes no change and grade -1 is for hypopigmentation. The grading is for each of the four treatments at two time points; eight and twelve weeks after the last treatment.

Results

All Seven patients completed the study with all treatments being tolerable with no anesthesia necessary. As shown in Table 1, four patients developed PIH, one had no pigmentary changes and two patients developed mild hypopigmentation. The scores of hyperpigmentation ranged from 1 to 4.

In those who developed hyperpigmentation, three out of four patients had their maximal PIH at either the beginning and/or the end of the menstrual period on their first and fourth treatments, in other words, except for one volunteer, the pattern was that of a deeper PIH when laser treatment is given just before or after the menstrual period. The lowest scores were seen at the second treatment, which corresponds to the day just before ovulation.

Discussion

The first and fourth treatments corresponds to phases of the menstrual cycle where both estrogen and progesterone have lower values, it's not clear why would such time points have higher scores in this study. It might be that these days closer to menses, where half of normal women were found to have darker skin than usual.[8] It would have been interesting to test during menses, where in addition to the luteal phase, lower thresholds for pain were found.[9] Painful laser treatments,

TABLE 1.

Scores of Dyspigmentation											
				Scores at 2 months				Scores at 3 months			
Patient number	Age	Skin type	Period length	1st Rx	2nd Rx	3rd Rx	4th Rx	1st Rx	2nd Rx	3rd Rx	4th Rx
1	43	V	25/4	-1	-1	-1	-1	-1	-1	-1	-1
2	39	V	28/5	1	3	3	2	1	3	3	3
3	37	IV	28/4	0	0	0	0	0	0	0	0
4	34	III	30/6	4	1	2	2	4	0	2	1
5	40	III	28/5	3	2	1	4	2	1	0	4
6	32	V	30/5	1	0	0	1	1	0	0	1
7	27	III	31/4	-1	-1	-1	-1	-1	-1	-1	-1

Table 1 shows the scores for pigmentation both at, two and three months after the last treatment for each site (based on a visual pigmentation score, with 1 being the mildest pigmentation, 5 being the darkest, 0 for no change and -1 for hypopigmentation). Period length is given as such: total duration/menses duration.

which usually coincide with more intense treatments may predispose to hyperpigmentation.

Two patients developed mild hypopigmentation in all treatment sites. In both patients it was observed that the hypopigmentation was localized to the treatment area at the Centre, with a rim of hyperpigmentation surrounding it. Perhaps this could be explained by the fact that maximal heating occurs at the Centre where a certain threshold is exceeded, and hypopigmentation occurs. Away from the center and below that threshold, melanocytes are stimulated and hyperpigmentation occurs. The laser parameters implemented in this study are not routinely used in clinical practice, but have been used in this study to induce hyperpigmentation in small treatment areas. After all, the aim of the study was not to measure the rate of laser-induced hyperpigmentation but to detect any effect of menstrual cycle on the risk of developing hyperpigmentation. The other interesting finding is that unlike in PIH, when hypopigmentation occurred, it did in all areas regardless to the menstrual phase, probably because it is more related to the laser settings.

The biggest challenge was to score the four treatments in a standardized manner. Since the treatments were given at different time points, and the pigmentation in each treatment site evolves at a different time frame, it was important to score later (3 months), where this issue is less pertinent. Nevertheless, the score pattern didn't change dramatically from 2 to 3 months further undermining any time bias. Furthermore, if the menstrual cycle was irrelevant to pigmentation risk, a pattern were the scores were the same allover or trending to a higher or lower score from the first to the last treatment is more likely.

Even though the study was done on a fractionated CO_2 laser, such results might be extrapolated to other lasers and other surgical procedures such as chemical peels and cryotherapy where PIH is a possibility. Likewise, other complications might be linked to menstruation. For example prolonged erythema and crusting seen post hair removal precedes hyperpigmentation and itself might be related to the timing of the menstrual period. Other sporadic complications such as paradoxical hypertrichosis and folliculitis might also be influenced by hormonal variations.

One might argue that these findings are mere random events. Stress, sun exposure and other hidden factors may play a role too. It would be interesting to duplicate these results on the same patients at later menstrual periods. In conclusion, a larger study is necessary to confirm the association of laser induced post inflammatory hyperpigmentation to menstruation and define the days at which it is safest to have laser treatments.

Disclosures

The author has not disclosed any relevant conflict of interest.

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