



Innovative Use of Negative Air Ions As an Alternative Therapy for Acne Vulgaris: A Report of Three Cases

Hye Sung Han, Guk Jin Jeong, Hae Woong Lee¹, Joo Hyun Shim², Seong Jun Seo, Kui Young Park

Department of Dermatology, Chung-Ang University College of Medicine, Seoul, ¹Louis Dermatologic Clinic, Guri, ²Department of Dermatology, National Police Hospital, Seoul, Korea

Received May 8, 2020
Revised July 25, 2020
Accepted August 23, 2020

Corresponding Author

Kui Young Park
Department of Dermatology, Chung-Ang
University Hospital, 102 Heukseok-ro,
Dongjak-gu, Seoul 06973, Korea
Tel: +82-2-6299-1525
Fax: +82-2-6299-1718
E-mail: kyky@caumc.or.kr
<https://orcid.org/0000-0001-5965-1754>

Acne vulgaris is a universal skin disease with multifactorial pathogenesis. Although an extensive range of treatment options exist for acne, a substantial number of patients are still struggling for an optimal treatment option due to the side effects or contraindications to the conventional acne treatment. Negative air ions (NAIs) are electrically charged molecules that naturally exist in the atmosphere. Since they are natural component of air, there are no known side effects and contraindications to their application. Furthermore, among the identified benefits of NAIs, certain mechanisms are related to acne pathogenesis, allowing them to be attractive candidates for acne treatment. Here, we describe three patients with acne who showed considerable clinical improvement after NAI therapy. All of the patients had failed to tolerate traditional acne treatment options. In all three cases, considerable improvement was observed in acne severity and the number of total lesions. Based on the three cases and a review of literature underlying the effects of NAIs, we suggest that NAIs may be a safe and effective alternative therapeutic option for acne vulgaris.

Keywords: Acne vulgaris, Complementary therapies, Negative air ions

INTRODUCTION

Acne vulgaris is a common disease of pilosebaceous units, characterized by the release of inflammatory mediators, hyperkeratinization, increased sebum production, and colonization by *Cutibacterium acnes*¹. It is a universal skin disease affecting more than 85% of adolescents, and accounts for more than 30% of patients visiting dermatology clinics². The current treatment guideline suggests various treatment options, such as topical or oral antibiotics and retinoids, with qualified evidence³. However, these treatment options may be accompanied by various side effects such as antibiotic resistance or skin irritation and be contraindicated for a substantial number of patients who are young, preparing for pregnancy, or have underlying internal diseases. Owing to these limitations, the general public has been opting for more natural and safer treatment options such as complementary and alternative medicine but the evidence for these treatments is often lacking⁴.

Negative air ions (NAIs) are electrically charged molecules that naturally exist in the atmosphere⁵. Many experiments have been performed utilizing NAIs, due to their advantage of being natural components of air without any side effects. Dermio Care[®] (Weyergans High Care AG, Western Rhineland, Germany) is a novel facial treatment device that relies on highly concentrated NAIs, which enrich the surrounding oxygen. The device generates 5.5×10^6 negative ions/cm³ that encounter the facial skin under a protecting helmet (Fig. 1). The treatment procedure is highly tolerable, and it does not cause any pain or irritation.

We report of three patients with acne who showed considerable clinical improvement after NAI therapy. Patients who had failed to tolerate common treatment methods were selected as candidates for NAI therapy. All patients were instructed to use the same cosmetic products that they had been using before the treatment. NAI therapy was performed using Dermio Care[®], which was applied twice a week for 20 minutes in each treatment session. Written informed consent was obtained from the

patients and their guardians to publish the photographs and clinical results. To the best of our knowledge, this is the first clinical report regarding NAI therapy for the treatment of acne.

CASE REPORT

Case 1 is that of a 12-year-old girl (Fitzpatrick skin phototype [FST] IV) who presented to our clinic with facial acne. On presentation, she had moderate facial acne with Global Acne Assessment Score (GAAS) (Supplementary Table 1) of 2. Prior to her visit, she had undergone multiple sessions of chemical peeling and acne extraction but had voluntarily stopped the treatment owing to pain and irritation. The patient's mother had refused administration of topical antibiotics and retinoids because of the young age of the patient. On presentation, the patient had multiple erythematous papules on her cheek and perioral area (Fig. 2A). As part of the protocol, she was treated with Dermio Care[®] twice a week for 4 weeks, resulting in a total of 8 treatment sessions. Significant improvement was observed on photographic follow-up after 8 sessions of treatment (Fig. 2B).

Case 2 is that of a 14-year-old girl (FST IV) who presented to our clinic with acne lesions that had repeatedly aggravated for 2 years. On presentation, she was graded as GAAS score of 2 with several inflammatory papules and closed comedones on her forehead (Fig. 3A). Prior to her visit, she had been prescribed with topical benzoyl peroxide/clindamycin but had been nonadherent to the treatment owing to skin irritation and inconvenience of daily application. She was treated using the

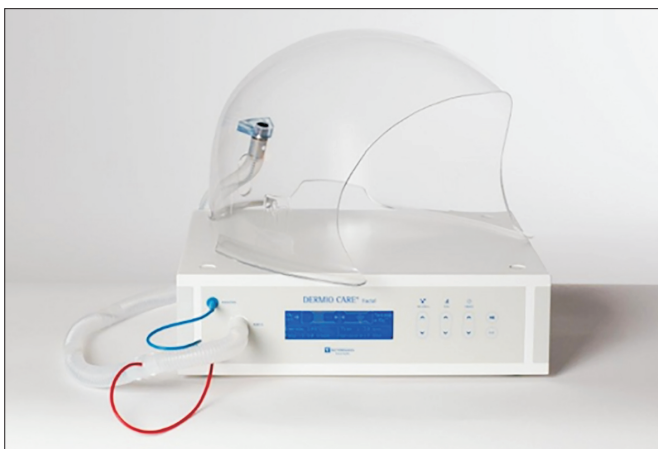


Fig. 1. Dermio Care[®] (Weyergans High Care AG, Western Rhineland, Germany), a novel facial treatment device that relies on highly concentrated NAIs that enrich the surrounding oxygen.

same protocol as used for Case 1, and she tolerated the procedure very well. After 4 weeks of treatment (8 sessions in total), notable improvement of acne lesions was observed (Fig. 3B).

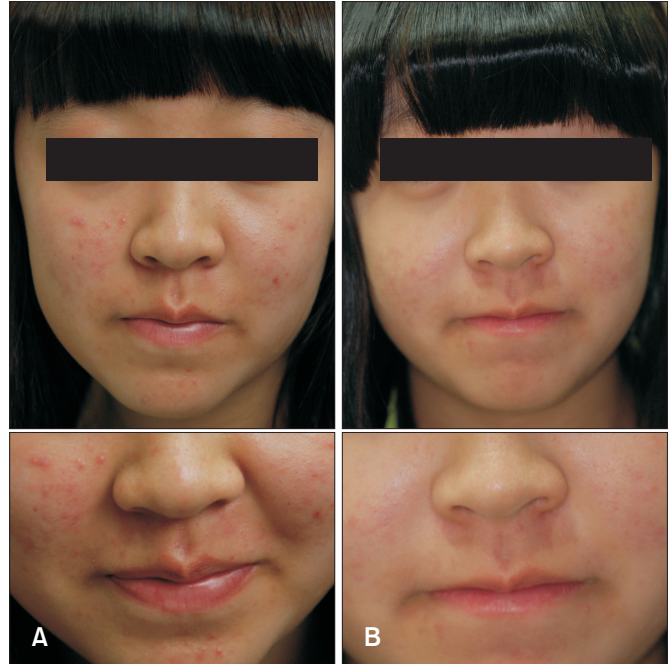


Fig. 2. Case 1: a 12-year-old girl, Fitzpatrick skin phototype IV, with mild-to-moderate acne vulgaris. (A) Patient at baseline before treatment and (B) after 8 sessions of negative air ions treatment.

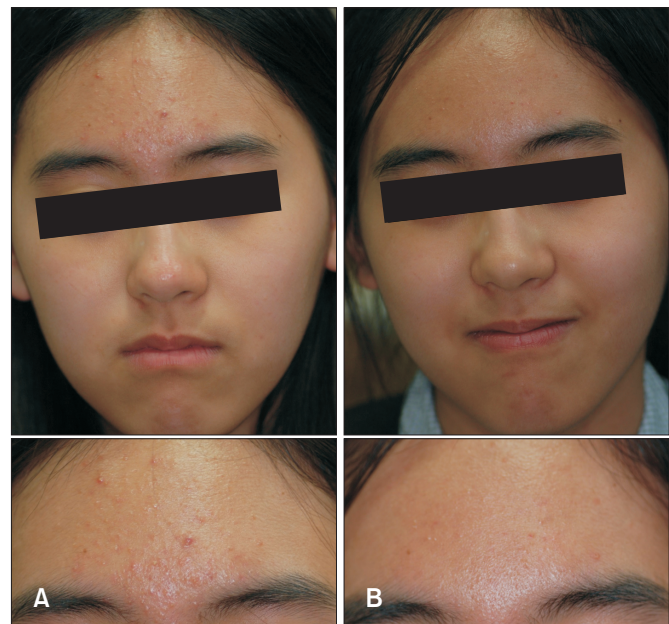


Fig. 3. Case 2: a 14-year-old girl, Fitzpatrick skin phototype IV, with mild-to-moderate acne vulgaris. (A) Patient at baseline before treatment and (B) after 8 sessions of negative air ions treatment.



Fig. 4. Case 3: a 21-year-old male, Fitzpatrick skin phototype IV, with mild-to-moderate acne vulgaris. (A) Patient at baseline before treatment and (B) after 6 sessions of negative air ions treatment.

Case 3 is that of a 21-year-old Asian male (FST IV) who presented to our clinic with acne lesions on his mandibular area. On presentation, he was graded as GAAS of 2 with multiple inflammatory acne lesions and brown-colored macules, indicative of post-inflammatory hyperpigmentation (Fig. 4A). Prior to his visit, he had been treated with topical retinoids but had suffered from skin irritation and had voluntarily discontinued the treatment. After 3 weeks of NAI treatment (6 sessions in total), a visible reduction in acne lesions as well as post-inflammatory hyperpigmentation were noted (Fig. 4B).

In all three cases, notable clinical improvement was observed in the severity of acne and the number of total lesions (GAAS score 0 or 1). None of the patients reported any adverse effects of the treatment.

DISCUSSION

The possible therapeutic mechanism of NAIs on acne may be summarized as follows: 1) resolution of the reactive oxygen species (ROS), 2) control of inflammation by activating natural killer (NK) cells, and 3) positive effects on emotions and behaviors.

First, several animal studies have revealed that ROS are significantly reduced upon exposure to NAIs⁶. Further, the activity of erythrocyte cytosolic superoxide dismutase (SOD) was considerably increased after pretreatment with NAIs⁷. These

results suggest that the NAIs reduce ROS by stimulating SOD, which converts superoxide into hydrogen peroxide. Oxidative stress plays an important role in the pathogenesis of acne. Previous studies have shown that lipid peroxidation is the driving force behind comedogenesis, and neutrophil-derived ROS is involved in acne inflammation⁸. Thus NAIs may render therapeutic effects on acne lesions by targeting such ROS-related pathogenesis of acne.

Second, a previous animal study showed that NAIs significantly enhanced the cytotoxic activity of NK cells⁹. The role of NK cells in the pathogenesis of acne has rarely been studied. However, its role in synovitis-acne-pustulosis-hyperostosis-osteomyelitis (SAPHO) syndrome, a chronic inflammatory condition in which acne is the central cutaneous manifestation, has been recently recognized. The proportion and absolute counts of NK cells were considerably reduced in patients with SAPHO, resulting in an uninhibited upregulation of T helper type 17 and 1 (Th17/Th1) cell response¹⁰. Interestingly, the Th17/Th1 cell response is enhanced by *C. acnes* and is thought to be an important immunologic process in the development of acne¹¹. Therefore, it can be speculated that NAIs, by enhancing the cytotoxic activity of NK cells, may reduce inflammation induced by *C. acnes*.

Last but not least, several studies have suggested that anxious or agitated individuals experience relief upon exposure to NAIs¹². Others have shown that NAIs exert protective effects

against acute and chronic stress¹³. The anti-stress effects of NAIs are explained by serotonin-mediated arousal mechanisms and their antihypoxic effects¹⁴. Stress is a well-known aggravating factor of acne, and is highly correlated with acne severity¹⁵. This association is explained by the stress-induced hormones inducing sebaceous hyperplasia or the stress-related neuroactive substances activating inflammation¹⁶. As a result, the positive effects of NAIs against stress may preserve acne against stress-induced aggravation and inflammation.

Based on the three clinical cases of acne patients successfully treated with NAIs, we have discussed the possible mechanisms underlying the effects of NAIs. However, the above-mentioned mechanisms should be further investigated in order to investigate the direct mechanism of action of NAIs on acne. Furthermore, all our patients were young Asians with FST IV, who presented with mild-to-moderate acne (GAAS score 2). Therefore, further studies on larger-scale populations and comparative studies evaluating NAI as a monotherapy vs. in combination with other therapeutic modalities are warranted.

In conclusion, based on these preliminary clinical results, we suggest that NAI therapy has the potential to be an easy, safe, and effective alternative adjuvant therapy for acne. Although NAI therapy may not be considered as a curative therapy, it can be regarded as a valuable adjuvant and complementary treatment for acne. As the general public has been showing an increasing interest in more natural and safer treatment options, it is necessary to further investigate alternative therapeutic options for the treatment of acne vulgaris^{4,17}.

SUPPLEMENTARY MATERIALS

Supplementary data can be found via <http://anndermatol.org/src/sm/ad-34-216-s001.pdf>.

CONFLICTS OF INTEREST

The authors have nothing to disclose.

FUNDING SOURCE

None.

ORCID

Hye Sung Han, <https://orcid.org/0000-0002-3556-0740>
 Guk Jin Jeong, <https://orcid.org/0000-0002-2379-0370>
 Hae Woong Lee, <https://orcid.org/0000-0001-7688-1172>
 Joo Hyun Shim, <https://orcid.org/0000-0003-1496-6984>
 Seong Jun Seo, <https://orcid.org/0000-0003-2915-839X>
 Kui Young Park, <https://orcid.org/0000-0001-5965-1754>

REFERENCES

- Scholz CF, Kilian M. The natural history of cutaneous propionibacteria, and reclassification of selected species within the genus *Propionibacterium* to the proposed novel genera *Acidipropionibacterium* gen. nov., *Cutibacterium* gen. nov. and *Pseudopropionibacterium* gen. nov. *Int J Syst Evol Microbiol* 2016;66:4422-4432.
- Williams HC, Dellavalle RP, Garner S. Acne vulgaris. *Lancet* 2012;379:361-372. Erratum in: *Lancet* 2012;379:314.
- Thiboutot DM, Dréno B, Abanmi A, Alexis AF, Araviiskaia E, Barona Cabal MI, et al. Practical management of acne for clinicians: an international consensus from the Global Alliance to Improve Outcomes in Acne. *J Am Acad Dermatol* 2018;78(2 Suppl 1):S1-S23.e1.
- Fox L, Csongradi C, Aucamp M, du Plessis J, Gerber M. Treatment modalities for acne. *Molecules* 2016;21:1063.
- Kosenko EA, Kaminsky YuG, Stavrovskaya IG, Sirota TV, Kondrashova MN. The stimulatory effect of negative air ions and hydrogen peroxide on the activity of superoxide dismutase. *FEBS Lett* 1997;410:309-312.
- Livanova LM, Levshina IP, Nozdracheva LV, Elbakidze MG, Airapetyants MG. The protective effects of negative air ions in acute stress in rats with different typological behavioral characteristics. *Neurosci Behav Physiol* 1999;29:393-395.
- Jiang SY, Ma A, Ramachandran S. Negative air ions and their effects on human health and air quality improvement. *Int J Mol Sci* 2018;19:2966.
- Akamatsu H, Horio T. The possible role of reactive oxygen species generated by neutrophils in mediating acne inflammation. *Dermatology* 1998;196:82-85.
- Yamada R, Yanoma S, Akaike M, Tsuburaya A, Sugimasa Y, Take-miya S, et al. Water-generated negative air ions activate NK cell and inhibit carcinogenesis in mice. *Cancer Lett* 2006;239:190-197.
- Chong WP, van Panhuys N, Chen J, Silver PB, Jittayasothorn Y, Mattapallil MJ, et al. NK-DC crosstalk controls the autopathogenic Th17 response through an innate IFN- γ -IL-27 axis. *J Exp Med*

- 2015;212:1739-1752.
11. Kistowska M, Meier B, Proust T, Feldmeyer L, Cozzio A, Kuendig T, et al. Propionibacterium acnes promotes Th17 and Th17/Th1 responses in acne patients. *J Invest Dermatol* 2015;135:110-118.
 12. Sulman FG, Levy D, Levy A, Pfeifer Y, Superstine E, Tal E. Air-ionometry of hot, dry desert winds(Sharaw) and treatment with air ions of weather-sensitive subjects. *Int J Biometeorol* 1974;18:313-318.
 13. Baron RA. Effects of negative ions on cognitive performance. *J Appl Psychol* 1987;72:131-137.
 14. Livanova LM, Levshina IP, Nozdracheva LV, Kurochkina EV, Elbakidze MG, Aïrapetians MG. [The prophylactic effect of negatively charged air ions in acute stress in rats with different typologi-
cal behavioral characteristics]. *Zh Vyssh Nerv Deiat Im I P Pavlova* 1996;46:564-570. Russian.
 15. Chiu A, Chon SY, Kimball AB. The response of skin disease to stress: changes in the severity of acne vulgaris as affected by examination stress. *Arch Dermatol* 2003;139:897-900.
 16. O'Sullivan RL, Lipper G, Lerner EA. The neuro-immuno-cutaneous-endocrine network: relationship of mind and skin. *Arch Dermatol* 1998;134:1431-1435.
 17. Magin PJ, Adams J, Pond CD, Smith W. Topical and oral CAM in acne: a review of the empirical evidence and a consideration of its context. *Complement Ther Med* 2006;14:62-76.