Control of Palmar Hyperhidrosis with a New "Dry-Type" Iontophoretic Device

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BACKGROUND Palmar hyperhidrosis is characterized by excessive sweating on the palm, and among the various treatment modalities, tap water iontophoresis has been widely used.

OBJECTIVE The objective of this study was to assess the effect of a new ''dry-type'' iontophoretic device that was locally manufactured and did not use tap water to control sweating.

METHODS Ten subjects with palmar hyperhidrosis were enrolled in this study. To be treated the patients were instructed that they only have to grasp the device. Only one palm was treated for 2 weeks, and then the treatment was discontinued the following next 2 weeks. The other palm was not treated as a control. At the end of second week, biopsy specimens were obtained from untreated and treated palm, respectively, and examined histologically.

RESULTS Nine of 10 patients were satisfied with this therapy reducing their sweat outputs from 33% to 51% of baseline at the end of 2 weeks' treatment, and after 2 weeks of discontinuation of treatment sweat productions returned to near baseline. The pathologic examinations showed some occlusions and destruction of intraepithelial eccrine ducts only in the treated palm.

CONCLUSION We suggest that dry-type iontophoresis could reduce palmar sweating more conveniently than other conventional methods.

The authors have indicated no significant interest with commercial supporters.

Palmoplantar hyperhidrosis is usually localized to the palms and soles and may become worse in warm temperatures and with emotional stresses. It could occasionally cause a number of serious conditions that can affect daily life, relationships, and careers.[1] Although it can be autosomal dominantly inherited in some cases,[2] it is not an uncommon benign disease of unknown etiology. A variety of treatments have been used to control or reduce the profuse sweating of the palms, soles, and axillae. A topical aluminum chloride solution has been frequently used as a first line of treatment, although it may be unsuccessful. With surgical treatment options, an endoscopic transthoracic sympathectomy is effective in eliminating sweating of the hands in the majority of patients. It could be associated with complications that may be unacceptable for the treatment of a benign condition, however. Recent data have demonstrated botulinum toxin type A (BTX-A) as a treatment option in some circumstances.[3] Among these therapeutic options, tap water iontophoresis has been widely used for several decades. Commercial iontophoretic units can be easily available for home use in these days, use but these also need a pan of water in which hands or feet are immersed.[4,5]

We thought the palm was already immersed with sweating by the hyperhidrosis condition so that the tap water for iontophoresis may not be needed. Here, we introduce a new device, "dry-type iontophoresis," named by us, which uses only patient's sweat itself, and all one must do is grasp the device.

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Materials and Methods

Ten subjects (7 men and 3 women) with palmar hyperhidrosis were enrolled in this study. Their mean age was 23.5 years ranging from 18 to 34 years, and all subjects were otherwise healthy without psychiatric problems, diabetes, or thyroid diseases. All patients signed an informed consent that was approved by our institutional review board. The study protocol conformed to the guidelines of the 1975 Declaration of Helsinki.

The dry-type iontophoretic unit consisted of a central insulating plastic tube and double-helix stainless wires that were directly connected with a 9-V dry battery installed in the device. It permitted the electric current up to 25 mA using a current limiting semiconductor. The electric current was ergonomically regulated from 5 to 25 mA according to the hyperhidrotic condition, because profuse sweating conditions permit higher current, and low sweating, lower current. Patients were instructed that the device should be grasped gently like holding an egg and then should be moved slightly or rolled every 5 minutes to change the site of the grasped position, which maximizes the anhidrotic effects of the iontophoresis (Figure 1). They were asked to use the device for 30 minutes daily on one hand in the first week and every other day in the following week; the treatment was then discontinued to evaluate the remission period for 2 weeks. The other hand was not treated with the device as a negative control. The sweat intensity was measured on Days 0, 14, and 28 using a pad glove method described by Karakoc et al.[5] Briefly, pad gloves made from gauze material and surgical gloves were prepared and weighed on an electronic scale with a sensitivity of 0.001 g. The patients then applied the pad gloves to both hands. The surgical gloves were placed over the top. Patients waited in a comfortable and stress-free room for 1 hour. At the end of 1 hour, the pads were carefully removed so as to avoid sweat evaporation and immediately reweighed. Results of the sweat intensities were given as grams per hour. The biopsy specimens were obtained after 2 weeks of treatment from both the treated and the untreated hands, which were examined histologically with hematoxylin-eosin stain and periodic acid-Schiff stain.

Figure 1. Grasping of the device for palmar hyperhidrosis. The palm near the wrist and volar aspect of the thumb were not contacted with the electric wires; hence these areas were less effective.

Results

In general, all patients improved their hyperhidrotic conditions; however, 9 of 10 patients were satisfied with this therapy reducing their sweat outputs from 33% to 51% of baseline. The person who was unsatisfied with this therapy reduced his sweat production by approximately 25%. Although this score was significant statistically, he was subjectively not satisfied with the result. After the final treatment, sweat production decreased on average 42.7% in the treated palm versus 1.8% in the untreated palm, which was statistically significant ($p < .001$). During

TABLE 1. Comparison of Sweat Intensity between Treated and Untreated Palms (± SD)

	Before treatment (g/h)	*After 2 weeks' treatment (g/h)*	*2 weeks after discontinuation (g/h)*
Treated palms	4.282 ± 0.41	2.457 ± 0.37*	3.502 ± 0.43*
Untreated palms	4.189 ± 0.29	4.016 ± 0.31*	4.091 ± 0.38*

Note. Paired *t* test:*$p < .001$.

the 2-week follow-up after discontinuation of treatment, the treated palms continued to show a statistically significant decreased sweat output compared with that of untreated palms ($p < .001$; Table 1).

Side effects noted were erythema and mild local burning. Darkly stained lines developed undesirably on the treated palm, which was more likely to be produced when the grasped position was fixed during the treatment. The darkly stained lines were more likely to develop in the first treatment but tended to be less produced as the treatment went by and were removed easily by hand-washing (Figure 2).

The pathologic examinations showed some occlusions and destruction of intraepithelial eccrine duct only in the treated palm. The horny layer of the treated palm was thinner than that of untreated palm. Lymphocytes were slightly more infiltrated in the dermis of the treated palm than in the untreated control (Figure 3).

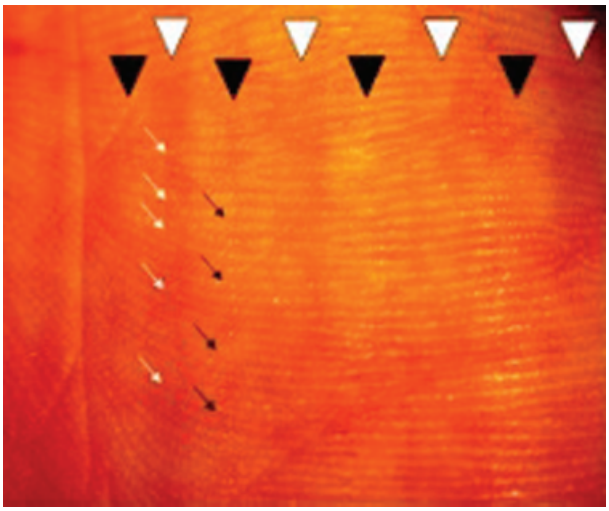

Figure 2. Stereoscopic view (× 10) after single 5-minute grasping of the device. The areas contacted with negative electrode (anode, white arrow) stained darkly but small beads of sweat were shown in the sites contacted with the positive electrode (cathode, black arrow). Therefore, it is postulated that the negative electrode had more of an inhibitory effect than the positive electrode.

Discussion

Palmar hyperhidrosis is a source of significant discomfort and sometimes may cause social embarrassment and occupational distress. Primary idiopathic hyperhidrosis is not uncommon disease of unknown etiology. Some studies estimated the incidence of idiopathic hyperhidrosis to be 0.6% to 1.0%.[1,6] Many treatments have been proposed including such techniques as topical and systemic agents, iontophoresis, BTX-A injections, and surgical sympathectomy. These methods also have many advantages and good constant results, but often have some limitations in high cost in BTX-A injections and the fact that sympathectomy is an invasive procedure, which often has some undesirable effects such as compensatory hyperhidrosis. So the optimal treatment still remains as a challenge.

Of all these options, tap water iontophoresis for the treatment of hyperhidrosis has long been known to inhibit sweating[4,7] and treats hyperhidrosis with minimal undesirable effects. Clinical experience, however, is that many patients feel iontophoresis to be time-consuming and inefficient. In addition, iontophoresis should not be used in pregnancy or in the presence of cardiac pacemakers and metal implants.[3] It is also necessary for the patient to be treated with iontophoresis repeatedly to maintain control of sweating because hyperhidrosis tends to be a chronic problem. So these factors might cause

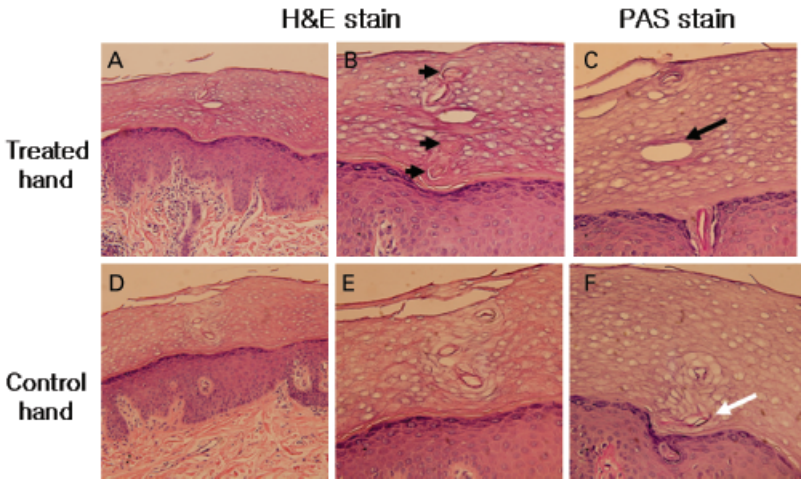

Figure 3. Biopsy specimens from the treated palm showed some occlusions of the intraepidermal eccrine ducts (arrowheads) and dermal lymphocytic infiltrations, but these changes did not occur in the untreated palm (hematoxylin-eosin, original magnifications: (A) and (D), × 100; (B) and (E), × 400). Some loss of periodic acid-Schiff (PAS)-positive stainability in the intraepidermal ducts of the treated palm (black arrow) was found compared with that of the untreated palm (white arrow; PAS, original magnification: (C) and (F × 400).

less compliance and lower response in the treatment of hyperhidrosis with iontophoresis. In that point of view, some home care units such as Drionic (General Medical Co., Los Angeles, CA), which flows DC current through the palm surface within one hand, seems to be one useful method. They also use tap water and have some limitations in its application on the palm, however. Namely, they always need to be positioned horizontally not to be spoiled around with tap water, so they can be used only at home, having difficulty in being carried. Moreover, iontophoresis might be less effective when it is used at home where the users are calmed down to reduce their sweat, because we have observed in personal inspection that the electric current tends to decrease when the user is calmed down, but the same user does not tend to decrease the electric current during emotional stress or when doing some type of activity.

In this DC application method using the patient's sweat itself as the medium of electric currents, there were no limitations in use. It can be used at any time in daily life, such as while studying, driving, watching TV, walking, or jogging because it does not use any water or chemicals and is compact in size, very convenient for carrying around. So this dry-type iontophoresis would achieve the possibility of better compliance and response with a better availability for use.

Sweating was reduced less effectively in the areas of the thenar and hypothenar that were not fully contacted with the electric wires, as shown in the Figure 1. Hence in practical usage, the users were asked to expose the spared areas to the device by rolling it between both palms.

Iontophoresis has been postulated to lead to hyperkeratinization and subsequent obstruction of the eccrine sweat duct unit. This has been challenged, however, by a study in which light microscopy and transmission electron microscopy of posttreatment skin biopsy specimen failed to show morphologic changes.[8] In this study, some intraepithelial eccrine sweat ducts were occluded in some biopsy specimens but not in others as shown in Figure 3. Therefore, it is suspected that anhidrosis from iontophoresis could be partially related with the eccrine ductal obstruction, although the actual mechanism of inhibition is unknown.

Sato and coworkers reported that decreased pH in the sweat duct due to an increase in H^+ ions during

tap water iontophoresis may contribute to eccrine gland dysfunction.[9] In this study, a stereoscopic view of palm after a single 5-minute treatment showed that the sites contacted with electric wire which was connected to anode of battery stained darkly but no changes occurred in the sites contacted with cathode as shown in Figure 3. Hence it is postulated that anode has a better inhibitory effect on sweating than cathode and it may be related with H^+ or other positive ions, and the users were recommended to move or roll the device frequently during the treatment for the prevention of darkly stained lines.

Some authors propose that iontophoresis may cause a functional impairment of the sweat gland, by completely blocking sympathetic nervous system transmission to the gland, raising the threshold for transmission of sympathetic nerve impulse, or changing the cellular secretory physiology.[10]

This machine needs patient's sweat for the current to work, so if the patient would achieve near euhidrosis after treatment, the presence of euhidrosis may prevent further efficacy of the machine. To maintain the euhidrosis state, it is recommended to use this machine in certain sweat-producing states like jogging.

In summary, this dry-type iontophoresis could control the palmar hyperhidrosis using patients' own sweat as a medium for DC current instead of tap water.

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