Pharmacology and therapeutics

Safe control of palmoplantar hyperhidrosis with direct electrical current

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Abstract

Background Primary (idiopathic) hyperhidrosis is a benign disease of unknown etiology, leading to the disruption of professional and social life and emotional problems. A variety of treatment methods have been used to control or reduce the profuse sweating. In this study, we report the efficacy of direct current (d.c.) administration in the treatment of idiopathic hyperhidrosis.

Methods One hundred and twelve patients with idiopathic hyperhidrosis were enrolled in the study. Initial sweat intensities of the palms were measured by means of the pad glove method. The patients were treated in eight sessions with d.c. administration using a complete regulated d.c. unit based on tap water iontophoresis. The final sweat intensities of responders were determined 20 days after the last treatment. Nonresponders returned earlier than 20 days, with final sweat intensities measured at least 5 days after the last treatment. In 26 responders, plantar hyperhidrosis was also treated. After the first remission period, the second of eight treatments was applied to the palms of 37 responders.

Results This therapy controlled palmar hyperhidrosis in 81.2% of cases. The final sweat intensities of the palms of responders were significantly reduced after eight treatments ($P < 0.001$). The first average remission period was 35 days. Minimal undesirable effects were noted.

Conclusions This technique appears to control hyperhidrosis on the palms and soles only if regular treatment is applied. Plantar hyperhidrosis appeared to resolve simultaneously when palmar hyperhidrosis was successfully treated.

Introduction

Hyperhidrosis is excessive sweating in response to emotional and other stimuli. Primary (idiopathic) hyperhidrosis is a benign disease of unknown etiology, leading to the disruption of professional and social life and emotional problems. It is not uncommon. One study estimated the incidence of idiopathic hyperhidrosis to be 0.6–1.0%.[1,2] A variety of treatments have been used to control or reduce the profuse sweating involving the palms, soles, and axillae.[1,3–7] Electrical treatments for hyperhidrosis were used in the 1930s. The publication of a description of a simple device for iontophoresis has led to a revival of interest in this subject.[8] The process of tap water iontophoresis has long been known to inhibit sweat production.[9,10]

In this study, we evaluated the effectiveness and safety of direct current (d.c.) administration in 112 patients with idiopathic hyperhidrosis.

Materials and methods

One hundred and twelve patients with idiopathic palmoplantar hyperhidrosis were enrolled in the study. The clinical and laboratory findings of the patients were considered as well as their history of hyperhidrosis. All patients in whom the nature of hyperhidrosis was suitable for d.c. treatment were informed about the procedure. Palmar and plantar areas were inspected in order to detect any contraindication, such as cuts or vesicles. The palmar sweat intensities of both hands were determined using the pad glove method described by Kalkan *et al.*[11] For these measurements, pad gloves made from gauze material and surgical gloves were prepared and weighed on an electronic scale with a sensitivity of 0.0001 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 h. At the end of 1 h, the pads were carefully removed so as to avoid sweat evaporation and immediately re-weighed. Results of the sweat intensities were given as g/h. D.c. treatment was applied to the palms of the patients using a complete regulated d.c. unit, with current and potential ranges of 0–30 mA and 0–90 V, respectively. Positive and negative electrodes, which were both applied to a single hand or a single foot, were installed ergonomically on an insulating fiberglass material with a gap of 1.5 cm (Fig. 1). The electrodes were covered with pad made from gauze and cotton material. The pads were moisturized with tap

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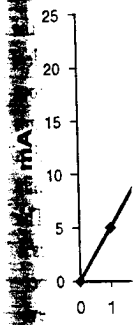

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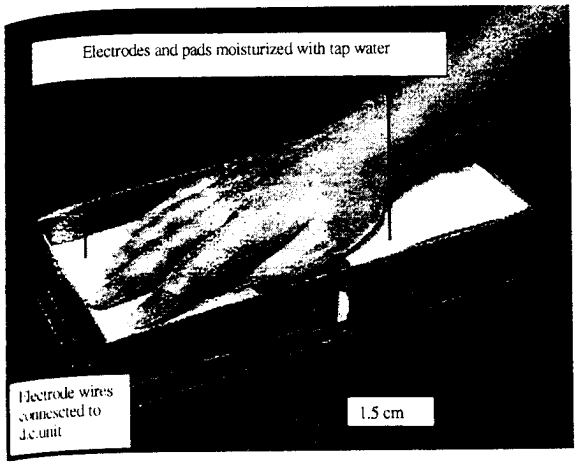

Figure 1 Illustration of electrode position for palmar and plantar hyperhidrosis

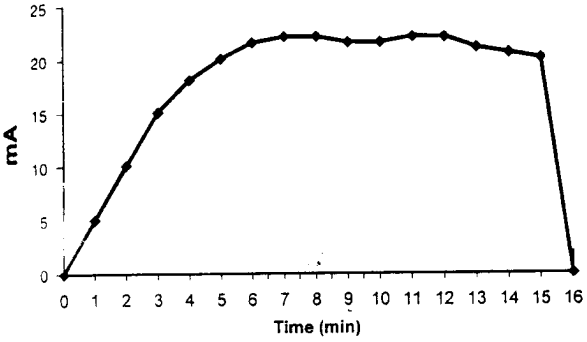

Figure 2 Average values of direct current applied for palmar hyperhidrosis in 15-min time period

water for current conduction. Eight applications were performed on days 1, 2, 4, 7, 11, 16, 21, and 28. The current limit was slowly increased from 0 to 10–15 mA during the first 3 min, and was increased to the maximum tolerable limit. According to each patient's comfort, the current level was adjusted to a normal tolerable limit and was maintained at this level until the end of the session. The time was restricted to 15 min for each hand. At the end of current administration, the level was slowly decreased to zero within 1 min (Fig. 2). As it was more effective, anodal current was applied to the proximal area of the palms during the first four treatments, and the polarity of the electrodes was changed for the remainder of the eight treatments.[9] During the application period, the envisaged schedule was changed for some patients because of minimal damage of the palms caused by undesirable effects of d.c. treatment. In these cases, the next treatment was postponed until the discomfort resolved. Undesirable effects were noted at any time during therapy.

After a total of eight treatments on the palms, patients returned 20 days after the last treatment for measurement of their final sweat intensities. They also noted the recurrence time of hyperhidrosis.

The final sweat intensities of responders were measured 20 days after the last of eight treatments. The final sweat intensities of nonresponders were measured when they returned to complain about their unsatisfactory results within 20 days after the last treatment (at least 5 days after the last treatment).

Most of the responders explained that, after treatment for palmar hyperhidrosis, plantar hyperhidrosis was not observed and it was not necessary to treat plantar hyperhidrosis. We also inspected the dryness of the soles and socks of responders after treatment for palmar hyperhidrosis. Twenty-six responders, however, were not satisfied with the reduction in plantar hyperhidrosis after treatment for palmar hyperhidrosis. Plantar hyperhidrosis was treated in these patients with the same procedure after the final sweat intensities of the hands had been determined.

The effectiveness of d.c. treatment for palmar hyperhidrosis was evaluated by sweat intensity measurements. Data were analyzed by Student's *t*-test and the average values were calculated. Recurrence of hyperhidrosis within 20 days of the last treatment was defined as a negative response. The evaluation of plantar hyperhidrosis was made from patients' complaints and inspections of the soles and socks, because sweat intensity measurement of the soles was not possible by the pad glove method.

After the first remission period had ended, a second course of eight treatments was applied to the palms of 37 responders, and the second remission period was investigated within 6 months of the first treatment session. At this time, the sweat intensities of the palms were not determined.

Results

One hundred and twelve subjects were enrolled in the study [50 (45%) male and 62 (55%) female]. The average age of the patients was 20.34 ± 4.9 years, ranging from 8 to 32 years. The location of hyperhidrosis was palmar only in 7.1%, palmoplantar in 78.6%, and palmoplantoaxillar in 14.3%. Factors that led to the activation of hyperhidrosis in our cohort are shown in Table 1. Emotional stimuli were noted in 89.2% and another common finding was familial history (53%). None had psychiatric problems or elevated levels of blood glucose or thyroid hormones.

The initial sweat intensities of the palms were found to be 2.98 ± 1.19 g/h on the right side and 3.04 ± 1.32 g/h on the left side before treatment. The final sweat intensities of

Table 1 Classification of the major activating parameters in idiopathic hyperhidrosis

Activating parameter	(%)
Family history	53.5
Emotional stimuli	89.2
Thermal activation	60.0
Mechanical activation	21.4

Table 2 Sweat intensities of both hands pre- and post-treatment (± SD, g/h)

Sweat intensity (g/h)	Right hand	Left hand
Initial (total) (n = 112)	2.98 ± 1.19	3.04 ± 1.32
Final (responders) (n = 91)	0.39 ± 0.12*	0.52 ± 0.15*
Final (nonresponders) (n = 21)	2.82 ± 0.98	2.91 ± 1.02

*P < 0.001, difference from initial data.

Table 3 Minimal and temporary undesirable effects of direct current on the palms and soles. Data show number of patients

	Erythema	Vesicle	Discomfort from burning
Palms	10	8	16
Soles	2		4
Total	12	8	20

responders measured 20 days after the last treatment were 0.39 ± 0.12 g/h on the right side and 0.52 ± 0.15 g/h on the left. These changes were significant at P < 0.001 for both sides. In 21 cases (nonresponders), the decrease in sweat production of the palms was not significantly different from the initial data (P > 0.05). Table 2 shows the sweat intensities of the patients measured before and after the first eight treatments. Therapy controlled palmar hyperhidrosis in 81.2% of patients after the first eight treatments. The average first remission period was 35 ± 6 days. In 65 responders, plantar hyperhidrosis was resolved secondary to palmar treatment, until the resumption of palmar hyperhidrosis. The second remission period was found to be 48 ± 9 days after the second course of eight treatments had been applied to the palms of 37 responders.

Undesirable effects were erythema, local burning, and vesicular formation on the palms or soles. Erythema was seen in 12 patients and vesicular formation in eight. Twenty patients complained of temporary burning (Table 3). "Pin and needles" sensation also occurred in all cases.

Discussion

Many techniques have been used to treat palmoplantar hyperhidrosis. Recent popular therapeutic options include sympathectomy or botulinum toxin, and several side-effects have been reported.[3,12–17] Shelley *et al.* described the effect of iontophoresis on sweat glands. Tap water iontophoresis for the treatment of hyperhidrosis was described by Boumann and Grunewald-Lentzer and Levit.[18] This technique treats hyperhidrosis with minimal undesirable effects.

During the postoperative period after thoracic sympathectomy for palmar or axillary hyperhidrosis, compensatory sweating is seen in 56–67% of patients at short- and long-term follow-up.[3,12–14] In the immediate postoperative period, atelectasis, pneumonia, pneumothorax, and hemothorax have been reported.[13] Long-term complications include Horner syndrome, neuralgia, gustatory sweating, and phantom sweating.[13,14]

The effect of botulinum toxin in decreasing sweat output was observed for a variable period ranging from 5 to 14 months. Reported side-effects were a slight decrease in hand muscle strength, slight and transient reduction of the power of the fingertip, temporary pain, and burning during injection.[15–17]

D.c. application decreases sweat output on the palms, soles, and axillae. The mechanism of action is not clear. Two mechanisms have been postulated. The first involves pore occlusion of sweat ducts secondary to hyperkeratinization and the second involves impairment of the electrochemical gradient of sweat output.[7–9] The electrothermal, electrochemical, and electrophysiological effects of d.c. treatment may involve both mechanisms.

In our study, 81.2% of patients were satisfied with the beneficial effects of d.c. treatment. This group of responders had an average first remission period similar to that of previous reports.[4,6,19] In 21 patients, this treatment had no significant effect. Two patients were not affected by d.c. administration at any time during the treatment period. Patients with a family history of hyperhidrosis made up 53% of our cohort. The relationship between idiopathic hyperhidrosis and genetics is not clear, however. The effect of emotional stimuli on hyperhidrosis is common in these patients, as pointed out previously.[20] Emotional stimuli and genetics may be two major factors in the etiology of palmoplantar hyperhidrosis.

The location of hyperhidrosis was generally palmoplantar. When palmar hyperhidrosis was treated, the soles responded simultaneously in 65 responders. This interesting observation indicates that a biofeedback mechanism may be involved. The therapy program also appears to be an important factor in the achievement of a desirable reduction in sweat production.

Conclusions

Our study demonstrates that d.c. administration based on tap water iontophoresis controls palmar hyperhidrosis after a total of eight treatments. Plantar hyperhidrosis may be ameliorated simultaneously when palmar hyperhidrosis is treated. The therapy program appears to be an important factor in the achievement of a beneficial effect of d.c. administration. Plantar hyperhidrosis may also be controlled by this technique. After the first remission period has ended, a second course of eight treatments gives better results than the first.

D.c. administration is safe, effective, and easy to use for the treatment of palmar and plantar hyperhidrosis. This technique should be offered to patients with palmoplantar hyperhidrosis prior to surgical intervention or botulinum toxin injection.

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