Effectiveness of Iontophoresis in Treating Plantar Hyperhidrosis

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Background: The purpose of this study was to evaluate the effectiveness of tap water iontophoresis as a treatment for plantar hyperhidrosis.

Methods: Thirty participants living with idiopathic plantar hyperhidrosis and consented to undergo treatment using iontophoresis were recruited. The Hyperhidrosis Disease Severity Score was used to evaluate the severity of the condition before and after treatment.

Results: Tap water iontophoresis was found to be effective in the treatment of plantar hyperhidrosis in the study group (P = .005).

Conclusions: Treatment with iontophoresis led to the reduction of disease severity and improvement of quality of life, and it is a safe, easy-to-use method with minimal side effects. This technique should be considered before the use of systemic or aggressive surgical interventions, which could have potentially more severe side effects. (J Am Podiatr Med Assoc 113(1), 2023)

Hyperhidrosis is a disorder characterized by excessive sweating, more than what is required for normal thermoregulation.[1] It can affect both children and adults, and although it is not life threatening, it interferes with patients' daily activities and may lead to emotional problems and psychological concern.[2] Almost half of those who self-identify as having excessive sweating do not discuss their symptoms with health-care professionals despite the severe negative impact on their quality of life because they believe that hyperhidrosis is not a medical condition and that no treatments exist.[3] In a survey conducted by the International Hyperhidrosis Society, 48.9% of patients waited 10 or more years before seeking medical help for their excessive sweating.[4] Once accepted as a medical disorder, patients spend much time and effort managing this condition to try to overcome it, which restricts them from many daily activities and poses huge problems, such as social phobia. In addition, excessive sweating, if left untreated, can lead to odor production, and in severe cases, can result in skin maceration and eventually trigger secondary infections, such as tinea pedis, viral warts, and dermatitis. Furthermore, health-care professionals underestimate what patients with hyperhidrosis experience daily, including obstacles that many people without hyperhidrosis would never consider, such as multiple daily showers, extra changes of clothing, difficulty opening doors, and feelings of depression and anxiety.[5]

Hyperhidrosis is a condition in which the eccrine glands secrete a large amount of sweat. These glands are morphologically and functionally normal in people living with palmoplantar hyperhidrosis; however, when these people become emotional or stressed, hyperhidrosis is stimulated.[2] Hyperhidrosis can be divided into primary/idiopathic and secondary types. Primary hyperhidrosis is localized to the palms, soles, axillae, and face. It is caused by intense emotion or stress and it affects patients mainly during waking hours. Secondary hyperhidrosis can be localized or generalized and is associated with another systemic disorder such as genetic syndromes; malignancy; infection; endocrine, vasomotor, or neurologic disorders; and drugs.[6] The majority of hyperhidrotic patients have normal morphology of sweat glands, but there is an abnormal response to stimulation of sweat glands by the hypothalamus.

A large number of therapeutic options are available for the treatment of hyperhidrosis. These include topical therapy, iontophoresis, oral medications (anticholinergic, α-adrenergic blockers), and

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surgical therapy. All these treatments have been reported to have their advantages and disadvantages. The medical treatment for hyperhidrosis has been reported to be ineffective in all but the mildest of cases.[7] Furthermore, some of these are irritating and cause staining of the skin. Sympathectomy, although effective, has potential complications and is rarely considered as an alternative.[8]

Tap water iontophoresis has long been known to inhibit sweat production; however, the mechanism of reduced hyperhidrosis by iontophoresis is not completely clear.[9] Iontophoresis is described as the introduction of an ionized substance through intact skin by the application of direct current. Iontophoresis is a noninvasive method of propelling bioactive, ionically charged substances transdermally by using an electromotive force generated from small electric charge interactions. Literature suggests that the electric charge generated causes the stratum corneum to thicken and subsequently blocks the sweat glands. Reported to have been used as early as 1740 to treat arthritis, iontophoresis is a simple process. Hands and feet are placed in shallow, water-filled trays, and an electrical current charges the water at a level comfortable for the user.[10] The process sends a light electrical current through the tray contents to ionize the particles in the water, which then pass into the skin. Theories are available as to how the ionized particles interfere with the sweating process. Some ideas are that the ionized particles may plug the sweat gland or interrupt the nerve signal, but no definite conclusion has been suggested.[11]

Iontophoresis treatments take between 20 and 40 min and need to be repeated frequently at first. Over time, follow-up treatments may be needed only every week or every month, depending on the person. Only minor side effects have been reported when using tap water iontophoresis, and these include skin irritation with erythema, vesicle formation, slight pain, or paresthesia in the treated areas.[2]

Iontophoresis is not commonly used by clinicians in treating hyperhidrosis in daily clinical practice. Further research of the use of iontophoresis is warranted to better understand the use and benefit of this technology in the treatment of hyperhidrosis in a podiatric clinical setting because only a few studies have been published in this field. Notwithstanding the positive results confirming that the therapy is safe when used on other body parts such as treatment for focal hyperhidrosis,[12] further studies could shed light on the effectiveness of this treatment on plantar hyperhidrosis. This study was carried out to evaluate the effectiveness of iontophoresis on the treatment of plantar hyperhidrosis. Results of this study aim to provide health-care professionals with key information on the clinical effectiveness of this specific noninvasive treatment for plantar hyperhidrosis.

Methods

Thirty randomly selected subjects living with plantar hyperhidrosis were included in this study. Significant hyperhidrosis was defined as excessive sweating at the palms and soles resulting in a social or occupational handicap. This study was approved by the university research ethics committee and all participants were provided with trial information sheets, and written informed consent was obtained before any data collection. All investigations were carried out in accordance with the principles of the Declaration of Helsinki.

Subjects were eligible for entry in the study if they were older than 18 years and had used no other treatment for plantar hyperhidrosis while being treated with iontophoresis. Iontophoresis is contraindicated and subjects were excluded from study if they were making use of cardiac pacemakers or prostheses, had ulcerations or other wounds, or were pregnant or breast-feeding. Patients had to complete all seven sessions of treatment as described later in this article. The testing modality was carried out by the same investigator to ensure uniformity.

Iontophoresis Protocol for the Study

The iontophoresis apparatus consisted of a source box of direct current with a direct current power supply, two electrodes, and an electrode pad. The procedure of the treatment was explained to the patients. It was also ensured that no injuries were present on the feet of the subjects. Foot bracelets or toe rings worn by the patient were removed before treatment.

Iontophoresis was used in a private clinical setting. Very limited published data on successful treatment protocols are available.[10] However, for the purpose of this study, patients received treatments at different intervals as recommended by the manufacturer of the iontophoresis unit. The treatment involved seven sessions for a duration of 4 weeks; each session lasted approximately 20 min. Subjects were asked to visit the clinic on days 1, 2, and 4 in the first week. During the second week, subjects were asked to visit the clinic twice; and in

the third and fourth weeks, subjects were asked to visit the clinic once.

During each session, the feet of the subjects were placed in a shallow plastic tray containing enough tap water to cover them. The anode and electrode were also immersed.[13] The machine was switched on at a minimum current, and the current was slowly increased until the patient felt mild discomfort. Water and room temperature were maintained at 20°C for all subjects. Each treatment session lasted 10 min. Patients were instructed not to try to remove their feet from the pans while the current was flowing, because this could result in a shock.

Hyperhidrosis Disease Severity Scale

Following informed consent, subjects were asked to complete the Hyperhidrosis Disease Severity Scale (HDSS). This scale was used to assess the quality of life and severity of the condition before and after treatment.

The HDSS[14] is a disease-specific, quick, and easily understood diagnostic tool that provides a qualitative measure of the severity of the patient's condition based on how it affects daily activities. The questions that make up the scale may be posed to the patient in written or interview form. The patient is asked to select the statement that best reflects his or her experience with sweating of the specified body area. Next to each statement is a number that indicates how responses should be scored. A score of 3 or 4 indicates severe hyperhidrosis. A score of 1 or 2 indicates mild or moderate hyperhidrosis. After treatment, as part of a measurement of treatment efficacy and patient satisfaction, the HDSS may be administered again. A one-point improvement in HDSS score has been associated with a 50% reduction in sweat production and a two-point improvement with an 80% reduction. The validity and reliability of the HDSS have been analyzed in three studies and have been found to have strong to moderate correlations with the Hyperhidrosis Impact Questionnaire, the Dermatology Quality of Life Index, and gravimetric sweat production measurements.[15]

Results

The χ^2 test was used for analysis of data. The statistical significance was determined at the level of $P = .05$.

A total of 30 participants, five men (16.7%) and 25 women (83.3%), presenting for the first time with untreated plantar hyperhidrosis were included in the study. Forty-three percent of the participants were aged between 18 and 25 years, 36.7% were aged between 26 and 35 years, and 20% were aged between 36 and 50 years. It was found that 82.8% (n = 29 of 30) of the participants were affected with hyperhidrosis in their hands and their feet. Furthermore, 17.2% were also affected in both their hands and their armpits. When interviewed, participants reported that factors prompting excessive sweating were stress (66.7%) and social events (53.3%). The lowest percentage of factors was that of food and drink (10%) and certain type of clothing (6.7%).

As illustrated in Table 1 and Figure 1, the χ^2 test was used to calculate the difference in hyperhidrosis severity before and after being treated with seven sessions of tap water iontophoresis. In this study, sweat production was reduced in 36.7% of the study population after treatment by 80%. In addition, 33.3% of the participants had a reduction in sweat production by 50%, and 30% of the participants reported no improvement after treatment. A significant difference ($P = .005$) was found in the mean HDSS scores before and after treatment.

Discussion

Very few studies have been conducted on the effectiveness of iontophoresis for the treatment of plantar hyperhidrosis. Indeed, most of these studies are

Table 1. HDSS Score Before and After Treatment

How do you rate the severity of your hyperhidrosis?[a]	Treatment		Total (%)
	Before (%)	After (%)	
My sweating is never noticeable and never interferes with my daily activities	1 (3.3)	9 (30.0)	10 (16.7)
My sweating is tolerable but sometimes interferes with my daily activities	7 (23.3)	10 (33.3)	17 (28.3)
My sweating is barely tolerable and frequently interferes with my daily activities	6 (20.0)	6 (20.0)	12 (20.0)
My sweating is intolerable and always interferes with my daily activities	16 (53.3)	5 (16.7)	21 (35.0)
Total	30 (100.0)	30 (100.0)	60 (100.0)

[a] $\chi^2 = 12.69$, v = 3, $P = .005$.

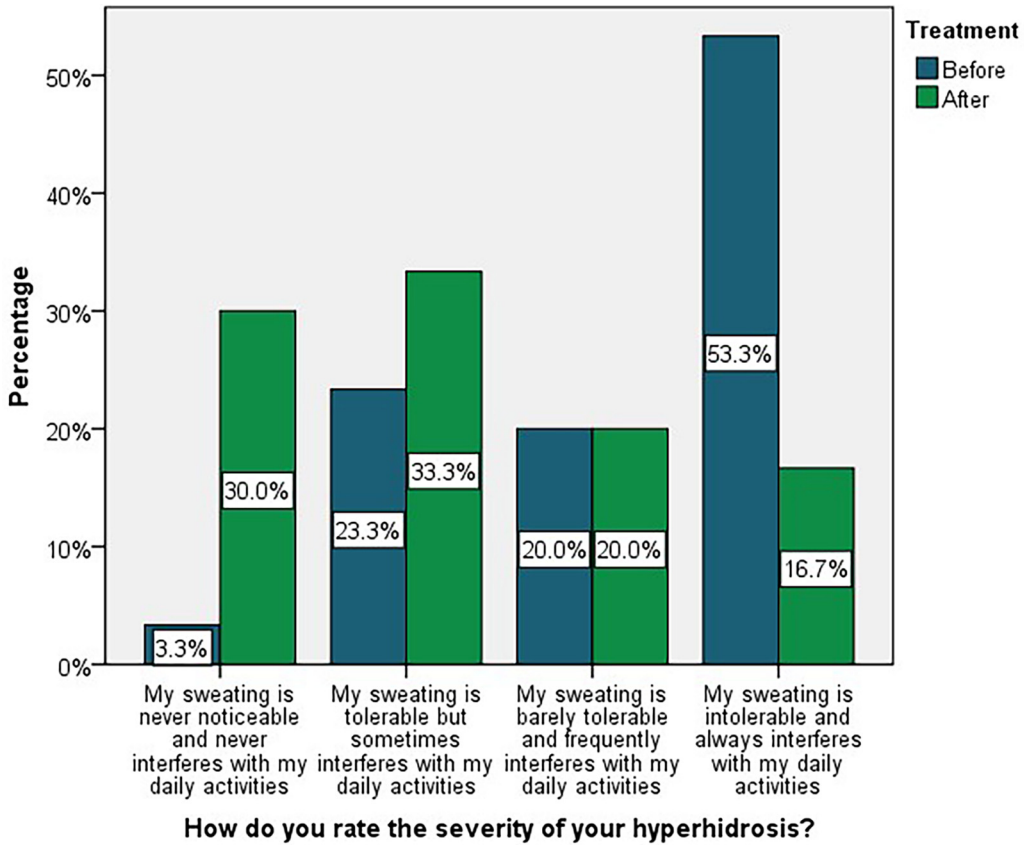

Figure 1. Hyperhidrosis Disease Severity Scale score before and after treatment.

old and there is a paucity of recent studies using this technique; thus, this method is not widely used in podiatric practice.[16] This study clearly demonstrates the efficacy of tap water iontophoresis in the treatment of plantar hyperhidrosis and improvement in quality of life in the study population, because the majority of participants reported reduced sweat production. The study results are congruent with those of Haider et al,[17] who concluded that iontophoresis is effective in 90% of cases when treating hyperhidrosis. A major advantage of iontophoresis is that it is free from side effects, is comfortable for the patients, and remains effective for approximately 4 to 5 weeks, sometimes even longer, depending on the individual.[17]

Iontophoresis is a simple, economical, and effective therapy that should be offered to patients with plantar hyperhidrosis before any invasive treatment.[2] Health-care professionals who are knowledgeable about hyperhidrosis and available treatments may be more likely to diagnose this condition and may be more comfortable beginning the sensitive dialogue about how excessive sweating might be affecting the patient's quality of life.[18] Although most patients present with primary hyperhidrosis, an accurate assessment must be made to rule out secondary causes of hyperhidrosis to tailor treatment appropriately and effectively with the aim of improving the patient's quality of life. Furthermore, health-care professionals need to be provided with education on the mechanisms of action and the benefits of iontophoresis, evidence of its use, and creation of a patient-specific plan of use/care inside a clinic and documenting its efficacy. This will assist future researchers in correlating more findings and generating a better understanding of the use of tap water iontophoresis in the treatment of plantar hyperhidrosis. Continued treatment is recommended to maintain its effect. An adequate treatment plan should be devised for each individual case according to the severity of the condition. This technique should be considered before the use of systemic or aggressive surgical intervention, which could have potential side effects.

Limitations

The sample size (n = 30) may be considered relatively small. Ideally, larger cohorts would be recruited

to increase the statistical power of the study results. Ideally, a larger prospective study should be conducted to confirm whether tap water iontophoresis could be included as an alternative treatment modality in podiatric and dermatologic clinics for the treatment of plantar hyperhidrosis. Participants should also be followed up to confirm the duration of the effectiveness of a seven-treatment program using tap water iontophoresis. The addition of pharmacologic agents to the water can enhance the efficacy of iontophoresis.[19] In patients who reported no improvement to simple tap water iontophoresis, such therapy might be useful.

Conclusions

Iontophoresis was found to be effective in the treatment of plantar hyperhidrosis in the study group. Iontophoresis should not be overlooked as a primary treatment of plantar hyperhidrosis in podiatric and dermatologic clinics. Further research is warranted to further investigate and explore the clinical efficacy of iontophoresis. Improved care could result in improved quality of life in people presenting with hyperhidrosis and improved outcomes.

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