Efficacy of pulsed direct current in tap water iontophoresis in treating primary palmar hyperhidrosis in pediatrics

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INTRODUCTION

Hyperhidrosis is a disorder of excessive sweating beyond what is physiologically necessary for thermoregulation. Primary hyperhidrosis is localized; it can affect the axillae, palms, soles, face, and other areas and is idiopathic. Palmar hyperhidrosis is a common condition in which the eccrine (sweat) glands of the palms secrete inappropriately large quantities of sweat. The condition may become socially and professionally debilitating. Idiopathic palmoplantar hyperhidrosis begins in childhood before age of 20 and frequently runs in families. Hyperhidrosis have negative effects on a patient’s social, professional, psychological, and physical well-being and negatively impacting occupational and daily activities. Hyperhidrosis prevalence is estimated to be 2.8% of the population, and onset is often in childhood or adolescence. Despite being relatively common, this condition is widely under diagnosed and under treated, particularly in pediatric patients. Historically, iontophoresis was used for a lot of conditions, including vitiligo and scleroderma. Currently tap water iontophoresis is considered to be the first line of treatment for hyperhidrosis of the palms and soles, the mechanism of action is currently not understood. Direct current treatments are normally fine when treating the feet, but if you need to treat other areas such as hands, underarms, face, neck or torso you will require pulsed current as pulsed current gives a far milder treatment. Chan et al., (1999) concluded that tap water iontophoresis is a safe and useful treatment modality for palmar hyperhidrosis. Gillick et al., (2004) described the use of tap water galvanism (TWG) using direct current (DC) with a patient who had postsurgical hyperhidrosis. The patient was a 36-year-old male electrician with traumatic phalangeal amputation and postsurgical development of hyperhidrosis. Literatures showed lack of controlled studies that reported the therapeutic effect of tap water iontophoresis using pulsed direct current on palmar hyperhidrosis in pediatrics. Therefore the current study was carried out to explore the therapeutic effect of using pulsed direct current in tap water iontophoresis as a treatment for primary palmar hyperhidrosis in pediatrics.

METHODS

Subjects: Twenty children diagnosed with primary palmar hyperhidrosis participated in this study (10 boys and 10 girls). Their ages ranged from 12 to 16 years.

Methods: The patients received 4 weeks of treatment with TWI using pulsed direct current. The treatment was administered for 20 minutes per session, three sessions a week. Sweat output was measured by recording the sweat mass by using a laboratory scale.

Results: The study showed a significant reduction in sweat output mass (P< 0.05) by a percentage of 48.86% after the suggested treatment period.

Conclusion: It was concluded that using tap water iontophoresis is useful and effective in reducing the sweat output in children with primary palmar hyperhidrosis.
METHODS

Subjects: Twenty children (10 boys & 10 girls) participated in this study; the mean value of their ages was 14±1.35 years, with maximum value of 16 years, and minimum value of 12 years. The mean value of body weight was 40.06±4.54kg with mean value of height was 142.12± 4.59cm, their body mass index (BMI) was 20.75± 1.93kg/m² (Table 1).

A consent form was signed after the procedure and possible side effects had been explained under supervision of their guardians.

Table 1: Mean and Standard deviation of age, weight, height, and BMI.

<table>
<thead>
<tr>
<th>Demographics</th>
<th>X±SD</th>
</tr>
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<tbody>
<tr>
<td>Age(years)</td>
<td>14±1.36</td>
</tr>
<tr>
<td>Weight(Kg)</td>
<td>40.06±4.54</td>
</tr>
<tr>
<td>Height(cm)</td>
<td>142.12± 4.59</td>
</tr>
<tr>
<td>BMI(kg/cm²)</td>
<td>20.75± 1.93</td>
</tr>
</tbody>
</table>

X: Mean SD: Standard deviation

Inclusion criteria: Children with primary palmar hyperhidrosis, to the extent that their palms were wet during most of the day, were given 4 weeks of TWI treatment. Their ages ranged from 12 to 16 years.

Exclusion criteria: Children suffering from medical conditions that were associated with hyperhidrosis were excluded. These conditions included hyperthyroidism, diabetes mellitus, spinal cord injury, brain damage or congestive heart failure. Children who had a local wound, severe eczema, or severe fungal infection of the palms were also excluded to minimize the risk of local burn. Any medication that might affect sweating was restricted 4 weeks before and during the study period.

Equipments: Sweat output mass were objectively measured using laboratory mass scale (KRUPS 380 Company, Switzerland max 500gm, d= 0.01gm). Tap water iontophoresis was administered using a pulsed direct current generator (Phyaction 780, Uniphy BV. Netherland.).

PROCEDURES

A. Measurement of sweat output mass:

Children were asked to walk on a treadmill with a speed of 5km/hour for 10 minutes and then to sit in an air-conditioned room whose ambient temperature was 19 to 22°C and humidity was 45% to 55%. Palms were dried by wiping with tissue once and their sweat output was objectively measured by using sensitive laboratory scale to record the mass gained by a standard diaper of approximately 30 g that was placed in contact with the palms for 10 minutes. Differences between initial and final measurements of diaper were noted in terms of gram/hour for sweat output of the palms. Arithmetic means and standard deviations of the sweat output values were calculated. The percentage sweat reduction after TWI was calculated as follows:

\[
\text{Pre-TWI sweat output - sweat output after TWI) × 100}
\]

Pre-TWI sweat output

B. Treatment procedures:

Both hands were positioned in pronation and were immersed in tap water the palms were placed flat and in contact with a felt pad that was connected to the anode. The cathode was placed on the elbows, a pulsed direct current of a 900-ms pulse width and a 100-ms rest period was used to minimize the risk of burn, the current intensities was adjusted according to the degree of tingling sensation in the palms to suit each patient's maximum tolerance level. Treatment was administered for 20 minutes per session, three sessions a week, for four weeks.

Data analysis: Data was analyzed by using statistical package for social sciences (SPSS). Paired t-test was used to compare between the mean of sweat output mass before and after the TWI. Level of significance was set at 0.05.

RESULTS

The descriptive statistical analysis of the mean values of sweat output mass before treatment (2.253±0.1) and after four weeks of application of pulsed direct current (1.152±0.054) revealed a significant statistical reduction of mean values of sweat output mass (P<0.05). Also the percentage of reduction was calculated to be 48.86% after four weeks of pulsed direct current application, when compared to the pretreatment value as shown in figure 1.

![Figure 1: The statistical analysis of mean values of sweat output mass before treatment (Pre) and after four weeks of TWI (Post).](image)

DISCUSSION

The current study was conducted to find out the effect of tap water iontophoresis (TWI) using pulsed direct current on primary palmar hyperhidrosis in pediatrics. The statistical analysis of the results indicated a significant statistical reduction of mean values of sweat output mass after four...
weeks of application of pulsed direct current, when compared with before treatment value, reflecting significant reduction in sweat output. Results of the current study were supported by those gained by Reinauer, et al., (1995), who found normal sweat secretion rates of palms after twelve treatment sessions of pulsed direct current of 4.3 or 10 kHz on 30 patients with palmar hyperhidrosis.

Moreover, the obtained results came in agreement with Dogruk, et al., (2014), who reported 50% or more decrease in sweating at the end of tap water iontophoresis treatment on 21 pediatric patients of age under 18 years with palmar hyperhidrosis. Also the results of the current study came along with the results of McAleer & Collins, (2013) which showed that 80% of the sample reported a moderate or great amount of improvement in symptoms and a moderate or great improvement in quality of life (according to a Disease Life Quality Index) after administration of tap water iontophoresis after nine treatments over 21 days.

In the agreement with the results of the current study, Kestenholz and Weder, (2002) suggested that tap water iontophoresis reduced sweat production by approximately 90%. Furthermore in a larger study enrolling 112 patients Kreyden (2002) stated that tap water iontophoresis controlled symptoms in 81% of patients after 8 treatments; mean remission length was 35 days.

The mechanism of action of TWI is still remains unclear. Sato et al., (1993), stated that decreased pH (strong acidity) in the sweat duct due to an increase in H+ ions during tap water iontophoresis may contribute to eccrine gland dysfunction. The generated by hydrolysis of water and the further accumulation of H+ in the sweat duct by direct current may be responsible for TWI-induced inhibition of sweating due to an unknown lesion(s) in the duct or sweat pore. The secretory coil function of sweat glands may also be altered because of exposure to intense acidity during TWI. The importance of H+ movement into the sweat pore for inhibition of sweating could be further exploited to develop new strategies for the control of sweating. Also it was stated that iontophoresis to lead to hyperkeratinization and plugging of the orifice of eccrine ducts. Also, it has been suggested that alterations in electrochemical gradients is the basis for the effect of iontophoresis on sweat production. One commonly held theory proposes that selective targeting of sweat glands occurs due to the high concentration of electrolytes, and the current causes protein coagulation and disruption of the eccrine gland function. An alternative theory holds that the electric current interferes with transmission of the stimulus that signals sweat secretion.

CONCLUSION: Within the scope of this study, it was concluded that tap water iontophoresis using pulsed direct current was of a significant effect in decreasing sweat out put in pediatric patients suffering from primary palmar hyperhidrosis.

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Conflict of Interest: None

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6. Iontocentre on April 12, 2013 at http://www.iontocentre.com/support/pulsed-or-direct-current/