

Efficacy of a 20% Aluminum Chloride in Alcohol Solution in the Treatment of Hyperhidrosis: A Study Using a Hydrometer

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Background : Excessive sweating, especially of the palms, soles and axillae, is a socially and an occupationally distressing, and sometimes disabling condition. A variety of treatment methods are used to reduce profuse sweating including topical agents, iontophoresis and sympathectomy.

Objective : We investigated whether a 20% aluminum chloride solution is efficient in the treatment of axillary and palmoplantar hyperhidrosis using a skin surface hydrometer.

Methods : We treated 31 patients (7 ; male, 24 ; female) by Drysol once a day at bedtime for four weeks. We had measured the conductances on the stratum corneum of the palms, soles and axillae using a skin surface hydrometer before and after treatment every week for four week

Result : There was a reduction of conductances after the treatment by Drysol ($p < 0.05$). The reduction of conductances was continued for four weeks ($p < 0.05$).

Conclusion : Drysol is an efficient, safe, and simple method for initial treatment of the primary hyperhidrosis. (Ann Dermatol 10:(1) 20~24, 1998).

Key Words : Primary hyperhidrosis, 20% Aluminum chloride in alcohol solution(Drysol), Skin surface hydrometer.

Primary hyperhidrosis is often localized to the palms, soles, axillae, and face. This excessive sweating is precipitated by emotional factors, but the patients are not unduly neurotic. However hyperhidrosis may produce secondary negative emotional, professional, and social consequences^{1, 2}. The prevalence of hyperhidrosis is 0.6% to 1.0% in young adults³. Human beings have two functionally distinct sets of eccrine sweat glands. One populates the entire skin with the exception of the palms and soles. These thermally

responsive glands play a key role in heat adaptation. In fact thermally responsive eccrine glands

are a unique human attribute. The other set of eccrine gland responds only to emotional stimulation and is analogous to the glands in frictional skin of other mammals. These emotionally responsive glands are present primarily in the palms and soles. Eccrine glands in the axillae are unusual in their responsiveness to both thermal and emotional stimulation⁴. A large number of therapeutic options are available for the treatment of hyperhidrosis. The medical treatment of hyperhidrosis is usually ineffective in all but the mildest cases. Many topical agents have been used, including aluminum chloride, potassium permanganate, formaldehyde solution, glutaraldehyde, and various anticholinergic compounds. 20% aluminum chloride hexahydrate in absolute anhydrotic ethyl alcohol available as a commercial prescription item (Drysol®), is useful for some patients with hyperhidrosis. Anticholinergic compounds have little effect when applied directly to the skin. When

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Table 1. Age distribution of hyperhidrosis patients and duration of disease

	Minimum(year)	Maximum(year)	Mean \pm SD
Age (n=31)	8.0	59.0	23.4 \pm 12.1
Duration (n=31)	4.0	50.0	14.6 \pm 10.9

Table 2. Sweat response with Drysol (mmho)

	Before Tx	1 week after Tx	2 week after Tx	3 week after Tx	4 week after Tx.
Palm (n=28)	15.7 \pm 3.6	9.8 \pm 5.3 *	8.3 \pm 4.0 *	7.3 \pm 3.6 *	3.8 \pm 4.2 *
Sole (n=26)	8.9 \pm 3.4	5.9 \pm 2.9 *	5.1 \pm 2.6 *	5.8 \pm 4.5 *	2.6 \pm 1.7 *
Axillar (n=22)	17.1 \pm 5.2	11.4 \pm 6.5 *	10.3 \pm 5.8 *	10.3 \pm 4.1 *	9.0 \pm 5.7 *

Mean \pm SD, * $p < 0.05$

taken orally the dosages required to achieve therapeutic effects are the same as those that cause side effects. The severity of these ocular and intestinal side effects limit their usefulness³. A tranquilizer such as diazepam may be helpful for those patients who suffer hyperhidrosis during specific anxiety-production situations. Surgical intervention is frequently offered to the patient with severe hyperhidrosis^{1,4,5}. A skin surface hydrometer can evaluate the hydration state of the skin surface quickly and quantitatively in terms of conductance to the high frequency electronic current of 3.5MHz^{6,9}. In a previous study we revealed that a skin surface hydrometer is useful to evaluate the efficacy of the treatment. We performed this study to evaluate the efficacy of Drysol in the treatment of hyperhidrosis on the palms, soles and axillae^{7,9}.

MATERIALS AND METHODS

Patients

Among 45 patients who visited the department of dermatology at Youngdong Severance Hospital due to hyperhidrosis from July 8th to August 14th, we excluded 14 patients who could not be followed up. The patients group consisted of 24 women and 7 men aged from 8 to 59. All patients were treated by Drysol for four weeks and none of the them had underlying diseases which caused secondary hyperhidrosis.

Methods

We examined all the patients using CBC and U/A to rule out secondary hyperhidrosis. We also used DITI(digital infrared thermographic imag-

ing) to confirm hyperhidrosis¹⁰. All patients applied 20% aluminum chloride hexahydrate(Sigma Chemical Co., St. Louis, Missouri) in absolute anhydrotic ethyl alcohol at bedtime and washed it off next morning for four weeks. We used a skin surface hydrometer (SKICON-200, IBS, Inc. Japan) to quantitate the amount of sweating before and after treatment every week for four weeks. Before measuring the patients, they had rested for at least five minutes at room temperature.

Statistical analysis

We did a statistical analysis of efficacy of Drysol by repeated measures of ANOVA using the SAS(statistical analytic system).

RESULTS

The mean duration of hyperhidrosis was 14.6 years and mean age of the patients was 23.4 (Table 1). Twenty eight patients had palmar hyperhidrosis and 26 patients had plantar hyperhidrosis. Twenty two patients had axillary hyperhidrosis. There was a significant reduction of sweating on the palms (15.7 to 9.8), soles (8.9 to 5.9) and axillae (17.1 to 11.4) after one week with Drysol treatment. Reduction of sweating continued for four weeks (Table 2). There were no significant complications except mild irritation and a burning sensation.

DISCUSSION

Hyperhidrosis or sweating in amounts greater than that required for insensible loss or physiological

needs may be primary (idiopathic) or secondary to other conditions such as hypothyroidism, obesity, anxiety states and the menopause, or it may occur in paroxysms in association with pheochromocytoma. Differentiation of normal sweating from hyperhidrosis is subjective and thus it lacks precise definition although attempts to measure normal rates of insensible loss from the skin have recorded values of 8-15 g/cm²/min⁵. Primary hyperhidrosis usually appears in childhood and persists for the rest of life. The sweat is secreted by eccrine glands innervated by cholinergic fibers from the sympathetic nervous system. These glands are distributed over the entire body but principally over the palms, soles and axillae. Sweating is precipitated by stimuli such as emotional excitement, heat and taste rather than exercise and it ceases completely during sleep^{1, 4, 5}. Axillary hyperhidrosis is socially embarrassing, causing wetness, staining and rotting of clothing. Patients with palmar involvement are reluctant to shake or hold hands and may become socially withdrawn. They are unable to grasp objects, papers become wet, ink runs and metal rusts. Plantar hyperhidrosis leads to bromhidrosis, blisters, infections and rotting of socks and shoes^{2, 5}.

Primary hyperhidrosis may be managed by a variety of techniques directed specifically at reducing the sweating to an acceptable level or abolishing it altogether. Non-surgical approaches include local measures, application of topical agents such as aluminum chloride, glutaraldehyde and tannic acid, iontophoresis, systemic anticholinergic medication and psychotherapy. Surgical treatment includes excision of axillae sweat glands, suction-assisted lipolysis and sympathectomy^{1, 2, 4, 5}. Patients with hyperhidrosis should apply an absorbent foot powder after bathing. Leather shoes and cotton or woollen socks should be worn, avoiding rubber and synthetic materials^{2, 5}. Iontophoresis is defined as the introduction, by means of an electric current, of ion of soluble salts into the tissues of the body for therapeutic purposes. This process is also called iontherapy, galvanoionization, ionic medication, and medical ionization. Iontophoresis has been used for the treatment of various dermatological conditions including ulcers, warts, lichen planus, vitiligo, scleroderma and hyperhidrosis. Currently three types of iontophoresis units are commercially available: line-operated units, simple battery-op-

erated units (Drionic), and rechargeable power sources. The most successful and popular application of iontophoresis for dermatological conditions is the treatment of hyperhidrosis. Tap water is the most commonly used conducting medium because it is effective and safe. Solution of various compound such as poldine methyl sulfate, glycopyrronium bromide, and atropine have been investigated and were shown to have a longer effect than water. However, side effects of systemic anticholinergic blockade prevented this form of treatment from gaining wide acceptance. While the efficacy and safety of tap water iontophoresis is well documented, its mechanism of action remains unknown. The most widely accepted hypothesis is that sweating is inhibited by mechanical blockage of the sweat ducts at the stratum corneum level with the depth and severity of the damage being dose-related. Stripping off the stratum corneum relieves the blockage and restores sweating^{11, 20}. There are many topical agents used for hyperhidrosis including tanning agents such as glutaraldehyde and tannic acid. They are usually effective in the treatment of hyperhidrosis but are associated with brown staining that precludes their use in most instances^{1, 2, 4, 5}. Primary hyperhidrosis can be effectively treated with systemic anticholinergic agents but unpleasant side-effects such as blurred vision, a dry mouth and urinary retention preclude their use except for very brief periods. Patients with hyperhidrosis often have psychological disturbances and have frequently been treated with tranquilizers. Psychotherapy or biofeedback has been used with limited success by some authors. This is not surprising because there is no evidence that hyperhidrosis is primarily a psychiatric disorder and it would appear that psychological disturbances are caused by the difficulties the patients experience in establishing social and professional activities^{2, 5}. A variety of surgical approaches have been used for carrying out sympathectomies. Recently endoscopic sympathectomies has been widely used. This technique is safe and provides effective treatment for patients

with axillae, palmar and facial hyperhidrosis. Complications of a sympathectomy procedure include compensatory hyperhidrosis (increased sweating in some other areas of the body), 24% to 44%, pneumothorax, 10% to 15%, permanent Honer's syndrome, 0.8% to 4%, wound infections

0.2% to 2%, hemothorax, 0.2%, and empyema, 1.5%. The efficacy of a sympathectomy for palmar hyperhidrosis is not in doubt, but the problems that may occur as a result of this surgical intervention are significant²¹⁻²³. One of the most serious complications is compensatory hyperhidrosis. The total sweat loss is the same before and after the operation. Most patients complain of excessive sweating on the abdomen, back, knees or chest after a sympathectomy.

This excessive sweating is induced by heat and not by emotional stimuli, a fact which confirms its compensatory nature. Generally, compensatory hyperhidrosis gradually improves^{24, 25}. Modified iontophoretic devices can be used for compensatory hyperhidrosis²⁶. Recently, subcutaneous injections of botulinum toxin at the hyperhidrotic site has been tried for the treatment of hyperhidrosis. Botulinum toxin acts primarily at peripheral cholinergic synapses, inhibiting the release of acetylcholine. Its therapeutic effect is mainly due to its action on the neuromuscular junction, where it causes transient paresis in the muscles where it is injected. Local injections of botulinum toxin have been established as the treatment of choice for cranial and cervical dystonias and related disorders. Recently there have been suggestions for potential clinical indications in non-muscular diseases where cholinergic terminals play a part. Botulinum toxin has a potent inhibiting effect on the cholinergically innervated sweat glands on the palms, leading to a marked reduction in sweat production. The long-term effect of local injections of botulinum toxins on focal hyperhidrosis of the palms also required further observation. In Frey's syndrome a treatment response lasting for at least 12 months was obtained. In palmar hyperhidrosis the treatment effect was reported to last for 13 weeks to 6 months²⁷⁻²⁹. Drysol is the most widely used topical agent in hyperhidrosis. It may work by mechanically obstructing the eccrine sweat gland pores or by causing atrophy of the secretory cells. To be effective the aluminum chloride must remain on the skin for 6 to 8 hours. The skin must be dry before application. If moisture is present, irritating hydrochloric acid forms. Therefore, aluminumchloride hexahidrate(20%) dissolved in anhydrotic ethyl alcohol(Drysol) is used. The aluminum chloride should be applied nightly until the desired degree of dryness is obtained. Thereafter, the agent should be applied as of-

ten as is necessary². Drysol had been known to be adequate for some patients with axillary hyperhidrosis but its use in palmoplantar hyperhidrosis has been less rewarding^{1, 2, 4, 5}. However this study showed that Drysol is effective not only in axillary hyperhidrosis but also in palmoplantar hyperhidrosis.

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