

## Tap water iontophoresis in palmo-plantar hyperhidrosis

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### SUMMARY

Plain tap water iontophoresis as a method of treatment of idiopathic palmo-plantar hyperhidrosis was evaluated. In the present study, different strengths of current were used for varying periods of time and the treatment was given 6 days a week, until the patients became euhydrotic. Whereas previous workers have used the two electrodes in separate pans, we, in one study, placed them in the same pan of tap water, so that electrolysis occurred at the electrodes on which palms or soles were resting, the current passing through the medium.

It was observed that, irrespective of the method used, euhydrosis of palms or soles was achieved. The time and the amount of current required to produce euhydrosis were significantly greater with the single pan technique (average 14.1 sittings in Group I) as compared to the separate pan method (average 7.09 sittings in group II) ( $t = 3.41$ ;  $P < 0.01$ ). The euhydrosis persisted for between 6 and 8 months (average 6.26 months).

In our study 90% of the patients treated developed anhidrosis on both the anode and cathode treated palms or soles. In 10% of the subjects, the effect was, however, greater on the anodal side.

Hyperhidrosis of palms and soles is a distressing condition, causing physical discomfort, social embarrassment, economic loss and mental stress. Medical treatment is often unsatisfactory. Many topical agents have been used, including aluminium chloride (Shelley, 1954), potassium permanganate, formaldehyde (Shelley *et al.*, 1954; Papa, 1966), and a large number of anticholinergic compounds (Shelley & Horvath, 1951; MacMillan *et al.*, 1964; Grice & Bertley, 1966). Most anticholinergic compounds are practically useless when applied topically to the palms and soles, and the severity of intestinal and ocular side effects limits the effectiveness of their systemic use.

Surgery, in the form of upper thoracic sympathetic ganglionectomy, may result in complications such as Horner's syndrome, pneumothorax, pleural effusion or phrenic nerve damage (Greenhalgh *et al.*, 1971).

Iontophoresis has been shown experimentally by Shelley *et al.* (1948) and Takata (1956) to produce anhidrosis. The technique was used therapeutically for the first time by Levit in 1968 using plain tap water for iontophoresis. Later, Grice *et al.* (1972) and Abell & Morgan (1974) compared tap water with and without added anticholinergic drugs as conducting media, and met with variable results.

We have made an attempt to study further the effectiveness, if any, of plain tap water iontophoresis

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in treating idiopathic palmar and plantar hyperhidrosis. We have tried to standardize the time of each sitting, the duration of treatment and the period for which the effect lasts.

#### MATERIALS AND METHODS

Patients studied were attending the Skin and V.D. Section, Sir Sunderlal Hospital of Banaras Hindu University on account of hyperhidrosis. The sample was selected only on their ability to report for treatment daily for at least 3 weeks. Fifty-six patients were thus chosen for iontophoresis treatment, but only 30 of these completed the course.

A detailed history and physical examination were carried out on every patient, and any systemic cause of hyperhidrosis was excluded.

Before starting treatment, impressions of the palms and soles were taken on Whatman filter paper (No. 1) soaked in a 1.0% ethanolic solution of bromophenol blue. During treatment, impressions were taken again at weekly intervals and also at the end of the course.

For iontophoresis, an apparatus was constructed locally, based on the circuit-diagram of the apparatus used by Levit in 1968. This instrument supplies a well filtered direct current of up to 50 mA which passes through palms and soles of patients, and it produces a voltage sufficient to drive this current over the body surface. As the anhidrotic effect is probably greater at the anode (Shelley *et al.*, 1948; Shelley & Horvath, 1950), a polarity reversing switch was introduced in the output line to enable either lead to be used as anode. Copper sheet electrodes measuring 27.8 × 13.9 cm were used. In the first 23 patients who completed a course of treatment for the palms, the anode was used only for the left, and the cathode for the right side. But in the remaining seven patients this was reversed, the anode being changed to the right side and cathode to the left. For treatment of plantar hyperhidrosis, the polarity was always the opposite of that used for the 2 hands in all 30 patients. Plain tap water was used as the conducting medium throughout the study. Just enough water was used to immerse the palmar or plantar skin.

Initially the electrodes were kept in separate pans, the current passing through the body. As some subjects were found to be intolerant of a current, even as low as 2 mA, the study was made on the following three groups:

#### Group I

Both electrodes in the same pan

	Current (mA)	Time (min)	Frequency
(A)	20	20	Daily
(B)	25	25	Daily

#### Group II

Electrodes in different pans

	Current (mA)	Time (min)	Frequency	Current density per cm <sup>2</sup>
(A)	10	15	Daily	0.029
(B)	10	25	Daily	0.029

#### Group III

The third group mentioned above

The patients' information after all patients were

in the present ranged from 7 to 10 duration of the

Those subjects the ipsilateral extremities. It was

Table I shows the sittings required for patients remain in groups IB, IIA

TABLE I.

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In group I, 20 mA for 25 min did not

Group II had electrodes in separate pans for 25 min. It was found that  $P > 0.05$ . For

treatment of the palms and soles during the course of treatment

In Group I, the tolerance using these di

## Group III

The third group consisted of patients who either were able to tolerate more current than those mentioned above or were given more or less amperage for varying time periods.

The patients were asked if they had any discomfort or itch during therapy, erythema or vesicle formation afterwards, or any other discomfort at any time during treatment. At the end of the study all patients were seen and examined to assess the state of the anhidrosis.

## OBSERVATIONS AND RESULTS

In the present study there were 30 patients with hyperhidrosis, three being females. Their ages ranged from 7 to 55 (average 20.5) years, most patients being between 11 and 30 years old. The duration of the hyperhidrosis was highly variable, ranging from 1 to 25 years.

Those subjects whose palms and soles were treated had electrodes of opposite polarity applied to the ipsilateral palm and sole: cathode to one palm and contralateral sole, anode to the other extremities. It will be evident from the results that changing the polarity did not affect the response.

Table 1 shows the results of iontophoresis in 6 patients in group IA. The average number of sittings required to induce euhidrosis in this group was 15.17, and the average time during which the patients remained euhidrotic after stopping treatment was 5.1 months. Similarly, the results for groups IB, IIA and IIB are shown in Tables 2-4 respectively.

TABLE I. Group I. Keeping both the electrodes in the same pan. (A) Current 20 mA; Time 20 min

Pt. no.	Age (years)	Duration of hyperhidrosis (years)	No. of sittings			Duration of anhidrosis (months)
			Palm	Soles	Recurrence	
1	12	Childhood (5-6)	27	26	Yes	9
2	12	5-6	12	7	Not followed	
3	25	1-6	9		No	5½
			9			
4	30	Childhood (24-25)	10	10	No	4½
5	20	2	7	17	No	4½
6	19	1		17	No	2

Improvement 100%: No. of sittings, Palms (N = 6). Mean = 15.17. Duration of anhidrosis N = 5 (in months) Mean = 5.1.

In group I, six subjects were given 20 mA for 20 min and the other seven patients were given 25 mA for 25 min. Increasing the current density and the time from 20 mA for 20 min to 25 mA for 25 min did not show any statistically significant increase in therapeutic effect ( $t = 0.57$ ;  $P > 0.05$ ).

Group II had 2 sub-groups, as described above. In both, a current of 10 mA was given with the electrodes in separate pans. In first sub-group the current was given for 15 min and in the other for 25 min. It was found that this time increase imparts no statistically significant benefit ( $t = 1.31$ ;  $P > 0.05$ ). For treating the 13 subjects in Group I electrodes in the same pan were used, whereas treatment of the 11 subjects in Group II was given through electrodes in different pans. The average course duration was 14.1 sittings for group I and 7.09 sittings for Group II. Thus the time to render palms and soles euhidrotic was shorter when they were placed in separate pans ( $t = 3.41$ ;  $P > 0.01$ ).

In Group III, the time, the course duration and the amount of current were varied, depending on the tolerance of the patient and the response. Table 5 shows the response to iontophoresis using these different individualized schedules.

TABLE 2. Group I. Keeping electrodes in same pan. (B) Current = 25 mA; Time = 25 min

Pt. no.	Age (years)	Duration of hyperhidrosis (years)	No. of sittings		Recurrence	Duration of anhidrosis (months)
			Palm	Soles		
1	7	4	12		Yes	7
2	29	9	1		Yes	11
3	30	Childhood (24-25)	15		Yes	5
4	13	2-3	9		Not followed	
5	26	14-15	12		Yes	5
6	12F	1-5	15		No	15
			Left Right	8		
7	14	3-4	21	21	Not followed	

Improvement 100%: Number of sittings, Palms (N = 7). Mean 13.28. Duration of anhidrosis (N = 6). Mean 8.6.

TABLE 3. Group II. Keeping both the electrodes in separate pans. (A) Current = 10 mA. Time = 15 min

Pt. no.	Age (years)	Duration of hyperhidrosis (years)	No. of sittings Palms	Recurrence	Duration of anhidrosis (months)
1	55	6	8	No	14
2	20	2	5	Yes	9
3	22	10-12	5	Not followed	
4	21	Childhood (15-16)	6	No	5
5	20	4	8	No	4

Improvement 100%: Number of sittings, Palms (N = 5). Mean 6.2. Duration of anhidrosis (N = 4). Mean 8.0.

TABLE 4. Group II. Keeping electrodes in separate pans. (B) Current = 10 mA. Time = 25 min

Pt. no.	Age (years)	Duration of hyperhidrosis (years)	No. of sittings		Recurrence	Duration of anhidrosis (months)
			Palms	Soles		
1	20	Childhood (14-15)	7	7	Not followed	
2	17F	10-11	8	—	Yes	3
3	24	Childhood	12		Not followed	
4	18	6	8	8	No	2½
5	17	3-4	5	—	No	3
6	25	Childhood (19-20)	7	—	No	5

Improvement 100%: Number of sittings, Palms (N = 6). Mean 7.83. Duration of anhidrosis (N = 4). Mean 3.37.

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TABLE 5. Group III. Miscellaneous group of varying current and time.

Pt. no.	Age (years)	Duration of hyperhidrosis (years)	Number of sittings		Recurrence	Duration of anhidrosis (months)
			Palm	Soles		
(A) Same pans						
1	22	5-6	20mA for 10 min. 24 sittings	—	Yes	10
2	13F	1	10mA for 15 min. 7 sittings	12	Yes	3
(B) Separate pans: Current 20 mA						
3	20	14-15	20mA for 20 min. 6 sittings	15mA for 20 min. 16 sittings	Yes	4
4	26	1	(a) 10mA for 25 min. 17 sittings	20 mA for 25 min. 41 sittings	No	3½
5	22	10-15	(b) 15mA for 25 min. 40 sittings		Not followed	
6	20	(14-15)	Left: 18 Right: 20	Left: 18 Right: 19	No	1

Improvement 100%.

## DISCUSSION

The present study explored the effectiveness of iontophoresis using tap water in the treatment of palmar and plantar hyperhidrosis.

Iontophoresis using plain tap water to produce anhidrosis was first described by Shelley *et al.* (1948) and Takata (1956) who performed the experiments on the back. It was not until 1968 that Levit described a simple apparatus for iontophoresis and reported its therapeutic effectiveness in patients with idiopathic hyperhidrosis of palms and soles. This was followed by the study of Grice *et al.* (1972) in which the results of iontophoresis using tap water alone and with an added anticholinergic compound (poldine methosulphate) were compared. They believed that water was not as effective without the poldine. Further, the effect was of shorter duration using tap water alone.

Abell & Morgan (1974) further studied the same problem, comparing iontophoresis using tap water alone and with the anticholinergic drug glycopyrronium bromide. They observed that tap water iontophoresis was much less satisfactory because euhidrosis could be achieved only by repeated treatments at short intervals, and only occasionally was improvement maintained for more than a few days after stopping treatment. The anhidrotic effect of glycopyrronium bromide, however, was greater and longer lasting. These authors observed that their patients rarely required treatment more frequently than every 5-6 weeks.

Our results were very encouraging. We were able to render palms and soles of all the patients anhidrotic using iontophoresis with tap water alone.

Certain variables observed during the study warrant discussion. Most of the subjects tolerated a current of 20-30 mA when the electrodes were in the same pan. Some patients, however, could not tolerate even 2 mA when the electrodes were in separate pans. It was therefore decided to study the effect of iontophoresis with the anode and the cathode in the same pan. We found that this was just as effective in producing an anhidrotic state. We had, however, used a larger amount of current, this

being 20 mA for 20 min and 25 mA for 25 min in Group I, as compared to 10 mA for 15 min and 25 min in Group II. Even though we had used 2-2½ times the amount of current when the electrodes were kept in the same pan, it took longer to bring about an euhydrotic state. Despite the longer time necessary to bring relief to patients using the two electrodes in a common pan, we would recommend it as being absolutely safe. It can be handled by any member of the staff or a relative of the patient without risk.

In the three other studies which have been published on this subject (Levit, 1968; Grice *et al.*, 1972; Abell & Morgan, 1974), treatments were given once or twice a week, and the effects assessed at weekly intervals for a period of up to 6 months. We have, however, treated patients every day except Sundays. The length of treatment varied and it was individualized depending upon the response. It was continued until the patient was euhydrotic and satisfied subjectively and took on average 2-3 weeks.

It has been generally accepted that the duration of effective treatment is inversely related to the amount of current. In our study we have given current for approximately 2-3 weeks continuously and the patients were in remission for up to 6-8 months (average 6.26 months).

#### *Untoward effects*

In the present study no untoward effects were seen. In the studies of Grice *et al.* (1972) and Abell & Morgan (1974), symptoms due to the anticholinergics were seen, particularly when large areas were treated (the palms, soles and axillae together, for example), when a high concentration of the drug was incorporated in the conducting medium, or when the duration of treatment was longer. As we have used only tap water, such side-effects were naturally not expected.

We also saw neither dyshidrosis nor vesicles. Shelley *et al.* (1948), Sulzberger *et al.* (1950) and Loewenthal (1962), on the other hand, even produced miliaria at the site of iontophoresis. This may perhaps be due to the fact that they used a larger current density; Shelley *et al.* (1948), for example, used 0.5 mA/cm<sup>2</sup> which produces miliaria on the skin of the back in a single sitting.

It is possible that we did not produce any vesiculation because we used a weaker current. Had we used more current or a longer treatment period, we might have produced this untoward effect.

Our results are in conformity with the results of previous workers in many respects. Iontophoresis may be recommended for the treatment of palmar and plantar hyperhidrosis, being effective in all cases. Although the response was greater on the anodal side in 3 of our 30 cases, tap water iontophoresis is effective irrespective of the polarity.

#### REFERENCES

- ABELL, E. & MORGAN, K. (1974) The treatment of idiopathic hyperhidrosis by glycopyrronium bromide and tap water iontophoresis. *British Journal of Dermatology*, **91**, 87.
- GREENHALGH, R.M., ROSENGARTEN, D.S. & MARTIN, P. (1971) Role of sympathectomy for hyperhidrosis. *British Medical Journal*, **1**, 332.
- GRICE, K.A. & BETTLEY, E.R. (1966) Inhibition of sweating by poldine methosulphate (Nacton). *British Journal of Dermatology*, **78**, 458.
- GRICE, K., SATTAR, H. & BAKER, H. (1972) Treatment of idiopathic hyperhidrosis with iontophoresis of tap water and poldine methosulphate. *British Journal of Dermatology*, **86**, 72.
- LEVIT, F. (1968) Simple device for treatment of hyperhidrosis by iontophoresis. *Archives of Dermatology*, **98**, 505.
- LOWENTHAL, L.J.A. (1962) Experimental miliaria: Iontophoresis with Salt solutions. *Archives of Dermatology* (Chicago), **86**, 115.
- MACMILLAN, F.S.K., RELLER, H.H. & SUNDER, F.H. (1964) The antiperspirant action of topically applied anticholinergics. *Journal of Investigative Dermatology*, **43**, 363.
- PAPA, C.M. (1966) The action of antiperspirants. *Journal of the Society of Cosmetic Chemists*, **17**, 789.
- SHELLEY, W.B. (1954) Experimental miliaria in Man. V. The effect of poral closure on the secretory function of the eccrine sweat glands. *Journal of Investigative Dermatology*, **22**, 267.

- SHELLEY, W.B. & HORVATH, P.N. (1950) Experimental miliaria in man. II. Production of sweat retention anhidrosis and miliaria crystallina by various kinds of injury. *Journal of Investigative Dermatology*, **14**, 9.
- SHELLEY, W.B. & HORVATH, P.N. (1951) Comparative study on the effect of anticholinergic compounds on sweating. *Journal of Investigative Dermatology*, **16**, 267.
- SHELLEY, W.B., LASKAS, J.J. & STONOVE, A. (1954) Effect of topical agents on plantar sweating. *Archives of Dermatology and Syphilology*, **69**, 713.
- SHELLEY, W.B., HORVATH, P.N., WEIDMAN, F.D. & PILLSBURY, D.M. (1948) Experimental miliaria in man. I. Production of sweat retention anhidrosis and vesicles by means of Iontophoresis. *Journal of Investigative Dermatology*, **11**, 275.
- SHRIVASTAVA, S.N. (1975) Thesis on evaluation of use of Iontophoresis in the treatment of hyperhidrosis. Submitted for M.D. of Banaras Hindu University.
- SULZBERGER, M.B., HERRMANN, F., KELLER, R. & PISHA, B.V. (1950) Studies of sweating. III. Experimental factors influencing the function of sweat ducts. *Journal of Investigative Dermatology*, **14**, 91.
- TAKATA, quoted by KUNO, Y. (1956) *Human perspiration* p. 357. Charles, C. Thomas, Springfield, Illinois.