Mechanism of Action of Iontophoresis in the Treatment of Palmar Hyperhidrosis

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Sweat glands from the palm of a patient with hyperhidrosis were examined by light and electron microscopy before and after treatment with tap water iontophoresis. No changes in structure were noted after treatment, disclaiming the currently accepted theory that mechanical ductal obstruction is the mechanism of action of this method. Furthermore, we believe the safety and effectiveness of this treatment are supported by our experience.

Hyperhidrosis of the palms and soles is a source of significant discomfort, social embarrassment, and vocational handicap to many individuals. This condition is rarely controlled with topical or systemic medical therapy, and surgical treatment by thoracic sympathetic ganglionectomy, while effective, risks grave complications.[1]

Iontophoresis appears to be a simple and effective solution to the problem of palmar and plantar sweating. The procedure involves exposing the patient's hands and/or feet to a 15 to 20 ma electrical current which may be conducted through a dilute solution of an anticholinergic drug or tap water. Several investigators have reported on the success of this method of treatment.[2–8] Usually an euhydrotic state can be achieved within two weeks and maintained by treatments every four to five weeks.

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While the efficacy and safety of the procedure have been well documented, the mechanism of action of this mode of therapy remains unknown. Many of its recent advocates accept the hypothesis that sweating is inhibited by mechanical blockage of the distal ducts of sweat glands. In the 1940's through the early 1960's, this mechanism was suggested by authors who were investigating the etiology of miliaria rubra.[9–11] By applying tap water or saline iontophoresis to the back, arms, thigh, or chest of patients, they were able to produce an anhidrosis which was followed by erythema and vesiculation. Post-treatment punch biopsy specimens provided convincing histologic evidence that abnormal keratinization followed by obstruction of the sweat gland ducts was indeed responsible for these observations. One must be cautious, however, in applying these findings to the explanation of palmar and plantar anhidrosis induced by iontophoresis. This is especially true when it is remembered that the morphology and physiology of sweat glands in the palms, soles, and axillae differ significantly from those of the back or elsewhere. Furthermore, although Levit[5] reported an irritant vesicular response, the appearance of iatrogenic miliaria has never been reported following iontophoresis of the palmar or plantar surface.

Superior results have been reported with iontophoresis of an anticholinergic drug solution as compared to tap water.[2,4,5] The autonomic effect of the locally applied drug is presumed to account for this disparity.

To our knowledge no studies have been reported which include histologic examination of palmar or

Figure 1. *Starch-iodine method reveals complete anhidrosis of the right palm after eleven exposures.*

plantar sweat gland morphology following iontophoresis. We report the following case in which this has been done.

Case Report

A 27-year-old white man had experienced intermittent excessive sweating of the hands and feet since childhood. Systemic medical treatment with propantheline, at age fifteen, had not been beneficial. His past medical and dermatologic history was otherwise unremarkable. Using a device similar to that described by Levit,[5] the patient received eleven 20 minute exposures to his right hand and left foot using tap water and a current of 20 ma. The anodal current was switched from the hand to the foot halfway through each exposure. Progress was objectively evaluated at weekly intervals by the method suggested by Minor[12] in which the hands or feet are painted with a solution of iodine, castor oil, and diluted alcohol. When thoroughly dry the skin is evenly powdered with cornstarch which darkens as sweating progresses. This treatment resulted in complete anhidrosis of the right hand and marked suppression of sweating of the left foot (Figure 1). Prior to treatment of the left hand, two 3 mm punch biopsy specimens were obtained from the hypothenar eminence using local anesthesia (2 percent lidocaine). These specimens were prepared for light and electron microscopy. When the biopsy sites healed the left hand

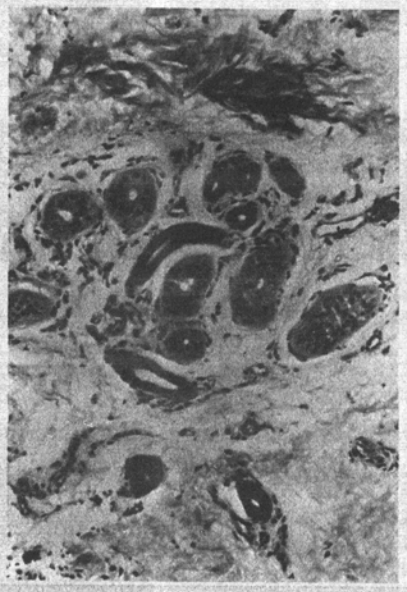

Figure 2. *Sweat glands of the left palm appear normal before treatment.*

Figure 3. *No morphologic changes are apparent after eleven exposures to the left palm which resulted in complete anhidrosis.*

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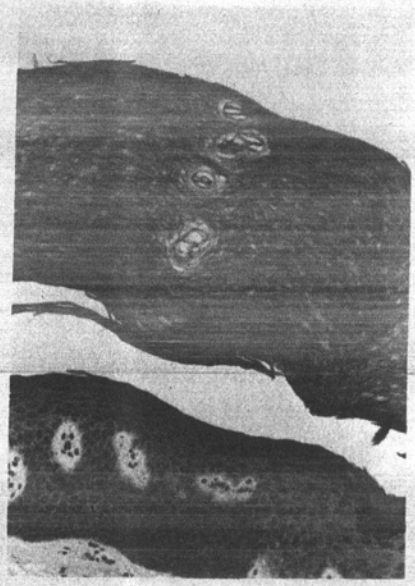

Figure 4. *Post-treatment biopsy specimen from the left palm reveals no occlusion or dilatation of the acrosyringia.*

and right foot were exposed to a course of iontophoresis identical to the previous one and biopsies were again taken from the hypothenar eminence for light and electron microscopy.

Study by light microscopy and transmission electron microscopy of both pre- and post-treatment skin biopsy specimens did not demonstrate significant morphologic abnormalities. The secretory coils of the eccrine glands as well as the dermal duct components were similar in each specimen (Figures 2 and 3). Acrosyringia of the post-biopsy specimens were not dilated or occluded (Figure 4).

Comments

Our histologic findings contest the currently accepted idea that iontophoresis reduces palmar and plantar perspiration by mechanical blockage of sweat gland ducts. In addition, neither our patient nor those studied by other investigators experienced the miliaria-like symptoms one might expect to occur following such ductal blockage. We cannot, however, ignore the observation by Gordon et al[3] and Grice et al[4] that stripping the palmar stratum corneum with Scotch Tape® following iontophoresis resulted in resumption of sweating. This may have been due to removal of an anticholinergic drug deposited topically by the iontophoretic process in Grice's experiment, but would not explain Gordon's results since he only used tap water in his study.

Summary

Our objective in carrying out this experiment was to determine the mechanism of action of iontophoresis in alleviating palmar and plantar hyperhidrosis. Although this was not achieved, we believe that we have accumulated significant evidence against the currently accepted explanation. In addition, our experience supports previous reports that iontophoresis is a simple, safe, effective, and inexpensive method of treating palmar and plantar hyperhidrosis.

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