ELSEVIER

Clinical Neurophysiology 116 (2005) 1348–1354

www.elsevier.com/locate/clinph

Changes in the sympathetic skin response after thoracoscopic sympathectomy in patients with primary palmar hyperhidrosis

A. Lladó[a], L. León[a], J. Valls-Solé[a,*], P. Mena[b], M.A. Callejas[b], J.M. Peri[c]

[a]*Neurology Department, Hospital Clínic, University of Barcelona, IDIBAPS (Institut d'Investigació Biomèdica August Pi i Sunyer), Barcelona, Spain*
[b]*Surgery Department, Hospital Clínic, Barcelona, Spain*
[c]*Psychiatry Department, Hospital Clínic, Barcelona, Spain*

Accepted 10 February 2005
Available online 29 March 2005

Abstract

Objective: To investigate whether thoracic sympathectomy induced any change in the pattern of abnormalities or in the waveform of the sudomotor skin response (SSR) in patients with primary palmar hyperhidrosis (PPH).

Methods: We recorded the SSR to median nerve electrical stimuli before and after bilateral thoracoscopic sympathectomy in 27 patients with PPH. We analyzed the changes in amplitude, type of waveform and pattern of abnormality.

Results: All patients reported symptomatic improvement. The amplitude of the SSR decreased significantly in patients examined within 1 year after surgery, but was not different in patients examined after 1 year. The number of abnormally enhanced responses reduced after surgery, but there was no significant change in the number of patients with enhanced excitability recovery or with double-peak responses to single stimuli. There was a significant increase in the number of SSRs with a predominantly negative waveform after surgery.

Conclusions: The persistence of SSR abnormalities after surgery suggests that the central nervous system dysfunction is not modified by sympathectomy. The change of the waveform to predominantly negative type after surgery could be the consequence of the decrease in the production of sweating.

Significance: Our results show the effects of sympathectomy on the SSR and on its abnormal patterns in patients with PPH.

Keywords: Sympathetic skin response; Hyperhidrosis; Sympathectomy; Skin conductance level; Action potential waveform

1. Introduction

The pathophysiology of primary palmar hyperhidrosis (PPH) is not clear. The analysis of the electrodermal activity (EDA) offers the possibility to study the sympathetic drive to the sweat glands (Vetrugno et al., 2003) and, therefore, allows for gathering information on the mechanisms underlying the altered control of palmar sweating in PPH patients with non-invasive means. The stimulus induced synchronized activation of a number of sweat glands, known as the sympathetic skin response (SSR), is the most common method used in clinical neurophysiological evaluation of the somato-sympathetic sudomotor circuit (Bordet et al., 1996; Montagna et al., 1985; Obach et al., 1998; Shahani et al., 1984; Solders et al., 1991; Valls-Solé et al., 1991). Various authors have reported abnormalities of the SSR in patients with PPH: Chen et al. (1995) reported that the SSR may be either absent or abnormally large in some PPH patients, Lefaucheur et al. (1996) reported abnormally large and double-peak responses to single stimuli, and Manca et al. (2000) showed the existence of an abnormally enhanced SSR excitability recovery with paired stimuli.

PPH patients experience an important relief of their symptoms after thoracic sympathectomy (Callejas Perez et al., 2002). However, it is not clear how this treatment modifies the SSR abnormalities. In Lefaucheur et al. (1996), the SSR was abolished after sympathectomy, to begin to reappear after 18 months in a few patients. In the study of Chen et al. (1995), the SSRs were present after surgery in

* Corresponding author. Address: Unitat d'EMG, Servei de Neurologia, Hospital Clínic, Villarroel, 170, Barcelona 08036, Spain. Tel.: +34 932275413; fax: +34 932275783.
E-mail address: jvalls@clinic.ub.es (J. Valls-Solé).

1388-2457/$30.00
doi:10.1016/j.clinph.2005.02.009

a 4th of their patients. Lewis et al. (1998) reported no correlation between response amplitude and patient's satisfaction, time after surgery, or compensatory sweating. We decided to investigate whether the surgical intervention induced any change in the pattern of SSR abnormalities in a group of PPH patients operated in our institution. We also evaluated possible changes in the SSR waveform that, according to Mitani et al. (2003), Toyokura (2003) and Toyokura and Takeda (2001), can be influenced by the production of sweating. We hypothesized that those SSR abnormalities related to the dysfunction of reflex sympathetic circuits would not be modified after sympathectomy except for a reduction in the amplitude of the response.

2. Patients

The study was carried out in patients with the diagnosis of PPH who underwent thoracoscopic sympathectomy between 1999 and 2004, and had been examined following a study protocol aproved by the local Ethical Committee, which included neurological, dermatological and psychological evaluation, as well as the study of the SSR (see below). Patients were contacted by telephone and were proposed to participate in a follow-up neurophysiological study. The patients who agreed in participating signed a consent form.

3. Methods

We recorded the SSR in both hands. Tests were performed in a room at ambient temperature (between 22 and 24 °C). We made sure that the skin temperature was above 31 °C. The skin of the palm and dorsum of the hand was cleaned prior to placing the surface electrodes to avoid excessive palmar humidity. Surface electrodes were attached to the palm and dorsum of both hands with an adhesive tape. All recordings were done using a MYSTRO5Plus electromyograph (Oxford Instruments, Old Woking, Surrey, UK). The frequency bandpass was 0.2–500 Hz. The time window for SSR recording was 10 s and the gain was 1 mV per division.

We diminished all possible sources of noise and external interferences by dimming the light and avoiding unnecessary movements of the examiners. If unexpected noises came up, the specific 10 s recording epoch was rejected and another recording was done.

4. Procedure

Tests were performed between 1 and 30 days before, and between 1 and 48 months after, surgery. Exactly the same study protocol, equipment, and setup, were used for both tests, which were always done at the same time of the day (early afternoon). Once the recording electrodes were in place, patients were let to relax for a period of time of about 5 min. Then, we proceeded with the following exam:

1. Evaluation of the basal EDA in both hands (Hot et al., 1999). Patients were relaxed and silent. We assumed that there was a significant oscillation of the skin conductance level (SCL), when there was a negative or positive shift of the baseline with an amplitude of at least 100 μV and a duration of at least 0.5 s.
2. Evaluation of the amplitude and morphology of the SSR to single electrical stimuli. Bipolar electrodes for electrical stimulation were attached to the wrist above the median nerve. SSRs were elicited by electrical stimuli applied first over the right median nerve and then over left median nerve at an intensity eliciting an apparent twitch of the thenar muscles. We applied 5 single stimuli separated by an interval of at least 20 s.
3. Evaluation of the SSR excitability recovery. We applied 3 pairs of electrical stimuli to the median nerve: a conditioning and a test one. The interstimulus interval was fixed at 2 s, since the recovery of the SSR at this interval was significantly larger in patients with hyperhidrosis than in healthy controls in a previous study (Manca et al., 2000).

4.1. Evaluation of patients satisfaction

Patient's satisfaction was assessed using a 10 cm long visual analog scale (VAS) and a questionnaire at the time of the study after surgery. In the VAS, patients retrospectively rated the degree of discomfort that they experienced before and after surgery (0 = no discomfort and 10 = the highest level of discomfort). The assessment after surgery included not only the evaluation of the direct effects of the treatment on the palmar sweating, but also the presence of compensatory sweating and its location.

5. Surgical procedure

The patient was positioned in lateral decubitus and anesthetized. A videothoracoscopic catheter was introduced through a trocar inserted in the axillary region. After pulmonary collapse, we visualized the first, second and third ribs. The second thoracic ganglion (T2) was usually located in the space between the second and third ribs, although in a few cases, we found it over the rib head, over the costovertebral joint, or even over the transverse process of the vertebra. The sympathetic trunk was often identified visually and, if not, by palpation or dissection. We severed the sympathetic trunk at the second and third ribs, thereby isolating the T2 and T3 ganglia. An increase in pulse width and temperature were observed in the ipsilateral hand inmediately after T2 sympathicolysis due to sympathetic