ORAL STIMULATION OF PATIENTS WITH BURNING MOUTH SYNDROME USING SINUSOIDAL CONSTANT CURRENT

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Abstract: Burning mouth syndrome (BMS) represents an oral pain disorder without the apparent lesions on oral mucosa. Genesis of BMS is still unclear, but neurological disturbances are highly suspected. The aim of this investigation is to compare the oral mucosal sensibility to sine wave constant current electrical stimulation between BMS patients and controls. The hypothesis that there is a possible alteration in reactibility in patients with BMS is tested. Participants are sorted in 2 groups: one consists of 37 BMS patients, and the other is control group with are 30 age and sex matched subjects. Current perception thresholds' testing was carried out on the tongue tip. For creating measurable sinusoidal constant current stimuli, we had produced sinusoidal constant current source. We performed tests at frequencies of 20, 200, 500 Hz, 2 and 5 kHz. We have used two active electrodes of different sizes comparison. BMS group had statistically significant lower current perception thresholds for any frequency and any active electrode applied (post hoc Scheffe multiple comparisons; $p<0.001$ with smaller active electrode applied and $p\leq0.007$ with larger active electrode applied), Sinusoidal constant current stimulation of oral mucosa showed somatosensory hyperfunction in patients with burning mouth syndrome, ascribing it a neurological origin.

Introduction

Burning sensation in the mouth can often be a symptom of local or systemic disease. As opposed to this, burning moth syndrome (BMS) represents a burning sensation in the mouth when clinical examination of the oral mucosa reveals no abnormalities and when no underlying dental or medical causes are identified (ZAKRZEWSKA et al, 1999, BUCHANAN and ZAKRZEWSKA, 2000). The symptom of burning pain can be localized to the tongue and/or lips, but it also can involve the whole oral cavity. In most cases the symptoms are bilateral, last for months or years, and intensity of pain increases towards the end of the day. In general population prevalence rates of BMS vary from 0.7% (LIPTON et al, 1993) to 2.6% (THORSTENSSON and HUGOSSON, 1996). BMS predominantly affects postmenopausal women (BASKER et al, 1978). The cause of BMS is unknown but recent investigations suggest that neuropathological mechanisms may be involved. JAASKELAINEN et al (1997) have found abnormal blink reflexes in BMS patients. They later noted, using positron emission tomography, a decreased dopaminergic inhibition in BMS patients (JAASKELAINEN et al, 2001). GRUSHKA et al. (1987) showed sensory abnormalities in features such as touch, two-point discrimination, temperature perception, pain threshold and pain tolerance in BMS patients. SVENSSON et al. (1993) showed altered sensory and pain thresholds in BMS patients using argon laser. ALAJBEG et al. (2001) applied galvanic current and found that patients suffering from BMS showed generally lower oral mucosal sensory thresholds than age- and sex-matched controls. Current perception thresholds measurements showed to be highly applicable psychophysical quantitative sensory testing method. In addition to galvanic stimulation, sinusoidal constant current has successfully been applied for cutaneous perioral sensory thresholds measurements (LERNER et al., 2000), as well as for perception threshold measurements of oral mucosa (ALAJBEG et al., 2004), in both studies on healthy individuals. In this study, we wanted to compare oral mucosal sensibility of BMS patients with controls, with a hypothesis that there might exist measurable difference in reactibility pattern between groups. By performing assessments of orofacial sensory function, we investigated neurophysiological aspects of the BMS.

Materials and methods

We have performed quantitative sensory testing on totally 67 subjects. The experimental group consisted of 37 BMS patients (mean age 61, 34 females). Before the present study, at previous admissions, subjects with complaint of burning sensation in their mouth were evaluated in order to elucidate the etiology of burning symptoms. A complete medical history was obtained and oral medical examination was performed to exclude the presence of oral lesions. Mycological smears were taken to identify Candidal infection. Every participant underwent tests according to BERGDAHL and ANNEROTH (1993), in order to exclude patients whose burning symptoms are consequences of local or systemic diseases. Only participants with negative findings were considered "true BMS" and were included in the investigation. The control group

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consisted of 30 age- and sex-matched subjects (mean age 60, 27 females). They were patients from the Department of prosthodontics, randomly chosen a week after they had their restorative treatment completed. Every subject had oral lesions excluded. A current perception threshold testing was carried out on tongue tip, in previous studies proven to be the most sensitive oral region (ALAJBEG *et al.*, 2001).

For creating measurable sinusoidal constant current stimuli, we had produced sinusoidal constant current source, VCS01. The source provides continuous current intensity increase from 70 μA_{RMS} to 10.0 mA_{RMS} at frequencies of 20, 200, 500 Hz, 2 and 5 kHz (Figure 1).

Figure 1: Sinusoidal constant current source VCS01 designed for the experiment. On the central position of the front panel are LCDs for RMS voltage and current intensity.

We have used two different active electrodes for comparison. Smaller active electrode with circular section has 2 mm diameter, and larger active electrode with rectangular section of 4 and 12 mm sides. They were both made of surgical steel. Return electrode was either stainless steel concave rectangular plate of 40 and 70 mm sides and positioned in volar part of forearm. Every participant had the forearm skin cleaned with 70% ethanol. Conduction gel ("Eko Gel", Italy) was put on cleansed forearm skin, followed by positioning of return electrode and fixing it by strap. Participants would then rinse their mouth with non-sparkling mineral water ("Jamnica", Croatia) to obtain similar electrolytic environment. Active electrode was placed on the investigated area, and current intensity was gradually increased by examiner. Linear increase of current intensity went to the point at which participant feels any change of sensation, which corresponds to the current perception sensory threshold. Every participant was then instructed to release the sound, and the current was recorded at which a sensation occurred. The sensory thresholds were recorded for both active electrodes, at all five frequencies. Measurements were performed in triplicates, and mean values of 3 successive measurements were taken into account. Testing was carried out in the morning, in calm and silent atmosphere. Since threshold measurement is a subjective test, evaluating the extent of the subject's cooperation is required, so we used "null stimuli". These are randomly interspersed among test stimuli, and if subjects responded to such stimuli, they were either alerted again to the instructions and the test would be restarted, or declared unsuitable for psychophysical testing. Obtained results were analyzed by standard statistical methods (descriptive statistics, ANOVA, post hoc Scheffe test).

Results

Mean values and standard errors of sinusoidal constant current intensities required to elicit a sensation on the tongue tip using small electrode and large electrode are graphically shown in Figures 3 and 4, respectively. With further focus on differences between groups, it can be observed that BMS group had lower current perception thresholds for any frequency and any active electrode applied. These differences (post hoc Scheffe multiple comparisons) showed to be statistically significant ($p<0.001$ with smaller active electrode applied and $p\leq0.007$ with larger active electrode applied), with exception of stimulation frequency of 2000 Hz with larger active electrode, which yielded no statistically significant differences ($p=0.314$), (Table 1). Regarding electrode size, thresholds obtained with small and large electrode were compared within the same frequency, within the group. Active electrode of smaller area elicited significantly lower sensory thresholds for every frequency in both groups (ANOVA, $p\leq0.001$). According to ANOVA, significant differences were found among 5 frequencies within every electrode setting for any tested group. ($p\leq0.001$). Post hoc Scheffe multiple comparisons showed differences between every two testing frequencies, but with following exceptions: between 20 and 200 Hz ($p=0.442$) and between 200 and 500 Hz ($p=0.095$) in BMS group, as well as between 20 and 200 Hz ($p=0.396$) and between 200 and 500 Hz ($p=0.578$) in control group.

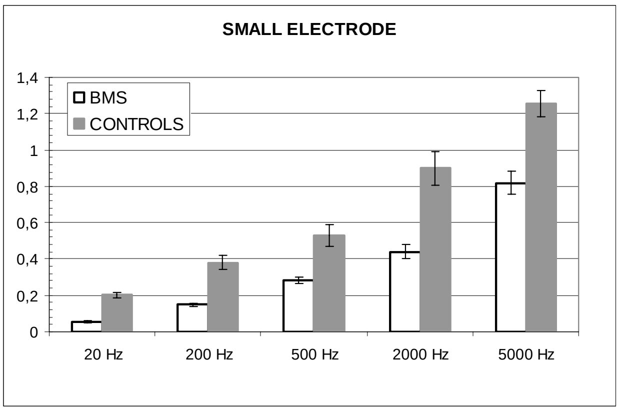

Figure 3: Mean current perception thresholds and standard errors on the tongue tip in BMS and controls when small electrode was applied. X-axis: stimulatory current frequencies (in Hz). Y-axis: current intensities (in mA_{RMS}) at current perception thresholds.

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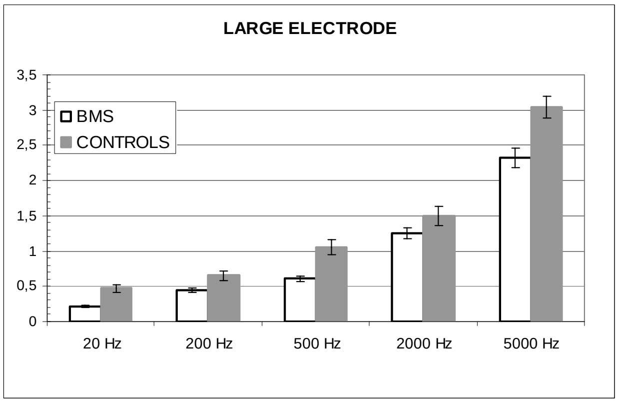

Figure 4: Mean current perception thresholds and standard errors on the tongue tip in BMS and controls when large electrode was applied. X-axis: stimulatory current frequencies (in Hz). Y-axis: current intensities (in mA_{RMS}) at current perception thresholds.

Table 1: Post-hoc Scheffe testing of obtained current perception thresholds differences between groups, for each frequency and used electrode.

USED ELECTR.	**FREQ. (Hz)**	**BMS** MEAN **(mA)**	**CONTROL** MEAN **(mA)**	**p-value**
SMALL	20	0.056	0.202	<0.001
	200	0.148	0.380	<0.001
	500	0.282	0.529	<0.001
	2000	0.440	0.899	<0.001
	5000	0.820	1.255	<0.001
LARGE	20	0.213	0.470	<0.001
	200	0.440	0.651	0.007
	500	0.608	1.052	<0.001
	2000	1.259	1.498	0.314
	5000	2.320	3.045	0.004

Discussion and conclusions

BMS patients group showed consistently lower oral mucosal sensory thresholds to constant current stimulation, indicating a presence of somatosensory hyperfunction in patients with BMS... The hyperesthesia in BMS subjects was also observed in our previous study with oral galvanic stimulation (ALAJBEG et al, 2001). As opposed to our findings, recent study by FORSSELL et al (2002), as judged by results of quantitative sensory testing and blink reflex recording, implies the presence of subclinical trigeminal neuropathy in BMS patients, coupled with hypoesthesia.

This study confirmed that current perception thresholds rise with the increase of current frequency, common feature described by DALZIEL and LEE, 1969. On the contrary, WARD and ROBERTSON (1998) have found the decrease of sensory and pain perception thresholds with current frequency increase from 1 to 10 kHz. They, however, reported the increase of thresholds with further frequency increase above 10 kHz.

Our results also confirmed that increase in electrode size, i.e. in contact area size from 3.14 mm^2 to 48 mm^2 (areas of smaller and larger electrodes, respectively) consistently caused the increase in current perception threshold for every frequency and within both groups, which is due to the current density decrease. Quantitative sensory testing of sinusoidal current perception thresholds on oral mucosa showed its potential as a reliable, repeatable and painless psychophysical oral sensory testing method.

Drawbacks of the method are that it is a “reaction time inclusive method”. Furthermore, “normative” data obtained in studies like ours can only be observed as relative values, because the absolute values will be changed following the change of any testing parameter, such as frequency, testing site or electrode design. Since it is a subjective psychophysical quantitative sensory testing, the question still remains if there is a real hyperesthesia or hypervigilance present in set of BMS patients.

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