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Alterations in taste perception as a result of hyperbaric oxygen therapy

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ABSTRACT

The present study evaluates the effect of hyperbaric oxygen therapy on taste sensitivity, hedonic perception of taste, and food preferences. The studied groups included 197 people in total (79 in the study group; 118 in the control group). All patients from the study group were treated with hyperbaric oxygen therapy due to chronic non-healing wounds. The control group consisted of healthy people, who did not receive hyperbaric oxygen therapy. The taste intensity, recognition thresholds, and hedonic perception were examined using gustatory tests. The aqueous solutions of sucrose for sweet, sodium chloride for salty, citric acid for sour, quinine hydrochloride for bitter, and monosodium glutamate for umami taste were used. The participants fulfilled the questionnaire to examine pleasure derived from eating certain types of dishes. Gustatory tests and analyses of the pleasure derived from eating in the study group were carried out before the first exposure to hyperbaric oxygen and then at the end of therapy, after at least 25 sessions of treatment. In the control group, examination of perception of taste sensations was conducted only once. The results of comparing patients with non-healing wounds with healthy people are characterized by reduced taste sensitivity. After participation in hyperbaric oxygen therapy, the improvement in perception of taste sensations and changes in hedonic evaluation have occurred among patients with non-healing wounds. In terms of food preference, a decreased desire for eating sweet desserts, chocolate, and crisps was observed in those patients who received hyperbaric oxygen therapy.

1. Introduction

Taste is one of our five senses. The sense of taste plays a critical role as “the gatekeeper” of the body, protects humans and animals from consuming dangerous substances and encourages the consumption of nutrient-rich food. Thus, disruptions in perception of taste sensation can have a substantial impact on nutrition (Cowart, 2005). Taste is one of its most important factors, providing enjoyment for food consumption. Weaker taste sensitivity reduces the joy of eating nutritious and tasty food and makes it difficult to detect rotten food. The lack of pleasure experienced during food consumption among patients with taste disorders not only reduces the appetite, but also leads to social and psychological problems. The most common cause of taste disorders is impairment of the peripheral receptors. Taste disorders due to changes in central nervous system have been found only in a few cases (Hamada, Endo, & Tomita, 2002; Onoda, Ikeda, Sekine, & Ogawa, 2012).

Local and systemic changes in body function are commonly reflected by the activity of chemosensors, including the taste receptors. Many pathologies are manifested by changes in taste perception. Chronic disease processes involving multiple organ systems are usually accompanied by sensory changes in taste buds.

Non-healing wounds are usually associated with systemic

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disorders, such as atherosclerosis, cardiovascular disorders, ischemia, or neuropathy, which may also contribute to the deterioration of perception of taste sensations. Type II diabetes is an example of a chronic disease in which both non-healing wounds and taste perception disorders appear (Borgnakke, Anderson, Shannon, & Jivanescu, 2015).

Disruptions in perception of taste sensations may occur in one of two forms. Patients will either complain of reduction or loss of taste perception (hypogeusia or ageusia), or they complain of the presence of a persistent, unpleasant taste sensation (phantogeusia), frequently in conjunction with disruptions in assessing taste quality (dysgeusia) (Cowart, 2011). According to normative data (Welge-Lüssen, Dörig, Wolfensberger, Krone, & Hummel, 2011), hypogeusia affects approximately 5% of the population. Complete lack of taste perception may occur in one or two individuals in a thousand.

Taste disorders may result from multiple causes, so devising a treatment plan is often challenging. In the Taste and Smell Clinic in Washington DC, scientists developed tripartite methodology to assist in the treatment of chronic taste dysfunctions. The program included:

1) Clinical evaluations (history of present illness related to taste dysfunction; history of prior acute and chronic illness, drug treatment, hospitalization etc.; neurological examination; head and neck examination; gustometry and olfactometry; imaging studies of the skull including the nasal region, imaging studies of the brain, and the assessment of brain function).
2) Biochemical evaluations (blood and urine evaluation; parotid saliva evaluation; nasal mucosa evaluation).
3) Integration of these results into a comprehensive pattern of taste dysfunction for each patient individually, to enable elaboration for an effective treatment and allow further therapy monitoring (Henkin, Levy, & Fordyce, 2013).

Other research groups have achieved improvement in perception of taste sensation after using transcranial magnetic stimulation therapy (Henkin, Potolicchio, & Levy, 2011), intranasal theophylline treatment (Henkin, Schultz, & Minnick-Poppe, 2012), or from zinc supplementation (Mahajan et al., 1980; Yoshida, Endo, & Tomita, 1991).

None of the methods mentioned above will affect all patients, so new treatments for taste disorders are still sought. Hyperbaric oxygen therapy (HBOT) has a number of positive effects on the human body, including a proven therapeutic effect on pathological changes that are accompanied by taste sensation dysfunction. The question then arises of whether it also affects the taste sensation.

HBOT is a treatment in which the patient is exposed to increased atmospheric pressure while breathing 100% oxygen. Breathing greater than 1 ATA (ATA-atmosphere absolute) O_2 increases production of reactive oxygen species. This is critically important, as it provides the molecular basis for a number of therapeutic mechanisms such as: increased wound growth factors synthesis; stem/progenitor cells' mobilization from bone marrow, which improves neovascularization; lower monocyte chemokine synthesis, increasing the activity of heme oxygenase-1 (HO-1), heat shock proteins, and hypoxia inducible factor 1 (HIF-1), which improve post-ischemic tissue survival (Thom, 2011). HBOT has been successfully used for the treatment of a variety of clinical conditions related to hypoxia (Feldmeier, 2003; Gurdol et al., 2008), and is used in the treatment of non-healing wounds such as diabetic foot, which is the most frequent cause of non-traumatic lower extremity amputation. Hyperbaric medicine is also used to treat aggressive muscle and skin infections caused by mixed antibiotic-resistant bacterial flora. Hyperbaric medicine supports and improves the body's defense mechanisms by providing extra oxygen to leukocytes. Early use of HBOT in patients with non-healing wounds reduces the amount of necrotic tissue around the wound requiring removal and reduces mortality after complications (Błochowiak & Sokalski, 2011).

Considering the positive effects of HBOT on the physiological functions of various tissues and organs, we set ourselves a question:

- Will hyperbaric oxygen therapy also affect sensory body functions in a range of perception of taste sensations in patients with non-healing wounds?

Therefore, the aim of the study was to determine possible changes in the perception of taste sensations, in hedonic evaluation, and in food preferences due to hyperbaric oxygen therapy use.

2. Patients and methods

2.1. Patients

The study group (H group) consisted of 28 women and 51 men, aged from 30 to 77 years (mean ± SD: 55.38 ± 10.55). Body mass index (BMI) ranged from 20.9 to 50.9 (mean ± SD: 29.6 ± 5.9). Twenty-nine patients were smokers and did not quit smoking during the treatment process. All patients were treated with hyperbaric oxygen therapy because of chronic non-healing wounds. The HBOT took place in a multiplace hyperbaric chamber in the presence of a medical attendant. All HBOT patients concluded 25–30 sessions of HBOT at 2.5 ATA (1 atm absolute –ATA) for 87 min per session. They had five sessions each week, at the same time. The pressure was obtained by compressed air and the patients breathed 100% oxygen through tightly fitted (nose and mouth) masks, exhaling through valves connected to the chamber's pneumatic system.

Diseases leading to the formation of wounds according to International Statistical Classification of Diseases and Related Health Problems (ICD) were: other specified local infections of skin and subcutaneous tissue (L08.8) in 38 (48%) patients; diabetes mellitus with peripheral circulatory complications (E10.5) in 24 patients (30%); varicose veins of lower extremities with both ulcer and inflammation (I83.2) in 12 (15%) patients; chronic osteomyelitis with draining sinus in three (4%) patients and decubitus ulcer (L.89) in two (3%) patients. From the time of wound appearance, it took from 1 to 470 months (mean ± SD: 42 ± 86, median: 10) to begin therapy. As a result of HBOT, in two (3%) patients the wound deteriorated, in three (4%) the wound remained unchanged, in 63 (79%) the wound improved, and in 11 (14%) the wound has healed completely.

2.2. Controls

The control group (C group) consisted of healthy people, who had not previously undergone hyperbaric oxygen therapy, non-smoking, made up of 42 women and 76 men aged between 30 and 76 years (mean ± SD: 55.20 ± 9.94). BMI ranged from 18.4 to 41.4 (mean ± SD: 27.8 ± 3.9).

The study was conducted in accordance with the Helsinki Declaration, and every participant provided written consent after being informed of the aim, protocol, and methodology of the study. The research project was approved by the Bioethics Committee of the Medical University of Silesia.

2.3. Basic testing conditions

Gustatory tests and analyses of the pleasure derived from eating in the H group were carried out prior to the first exposure to hyperbaric oxygen (H before) and then at the end of therapy, at least after 25 sessions of treatment (H after). In the control group (C), investigation of perception of taste sensations was conducted only once.

All tests in the H group (before and after) and in the C group were carried out in the morning on two consecutive days. On one of the days, the perception of three basic taste categories was analyzed; on the other day, one of the remaining tastes and taste preferences was analyzed. The study was performed with all patients on an empty stomach, with the exception of 24 patients in group H who consumed breakfast 2 h before the study. Patients who were allowed to consume breakfast were patients with diagnosed diabetes mellitus with peripheral circulatory complications (E10.5). An empty stomach in these patients during travel to the 'Dr. Stanislaw Sakiel Centre for Burn Treatment' from the place of residence, and during the study, would have been dangerous to their health due to the possibility of hypoglycaemia.

2.4. Gustatory tests

In the gustatory tests, we studied taste recognition threshold, taste intensity, and hedonic perception. These parameters were measured according to a procedure consistent with the standards of ISO 3972 (Mahajan et al., 1980).

For taste perception, we used the following aqueous solutions (Table 1): sucrose solutions for sweet; sodium chloride for salty; citric acid for sour; quinine hydrochloride for bitter; and monosodium glutamate for umami. All samples were labeled with randomized three-digit codes. The participants knew neither the type of substance used nor the coding system. The patients tasted the samples in the order shown in Table 1, according to the sip and spit method. A whole 15 ml sample was taken into the mouth and spat out after 5 s. The patients evaluated their taste sensations in response to each sample from a series of 10 concentrations with respect to quality (no sensation, sweet, salty, bitter, sour, umami). Based on these results, a taste recognition threshold (the lowest concentration resulting in the correct recognition of a taste in relation to its quality) was assigned.

A three-sample series of suprathreshold concentrations were used for examining both the intensity and hedonic perception of taste sensations. The patients recorded the intensity of taste perceptions on a 10-cm linear analog scale with the starting point marked "0" and the end point "10" (maximum taste perception), and the degree of pleasure derived from a taste sensation on a linear analog scale with extreme points described as maximally unpleasant (−5.0), maximally pleasant (+5.0), or a middle point referred to as neutral (0). The results were obtained by measuring the distance from the zero point on the scale to a subject's mark.

2.5. Pleasure derived from eating

Participants were shown color photographs of certain types of dishes. Each subject was asked to answer the following question: How pleasant does the dish shown in the photograph appear to you? Patients recorded their answers for each from 24 types of food (fish dishes, egg dishes, milk drinks, milk soup, cheese, beef and pork, sausages and ham, poultry, fast food, seafood, sweet desserts, chocolate, candies and jellybeans, salty products, crisps, sour products, spicy dishes, dumplings, pasta, bread, broth, other soup, vegetables and salads, fruits) on separate sheets using a 10-cm linear analog scale with the starting point marked "0" (lack of pleasure) and the end point "10" (maximum pleasure).

2.6. Data analysis

The statistical analyses were performed using Microsoft Excel 2010 and Statistica 10.0 software. The Wilcoxon test was used to compare taste recognition, intensity, hedonic perception, and the self-reported pleasure gained from food intake in patients before (H before) and at the end (H after) of treatment. The Mann–Whitney U test was used to compare the results of group H patients with diabetes mellitus to those of group H patients without diabetes mellitus. Since there was no significant difference between these subgroups of patients, a further Mann-Whitney U test was performed that involved entire group H participation. The Mann-Whitney U test was used to compare taste recognition, intensity, and hedonic perception in the control group and patients before HBOT. Significance was set at $p < 0.05$.

3. Results

The recognition thresholds for salty ($p < 0.001$), sweet ($p < 0.01$), umami ($p < 0.0001$), sour ($p < 0.0001$), and bitter ($p < 0.0001$) were higher in the H group before treatment than in the controls (Fig. 1).

The recognition of salty taste in the H group did not differ before and after treatment. On the contrary, the recognition threshold was decreased after therapy (H after) compared with before treatment (H before) for the recognition of umami ($p < 0.001$), sour ($p < 0.01$) and bitter ($p < 0.001$). The trend for a similar difference was observed in the recognition of sweet ($p = 0.08$).

Table 1
Concentrations of taste solutions used for the gustometric investigations.

Order of solutions	Concentrations					Type of examination
	Sodium chloride (g/l)	Sucrose (g/l)	Monosodium glutamate (g/l)	Citric acid (g/l)	Quinine hydrochloride (mg/l)	
1	0.16	0.34	0.08	0.0036	0.0222	Taste recognition threshold
2	0.24	0.55	0.12	0.0057	0.0378	
3	0.34	0.94	0.17	0.0088	0.0642	
4	0.48	1.56	0.24	0.0138	0.1092	
5	0.69	2.59	0.34	0.0216	0.1856	
6	0.98	4.32	0.49	0.0338	0.3156	
7	1.40	7.20	0.70	0.0528	0.5365	
8	2.00	12.00	1.00	0.0830	0.9121	
9	2.85	20.00	1.43	0.1300	1.5505	
10	4.07	33.33	2.04	0.2000	2.6359	
	(%)	(%)	(%)	(%)	(%)	Taste intensity and hedonic response
I	0.18	1	0.1	0.02	0.001	
II	0.36	10	0.3	0.04	0.002	
III	0.90	30	1.0	0.10	0.005	

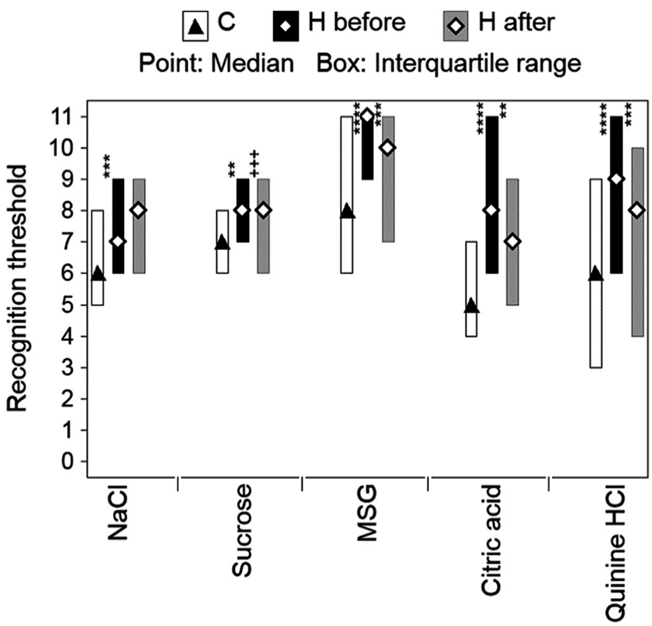

Fig. 1. Recognition thresholds for salty (NaCl), sweet (sucrose), umami (monosodium glutamate or MSG), sour (citric acid), and bitter (quinine hydrochloride) solutions for control (C) and hyperbaric oxygen therapy (HBOT) patients before (H before) and at the end (H after) of treatment. Number 11 on the scale represents too high a recognition threshold for the given concentrations $^{+++}p = 0.08$; $^{**}p < 0.01$; $^{***}p < 0.001$; $^{****}p < 0.0001$.

The intensity of taste sensations caused by quinine hydrochloride, 0.90% NaCl, 10% sucrose, and 0.3% monosodium glutamate (MSG) solutions did not differ for patients before hyperbaric oxygen therapy (H before) compared with the controls (Fig. 2).

In comparison to the control group, the intensity of taste sensation for 0.18% NaCl ($p < 0.001$), 0.36% NaCl ($p < 0.05$), 1% sucrose ($p < 0.01$), 0.1% MSG ($p < 0.001$), 1.0% MSG ($p < 0.05$), 0.02% citric acid ($p < 0.01$), and 0.04% citric acid ($p < 0.05$) solutions were described as less intense by patients before HBOT (H before). The trend for a similar difference was observed in the intensity of taste sensation for 0.10% citric acid concentration. The strength of sour taste sensation was recognized as less intense by patients before HBOT ($p = 0.06$).

The intensity of taste sensation for 30% sucrose solution only was considered as more intense by patients before HBOT (H before) compared to the controls ($p < 0.05$).

The intensity of taste sensation caused by sucrose did not differ significantly before (H before) and after (H after) HBOT. On the contrary, the intensity of taste sensation increased after therapy, compared with the situation before treatment for the 0.1%, 0.3%, 1.0% monosodium glutamate ($p < 0.05$, $p < 0.05$, $p < 0.001$, respectively) and for the 0.1% citric acid ($p < 0.01$) solutions. The trends for a similar difference were observed in the cases of 0.36% sodium chloride ($p = 0.07$) and 0.005% quinine hydrochloride ($p = 0.07$) concentrations.

Hedonic responses were significantly higher for patients before HBOT compared with the controls to 0.18% NaCl ($p < 0.001$), 0.3% MSG ($p < 0.05$), 1.0% MSG ($p < 0.05$) and 0.10% citric acid ($p < 0.05$) solutions. No significant differences were found for the hedonic response to any sucrose and quinine HCl solutions, 0.36% and 0.9% NaCl, 0.02% and 0.04% citric acid solutions (Fig. 3).

A comparison of group H before and after HBOT found no significant differences for the hedonic response to monosodium glutamate and quinine hydrochloride. For the solutions of 10% sucrose and 0.1% citric acid, hedonic responses were significantly lower after treatment (H after) in comparison to those before treatment (H before), at $p < 0.05$ and $p < 0.01$, respectively. Trends for a similar difference were observed in the cases of 0.36% sodium chloride ($p = 0.08$).

After HBOT, some foods were described as less pleasant than before therapy: sweet desserts ($p < 0.01$); chocolate ($p < 0.001$); and crisps ($p < 0.05$) (Fig. 4).

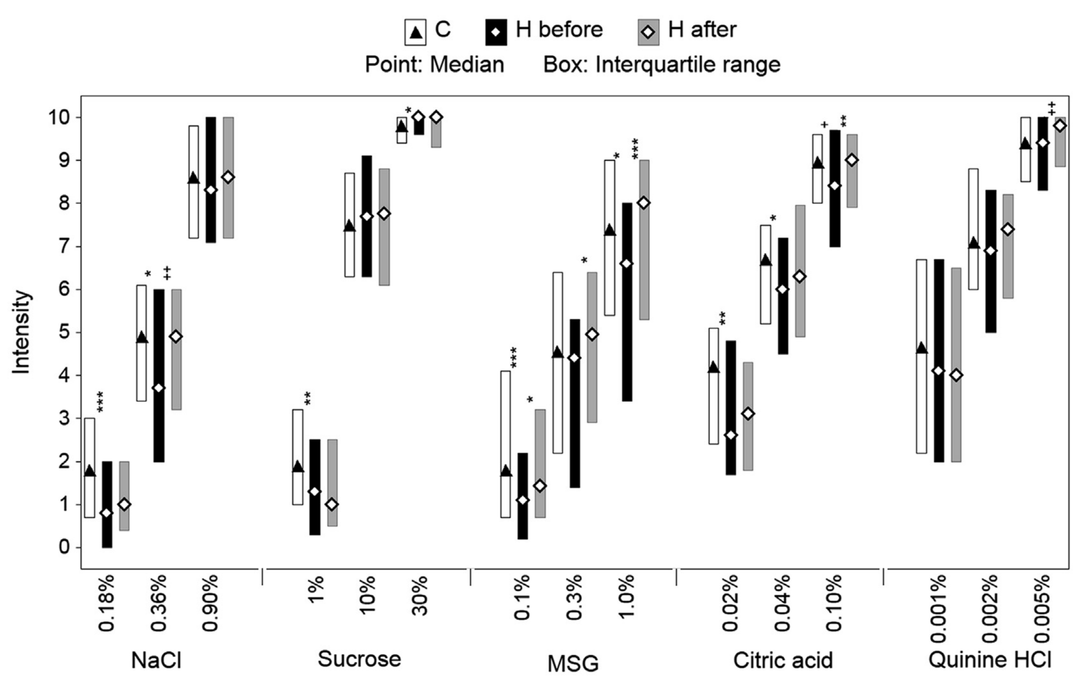

Fig. 2. Intensity of taste sensations for specific concentration of salty (NaCl), sweet (sucrose), umami (MSG), sour (citric acid), and bitter (quinine hydrochloride) solutions reported by controls (C) and HBOT patients before (H before) and at the end (H after) of treatment $^{+}p = 0.06$; $^{++}p = 0.07$; $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$.

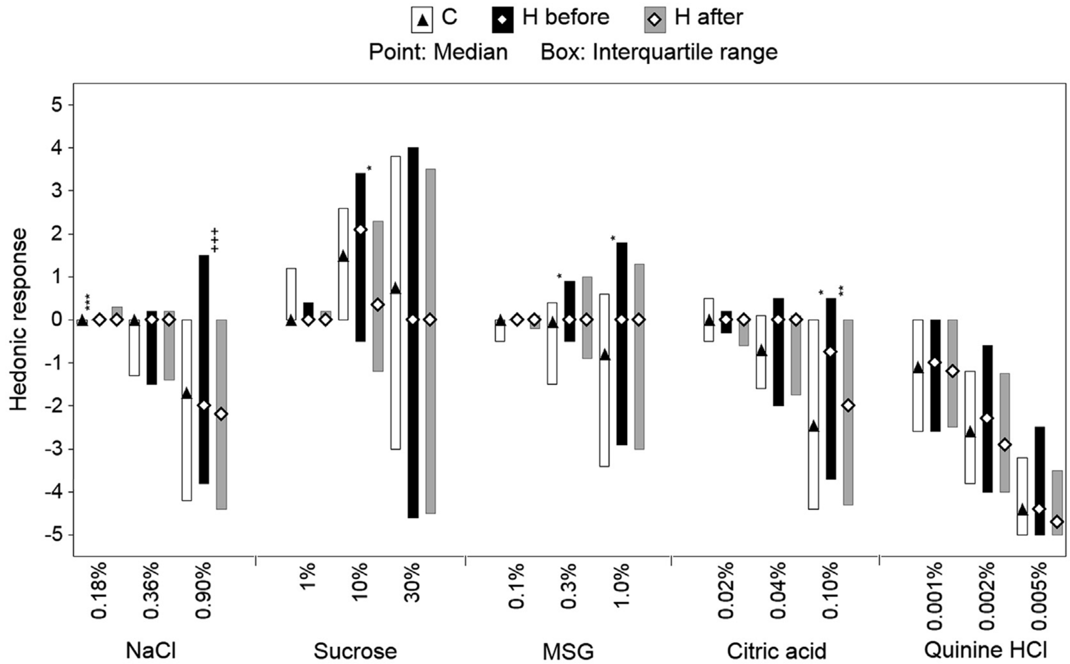

Fig. 3. Hedonic responses to specific concentration of salty (NaCl), sweet (sucrose), umami (MSG), sour (citric acid), and bitter (quinine hydrochloride) solution reported by controls (C) and HBOT patients before (H before) and at the end (H after) of treatment $^{+++}p = 0.08$; $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$.

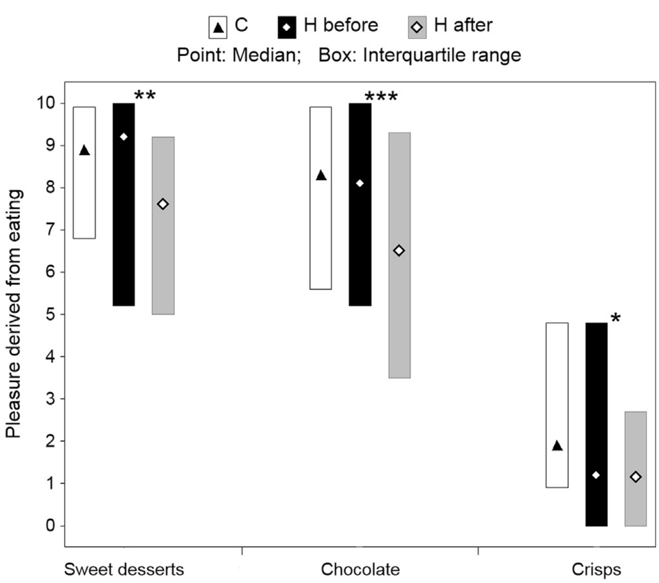

Fig. 4. Pleasure derived from eating various foods reported by controls (C) and HBOT patients before (H before) and at the end (H after) of treatment $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$.

4. Discussion

Taste plays a crucial role in creating taste sensations while eating. Despite support from visual and olfactory sensations, the chemoreceptors located in the oral cavity are responsible for the final identification and selection of food. Emotions, triggered by pleasant or unpleasant taste sensations, have a huge impact on food choice, while food preferences influence physical health condition (Chaudhari & Roper, 2010; Suchecka, Hartman, Klimacka-Nawrot, Stadnicki, & Błońska-Fajfrowska, 2012).

The positive effect of HBOT on taste perception has been demonstrated in this study. Before HBOT, patients with non-healing wounds were characterized by lower sensitivity of taste stimuli compared with healthy controls. HBOT increased their sensitivity of taste. The recognition thresholds of umami, sour and bitter tastes were decreased after therapy compared with situation before treatment, and there was a trend of decrease in the recognition threshold for sweet taste, which shows an increase in sensitivity of the organ of taste. Additionally, intensity of taste sensation for the 0.1%, 0.3%, 1.0% monosodium glutamate concentrations and for the 0.1% citric acid concentration was increased after therapy, compared with the situation before treatment. Trends of a similar difference for the 0.36% sodium chloride concentration and the 0.005% quinine hydrochloride concentration were observed. It has been also reported that HBOT affects the hedonic evaluation of taste sensations created after applying suprathreshold solutions.

Hedonic evaluations were significantly lower after treatment, in comparison to evaluation before treatment for 10% sucrose solution and 0.1% citric acid solution. Trends for a similar difference were observed in the cases of 0.36% sodium chloride solution.

There are no similar studies in the available literature (to the best of our knowledge), so the comparison of our results with those of other authors is difficult. However, it has been shown that in oral and oropharyngeal cancer patients treated with radiotherapy after HBOT improvement of taste sensitivity had manifested 2 years after the end of treatment (Gerlach et al., 2008). The most frequent side effect of radiotherapy is xerostomia, where salivary glands produce less than usual saliva. In addition, taste buds and their nerve fibers are damaged. Without hyperbaric treatment, taste sensation after radiotherapy does mostly recover to normal or near-normal levels, but only after a long interval. Within sense of taste, the mechanism of recovery is unknown. It can be speculated that HBOT stimulates taste buds and regeneration of nerve fibers. Production of saliva also increases, so food particles are readily available to the taste receptors (Gerlach et al., 2008). Detailed information on HBOT's influence on the perception mechanism of taste sensations is not available. Instead, we may look at the effects of hyperbaric medicine on the body, which may indirectly explain the results obtained in this study.

The effects of hyperbaric medicine are related to direct physical presence of oxygen in the blood and tissues, and bring numerous secondary biochemical and physiological benefits. Numerous studies have shown that HBOT induces neurogenesis (Wang, Yang, Xie, Yu, & Wang, 2009; Godman, Joshi, Giardina, Perdrizet, & Hightower, 2010; Zhang et al., 2010). The mechanism of this phenomenon is probably based on the abolition of hypoxia, improved microcirculation blood flow, and improved nervous tissue metabolism (Jagodziński & Knefel, 2007). *In vitro* studies have indicated that HBOT stimulates neural stem cells to differentiate into neurons and oligodendrocytes, and inhibits the differentiation of stem cells into astrocytes. It also increases the proliferation of other cells, and glial cell line-derived neurotrophic nerve growth factor and vascular endothelial growth factor receptor-positive cells, as well as epithelial cells and human microvascular endothelial cells (HMEC-1) (Godman et al., 2010; Milosevic et al., 2009; Tai et al., 2010; Shui & Beebe, 2008; Zhang et al., 2011).

All changes mentioned above may cause the improvement of reception, transmission, and interpretation of the impulses from taste buds. Under the influence of hyperbaric oxygen, the proliferation of epithelial cells increases, which can also have a positive impact on the regeneration of epithelial origin taste (Lindemann, 2001).

Hyperbaric oxygen is beneficial to mucous membrane. Vera Cruz et al. studied the microanatomy of the lower nasal turbinate mucosa in patients undergoing HBOT. HBOT causes minor, but significant changes of the nasal turbinate mucosa; namely, increases in granulocyte infiltration and greater basal membrane thickness (Vera-Cruz, Ferreira, Zagalo, dos Santos, & Àguas, 2008). It is possible that similar changes occur in the oral mucosa and lead to the improvement of perception of taste sensations.

We have demonstrated that hyperbaric medicine markedly modulates food preferences. After HBOT, few foods were described as less pleasant than before therapy. These were sweet desserts, chocolate, and crisps.

The lack of similar previous studies for comparisons meant that we could only trace the influence of factors that determined food preferences and may have changed as a result of HBOT.

There are multiple factors of diverse origin that form and influence food preferences. According to Wądołowska et al., these can be divided into two main groups: food choice factors and sociodemographic factors. One of the factors affecting food choice was taste (Wądołowska, Babicz-Zielińska, & Czarnocińska, 2008).

An increased taste sensitivity, as a result of HBOT, was demonstrated in this study, and was based on a decrease in the taste recognition threshold, and/or increase in the intensity of five basic flavour sensations. Gawędzki et al. demonstrated that increasing the intensity of the sweet taste sensation reduced the preference for sweet tea and sweet dishes, and increasing the intensity of the salty taste sensation reduced the preference for salty meals (Gawęcki & Galiński, 2010). Other authors have reported a reduction in the preferences for sweets, sugary carbonated beverages, and spicy products in patients with increased bitter taste sensitivity (Anliker, Bartoshuk, Ferris, & Hooks, 1991; Duffy et al., 2004; Bartoshuk, Duffy, & Miller, 1994; Duffy & Bartoshuk, 2000; Mennella, Pepino, & Reed, 2005; Prescott & Swain-Campbell, 2000). On this basis, it can be hypothesised that the improvement in taste sensation in patients receiving HBOT may have resulted in reduced preferences for sweet desserts, chocolate, and crisps.

The health status of a patient, and an internal state such as hunger/satiety, is an important factor influencing food preferences (Wądołowska et al., 2008). In this study, the majority of patients who received HBOT achieved noticeable improvement of the wound (63%), or wound healing (14%). These effects observed with non-healing wounds were indicative of positive systemic changes in the body. The results of other studies have confirmed the overall improvement in health after HBOT. Karadurmus et al. investigated the effects of HBOT, i.e. on glycaemic control, insulin resistance, and lipid profiles in patients undergoing systematic HBOT for diabetic foot ulcers (Karadurmus et al., 2010). The following parameters were controlled: fasting blood glucose, haemoglobin A1c, homeostasis model assessment of insulin resistance, and lipid profiles. A significant improvement in the average values of all parameters evaluated was demonstrated following HBOT. Şen et al. investigated the influence of HBOT on endocrine and immunological response in fat tissue in rats, and demonstrated increases in the gene expression levels of leptin and visfatin (Şen, Erbağ, Ovali, Öztopuz, & Uzun, 2016). Leptin is an anorexigenic hormone produced and released by the white adipose tissue, which has an important role in the control of hunger and satiety, and is responsible for the reduction of appetite. It has been shown that obese people have reduced levels of leptin or are resistant to its effect (Chou & Perry, 2013). Visfatin, which is produced by adipose tissue, stimulates the β-cells of the pancreas to secrete insulin, and is involved in the regulation of glucose homeostasis (Revollo et al., 2007). Positive changes under the influence of HBOT, including the regulation of food intake, insulin secretion, glucose homeostasis, and lipid metabolism, may have affected the changes in food preferences observed in this study.

It is worth noting that the perception of sweet desserts, chocolate, and crisps as being less pleasurable is advantageous for the study participants who were predominantly obese (34 people, 43%), overweight (25 people, 32%, mean BMI = 29.6), and some of them suffering from type 2 diabetes (24 people, 30%).

5. Conclusions

Patients with non-healing wounds compared with healthy people are characterized by reduced taste sensitivity. After participation in hyperbaric oxygen therapy, an improvement in perception of taste sensations and changes in hedonic evaluation can be found among patients with non-healing wounds.

In terms of food preference, hyperbaric oxygen therapy contributed to a decreased desire to eat sweet desserts, chocolate, and crisps.

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