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Short Communication

Low reported taste function is associated with low preference for high protein products in advanced oesophagogastric cancer patients undergoing palliative chemotherapy

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SUMMARY

Background & aims: Cancer patients undergoing palliative chemotherapy can experience a variety of chemosensory and food preference changes which may impact their nutritional status and quality of life. However, evidence of these changes in oesophagogastric cancer (OGC) patients is currently mostly qualitative and not supported by quantitative data. The aim of this study was to assess how self-reported and objective taste and smell function and food preferences change over time during chemotherapy in OGC patients.

Methods: This observational study included 15 advanced OGC patients planned for first line treatment with capecitabine and oxaliplatin. Participants completed two test sessions scheduled before start of cytotoxic treatment and after two cycles. Self-reported and objective taste and smell function and the macronutrient and taste preference ranking task were conducted at each test session.

Results: Self-reported taste and smell did not change upon chemotherapy. Objective taste function decreased during chemotherapy, although this was not statistically significant ($p = 0.06$), objective smell function did not change. Before and during chemotherapy, high protein foods were preferred over high carbohydrate and over low energy products, but food preferences did not change over time. A lower self-reported taste function correlated with a lower preference for high-protein products ($\rho = 0.526$, $p = 0.003$).

Conclusion: This study suggests that objective taste function decreases during chemotherapy in OGC patients, but not smell function. A low reported taste function was related to a lower preference for high-protein products.

1. Introduction

Oesophagogastric cancer (OGC) is a highly lethal disease. The overall 5-year survival rate for OGC is approximately 26%, as the majority of patients is diagnosed with advanced disease. For these patients, the benefit of palliative chemotherapy compared with best supportive care has been established both in terms of overall survival and quality of life [1,2]. However, cytotoxic treatment is often accompanied by side effects including alterations in taste and smell that may impact food preferences and quality of life [3,4]. A previous qualitative study of our group in OGC patients undergoing chemotherapy showed a large variation in the experience and impact of changes in taste and smell perception [3]. These chemosensory changes had consequences in terms of food preferences, with a change in food preferences and avoidance of specific products like meat. Taste and smell changes, and eating problems related to the location of the tumour affected daily life and social life. For humans it is difficult to distinguish taste and smell, as these systems are highly related in the perception of food. Therefore it is important to objectively assess taste and smell function to understand the nature of these changes. Thus far, it is unknown how self-reported *subjective* chemosensory changes and changes in food

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preferences relate to actual *objective* measures of taste, smell and food preferences in oesophagogastric cancer patients undergoing chemotherapy. Therefore, the aim of the current study is to measure how self-reported and objective taste and smell function and food preferences change over time during chemotherapy in OGC patients.

2. Materials and methods

2.1. Patients

Twenty-three patients with metastatic or irresectable carcinoma of the stomach or oesophagus were included. All patients were scheduled to start palliative cytotoxic treatment with capecitabine (Xeloda®) 1000 mg/m2 days 1–14 and oxaliplatin (Eloxatin®) 130 mg/m2 day 1 of three-weekly cycles and had a WHO performance status of 0–2. Treatment and tumour characteristics were obtained from medical records.

2.2. Study design

This observational study included test sessions before the first chemotherapy cycle (baseline) and shortly before the third chemotherapy cycle (follow-up). During each test session, the following aspects were assessed in the following order, as to minimize the influence on each other: self-reported taste and smell function, objective smell function, taste function and food preferences. The study was exempted from formal ethical approval by the medical ethics committee of the Academic Medical Centre.

2.3. Measurements

The Appetite Hunger and Sensory Perception questionnaire (AHSP) was used to assess reported taste, smell, appetite and hunger feelings [5]. Smell function was measured using the Sniffin' Sticks, using the extended version to prevent learning [6,7]. The test consists of three parts: odour threshold (THR, range 1–16), odour discrimination (DIS, range 0–16) and odour identification (ID, range 0–16). Overall olfactory function (TDI) was the sum of the three subtests. Taste function was assessed using the Taste Strips (Burghart, Wedel, Germany) to assess sensitivity for sweet, salty, bitter and sour. Scores for each taste ranged from 0 to 4, and total taste scores range from 0 to 16, which was the sum of the four basic taste scores [8]. Food preferences were assessed using the Macronutrient and Taste Preference Ranking Task, a computer-based food preference task with food pictures from four macronutrient categories (high-protein, high-carbohydrate, high-fat and low-energy), divided over sweet and savoury products [9]. Relative preferences were calculated for each category, as described in de Bruijn et al. (2017) [9].

2.4. Data analysis

Differences for taste, smell scores and food preferences within macronutrient and taste categories between baseline and follow-up were analyzed with Wilcoxons Signed Rank test. Preferences between food categories at baseline and follow-up were assessed using Friedman ANOVA with Dunn–Bonferroni test to assess post hoc differences. Spearman correlations were done to correlate reported taste and smell perception with objective taste and smell function, and to correlate reported and measured taste and smell with food preferences. Correlations were performed on all time points combined. Data were analyzed using IBM SPSS version 23.0, a p-value of <0.05 was considered statistically significant.

3. Results

Twenty-three patients were included, of which 8 dropped out because of early discontinuation of treatment (n = 3), feeling too ill to undergo the tests (n = 3), and death before the second measurement (n = 2). Table 1 shows demographic and clinical characteristics of the 15 OGC patients who completed baseline and follow-up measurements.

Self-reported taste, smell, appetite and hunger feelings did not differ between baseline and follow-up (Table 2). Objective taste function at follow-up was lower than at baseline (median 9 vs. 6), which was borderline statistically significant (p = 0.06). For the separate tastes, salt taste decreased the most, although all tastes (salt, sweet, sour and bitter) were not statistically significantly different (Table 2). Furthermore, we observed no differences in the objective measurements of smell function (TDI), threshold, discrimination or identification of odours between baseline and follow-up (Table 2).

Both at baseline and at follow-up, high protein products were preferred over high carbohydrate and low energy products (all

Table 1
Sociodemographic and tumour characteristics of the included OGC patients (n = 15).

		n (%) or mean ± SD
Gender	Male	14 (93)
	Female	1 (7)
Age (years)		61 ± 9.3
BMI (kg/m^2)		24.4 ± 2.7
WHO performance status[a]	0	8 (53)
	1	5 (33)
	2	2 (13)
Tumour characteristics		
Location	Oesophagus	10 (67)
	Gastroesophageal junction	2 (13)
	Stomach	3 (20)
Tumour type	Adenocarcinoma	13 (87)
	Large cell undifferentiated carcinoma	2 (13)
Previous surgery	Yes	4 (27)
	No	11 (73)
Previous treatment	Chemotherapy	6 (40)
	Chemoradiation	2 (13)
	No previous treatment	7 (47)

[a] World Health Organisation (WHO) performance status is a tool to assess a patient's general health.

Table 2
Median (IQR) scores of taste and smell function in oesophagogastric cancer patients before chemotherapy (baseline) and after two cycles chemotherapy (follow-up), n = 15.

	Baseline	Follow-up	P-value
Self-report			
Taste	28 (23–29)	28 (27–28)	0.42
Smell	22 (19–22)	22 (20–22)	0.78
Appetite	21 (19–22)	22 (20–22)	0.59
Hunger	35 (33–38)	34 (30–40)	0.45
Objective taste function			
Total taste	9 (5–12)	6 (5–11)	0.06
Sweet	3 (1–4)	3 (2–4)	0.21
Sour	1 (1–2)	1 (1–2)	0.71
Salty	3 (2–4)	2 (1–4)	0.08
Bitter	1 (0–3)	1 (0–2)	0.45
Objective smell function			
TDI	28.3 (22.0–34.8)	27.3 (21.7–34.5)	0.57
Threshold	6.3 (4–7)	6.5 (5–8)	0.09
Discrimination	10 (9–14)	10 (7–13)	0.23
Identification	12 (9–13)	11 (8–14)	0.15

IQR = Interquartile range, TDI = Threshold Discrimination Identification score.

$p < 0.05$), but no differences were observed in preferences for the macronutrient categories between baseline and follow-up (Fig. 1a). There were no differences in preferences for sweet and savoury products between baseline and follow-up, nor was there a specific preference for either sweet or savoury products (Fig. 1b).

A lower self-reported taste perception was correlated with a lower preference for high-protein products ($\rho = 0.526$, $p = 0.003$), but not to other food categories (all $p > 0.05$). Reported taste and smell perception were not significantly correlated with objective taste and smell function; nor were reported smell perception or objective taste or smell perception significantly correlated with food preferences (all $p > 0.05$).

4. Discussion

This is the first study that used both self-reported and objective methods to assess taste and smell sensitivity and food preferences in oesophagogastric cancer patients undergoing palliative chemotherapy. Although the sample size of the study is small, our results suggest that objective taste function decreases during chemotherapy in OGC patients, while objective smell function remains unchanged. Furthermore, self-reported taste and smell function did not change upon chemotherapy treatment. A recent qualitative study of our group in this patient group showed that OGC patients undergoing chemotherapy do experience chemosensory changes [3]. It could be argued that some experienced changes in the qualitative study were already present prior to chemotherapy, or that they are more hedonic in nature, related to the appreciation of tastes or smells, rather than reflecting an actual decrease in chemosensory function [4]. In addition, the qualitative study showed that there is a high variability in the experience of chemosensory changes during chemotherapy. It could be possible that these changes are therefore not detectable with our measures on a group level.

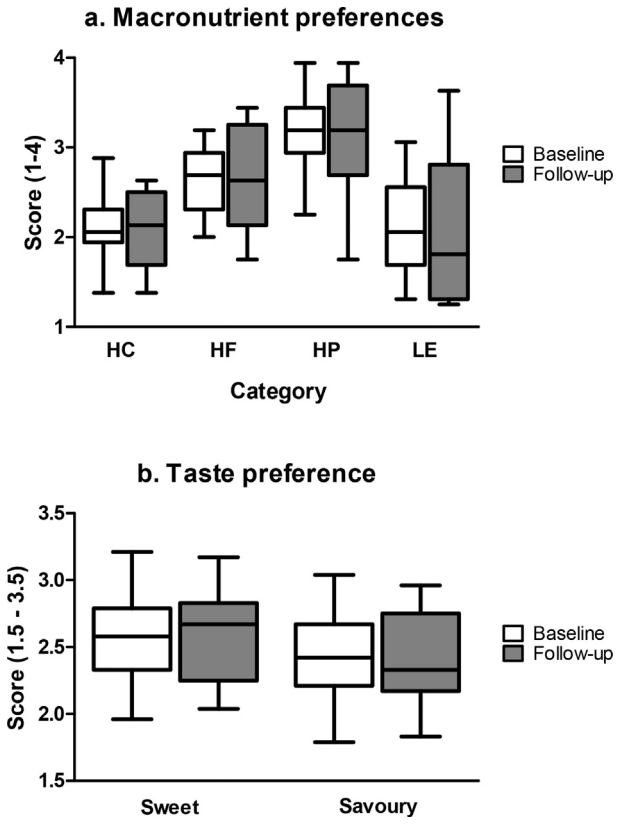

Fig. 1. Boxplot of baseline and follow-up measurements a. macronutrient preferences and b. taste preferences. Whiskers represent minimum and maximum. (HC: high carbohydrate; HF: high fat; HP: high protein; LE: low energy).

Although food preferences did not change during chemotherapy, there was a preference for high protein products over low energy and high carbohydrate products both before and during chemotherapy. This preference for high-protein products was not seen previously in a sample of young healthy adults [9]. Weight loss and malnutrition prevails in the majority of patients with oesophageal cancer before treatment [10]. This weight loss is often accompanied with a loss of muscle mass, indicating a poor protein status. Studies have shown that humans develop compensatory preferences for protein-rich food when being brought into a low protein status by a low-protein diet [11]. Therefore, the preference for high-protein products in our study could be the result of a low protein status in oesophagogastric cancer patients. However, data on changes in weight or body composition were not available in this study.

Importantly, we observed that a low self-reported taste function was correlated with a low preference for high-protein products. Dietary advice in oesophagogastric cancer patients is directed at enhancing protein intake [12]. Potentially, patients with a lower reported taste function have more difficulties to comply to a higher protein intake, as their preference for high-protein products is lower, although studies are needed to confirm this. For clinical practice it might be relevant to consider how patients report their taste function, as an indication whether a high protein intake may be troublesome, and to provide additional nutritional advice to ensure an adequate nutritional intake.

To further investigate the clinical relevance of the results of our study, future studies should assess whether changes in body composition (muscle mass) are associated with changes in preferences towards high-protein foods, and whether a lower preference for high-protein products may result in a lower protein intake. Subsequently, it can be investigated whether these outcomes are related to quality of life or other clinical outcomes.

5. Conclusion

This study suggests that objective taste function decreased during chemotherapy, but smell function does not change in oesophagogastric cancer patients undergoing palliative chemotherapy. A low reported taste function was related to a lower preference for high-protein products.

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Conflict of interest

The authors declare that there is no conflict of interest.

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