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Taste and smell function in testicular cancer survivors treated with cisplatin-based chemotherapy in relation to dietary intake, food preference, and body composition

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ABSTRACT

Background: Chemotherapy can affect taste and smell function. This may contribute to the high prevalence of overweight and metabolic syndrome in testicular cancer survivors (TCS). Aims of the study were to evaluate taste and smell function and possible consequences for dietary intake, food preference, and body composition in TCS treated with cisplatin-based chemotherapy.
Methods: Fifty TCS, 1–7 years post-chemotherapy, and 50 age-matched healthy men participated. Taste and smell function were measured using taste strips and 'Sniffin' Sticks', respectively. Dietary intake was investigated using a food frequency questionnaire. Food preference was assessed using food pictures varying in taste (sweet/savoury) and fat or protein content. Dual-Energy X-ray Absorptiometry was performed to measure body composition. Presence of metabolic syndrome and hypogonadism were assessed.
Results: TCS had a lower total taste function, a higher bitter taste threshold, higher Body Mass Index (BMI), and more (abdominal) fat than controls ($p < 0.05$). No differences in smell function and dietary intake were found. Testosterone level was an important determinant of body composition in TCS ($p = 0.016$).
Conclusion: Although taste function was impaired in TCS, this was not related to a different dietary intake compared to controls. Lower testosterone levels were associated with a higher BMI, fat mass, and abdominal fat distribution in TCS.

1. Introduction

Cancer patients treated with chemotherapy often experience changes in taste and smell, with a prevalence ranging from 45 to 84% and 5–60% for taste and smell changes, respectively (Gamper et al., 2012). These changes can be transient and recover within several months after chemotherapy (Boltong et al., 2014; Steinbach et al., 2009), although some reports state that taste and smell changes occur years after treatment (Boer, Correa, Miranda, & de Souza, 2010; Cohen et al., 2014; McLaughlin, 2013). Literature regarding these long-term taste and smell changes and their possible effect on dietary intake, food preference, and body composition is scarce.

Taste and smell changes in cancer patients have been associated with a decreased energy intake, body weight, and quality of life (Boltong et al., 2014; Zabernigg et al., 2010). Conversely, patients may develop unhealthy eating patterns due to taste and smell

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changes, resulting in overweight (Bernhardson, Tishelman, & Rutqvist, 2009; Mattes et al., 1990). A cross-sectional study in 118 patients with chemosensory changes of various etiologies showed that patients with a decreased taste and/or smell function reported weight gain more often, whereas patients with a distorted or phantom taste and/or smell reported weight loss more frequently (Mattes et al., 1990). In a cross-sectional study, cancer patients with only smell changes reported weight gain more often than patients with both taste and smell changes during chemotherapy (Bernhardson et al., 2009). Several studies indicate a high prevalence of obesity among cancer survivors years after cancer treatment (Brouwer, Gietema, Kamps, de Vries, & Postma, 2007; Nord, Fosså, & Egeland, 2003). Whether changes in taste and smell perception play a role in cancer survivors remains to be elucidated.

Since the introduction of cisplatin, metastatic testicular cancer has become a highly curable disease (Verdecchia et al., 2007). The downside of this treatment is the possible development of long-term complications, such as the high prevalence of overweight and metabolic syndrome, and the increased risk of cardiovascular disease (Nord et al., 2003; van den Belt-Dusebout et al., 2007; Willemse et al., 2013). Moreover, hypogonadism is a common side effect of orchidectomy, influencing body composition (Maes et al., 2002). Metabolic syndrome is a clustering of at least three of five of the following medical conditions: elevated waist circumference, elevated triglycerides, reduced high-density lipoprotein (HDL) elevated blood pressure, and elevated fasting glucose (Grundy et al., 2006). Dietary intake has been linked to individual components of the metabolic syndrome (Grundy et al., 2006). Given the increase in BMI and increased risk of cardiovascular disease and metabolic syndrome, attention to dietary intake of these patients seems warranted.

The present cross-sectional study investigated the taste and smell function in testicular cancer survivors (TCS) treated with cisplatin-based chemotherapy. The consequences of possible taste and smell dysfunction were explored regarding dietary intake, food preference, and body composition.

2. Materials and methods

2.1. Study population

Patients cured from disseminated testicular cancer (seminoma or non-seminoma), treated with first line chemotherapy consisting of etoposide and cisplatin with or without bleomycin were eligible. Patients received three or four cycles of chemotherapy with a cycle interval of 21 days. Inclusion criteria were: complete remission after chemotherapy with no evidence of disease at follow-up, age 18–50 years, and ability to comprehend Dutch. Exclusion criteria were: other chemotherapeutic regimes, active testicular cancer, mental disability, and co-morbidities affecting taste and/or smell function, such as neurologic disorders, rhinosinusitis, liver or renal problems, hyperactivity or hypoactivity of the thyroid gland or diabetes. The age group of 18–50 years was chosen to reduce confounds due to age, since taste and smell function are known to decrease with advancing age (Schiffman & Graham, 2000). Furthermore, testicular cancer patients are relatively young, with a peak prevalence between 25 and 40 years of age (Rajpert-De Meyts, Skakkebaek, & Toppari, 2000). Patients were matched with healthy males regarding age and nationality. Exclusion criteria were: medication use, mental disability, cancer history, and known morbidities affecting taste and/or smell function. Family and friends of the TCS were asked to participate in this study as healthy controls. Moreover, other healthy males without connection with the TCS were asked to participate as healthy controls using posters and flyers. The age of the controls was matched with the age of TCS. Therefore, the inclusion criterion with regard to age was narrowed at times for the control group throughout the study. TCS visiting the outpatient clinic for follow-up were informed both orally and in writing about the study. The treating physicians performed the recruitment of those participants. The researchers and a physician recruited the healthy controls. For TCS, data regarding eligibility were derived from medical records. For controls, eligibility was checked by telephone by a physician. All participants gave written informed consent. The study was approved by the ethical committee at the University Medical Center Groningen (UMCG) (NCT01641172).

2.2. Material and methods

For TCS, all tests were performed during routine follow-up visits 1, 3, 5 or 7 years after start of chemotherapy at the UMCG. All measurements were performed once in TCS and controls. Data on height, smoking, education, and sports level (sport frequency per week: never, 1–2 times/week, 3 or more times/week) were collected during a structured interview. Data concerning disease and treatment were derived from medical records.

2.3. Taste

Filter-paper taste strips (Burghart, Wedel, Germany) were used to measure sweet, sour, salty, and bitter taste thresholds (Mueller et al., 2003). This is a validated tool to assess the taste function and an appropriate test in clinical context, given the short time needed for testing. The following, standard, concentrations of each taste were used: sweet: 0.05, 0.1, 0.2, and 0.4 g/ml sucrose; sour: 0.05, 0.09, 0.165, and 0.3 g/ml citric acid; salty: 0.016, 0.04, 0.1, and 0.25 g/ml sodium chloride; bitter: 0.0004, 0.0009, 0.0024, and 0.006 g/ml quinine hydrochloride. The taste strips were placed in the middle of the tongue for whole mouth testing. The taste strips were presented in increasing concentrations in a randomized order. The participants were not allowed to smoke, brush teeth, use chewing gum or to eat or drink anything else than water 1 h prior to the measurement. Participants chose one of five possible answers (sweet, sour, salty, bitter or no taste). The mouth was rinsed with water before the assessment of each taste strip. Scores for each taste range from 0 to 4. A total taste score (range 0–16) was derived by summing all scores.

2.4. Smell

'Sniffin' Sticks' (Burghart, Wedel, Germany) were used to measure smell function (Hummel, Sekinger, Wolf, Pauli, & Kobal, 1997). This test consists of pen-like odour-dispensing devices and includes tests for odour threshold (THR), discrimination (DIS), and identification (ID). For the THR-test, a standard series of pens with 16 dilutions of *n*-butanol was used. Three pens were presented in randomized order, one contained the odorant and two solvent. Participants had to identify the odorant-containing pen. For the DIS-test, 16 triplets (two equal, one different odour) were presented. Participants had to discriminate which pen smelled differently. For the ID-test, 16 common odours were presented. Participants had to identify the odour using a 4-option multiple-choice task. The THR-score ranges from 1 to 16. The DIS- and ID-scores range from 0 to 16. A total smell score was derived by summing the THR, DIS and ID, resulting in a threshold, discrimination, identification (TDI) score (range 1–48) (Wolfensberger, Schnieper, & Welge-Lüssen, 2000). The extended version of the 'Sniffin' sticks' was used, containing 32 odour combinations for the DIS-test and 32 odours for the ID-test (Haehner et al., 2009). Each participant received a unique combination of 16 out of 32 triplets