Appearance-specific Satiety Increases Appetite and Quality of Life in Patients with Metastatic Liver Tumor: A Case Report

TAKUMI KAWAGUCHI*,**, EITARO TANIGUCHI**, MINORU ITOU**, JYUNJI AKIYOSHI**, SATOSHI ITANO**, MOMOKA OTSUKA¹, SHOKO IWASAKI¹, TOKIKO MATSUDA¹, RYOKO IBI¹, SATOMI SHIRAISHI¹, TETSUHARU ORIISHI**, SHOKO TANAKA¹, YUKO SARUWATARI¹ AND MICHI O SATA*,**

Departments of Digestive Disease Information & Research* and Medicine**, Kurume University School of Medicine, Departments of Nutrition¹, Nursing¹, Kurume University Hospital, Kurume 830-0011, Japan

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Summary: Loss of appetite is frequently seen and is a main factor affecting quality of life (QOL) in patients with advanced cancer. The etiology for loss of appetite in patients with cancer is multifactorial. The sensory properties of food are factors regulating appetite. Changes in taste, smell and texture of foods influence food intake. The appearance of the food is also a notable factor in sensory-specific satiety. We described a 46-year-old Japanese woman with multiple metastatic liver tumors. Although there was no obvious factor for loss of appetite, she suffered from a loss of appetite and subsequent malnutrition. In order to improve the appearance of food, we reduced the diet to 1000 kcal/day from 1500 kcal/day. On the new diet, the patient's appetite significantly increased and patient’s nutritional status was improved. Eating whole diet was an important achievement and increased in mental status of QOL. Arrangement for the appearance of food may be a simple and nontoxic therapeutic strategy for patients with cancer suffering a loss of appetite.

Key words advanced cancer, malnutrition, sensory-specific satiety, anorexia, nutritional status, SF-36

INTRODUCTION

Patients with advanced cancer often suffer from a loss of appetite, leading to malnutrition [1]. As many as 20% of patients with cancer die of the effects of malnutrition rather than of the malignancy [2]. Loss of appetite is also a main factor affecting quality of life (QOL). Thus, maintaining appetite is a valuable part of managing patients with advanced cancer.

The etiology for loss of appetite in patients with cancer is multifactorial [3]. Loss of appetite can result from systemic effects of cachexia and altered metabolism by tumor. Local effects of tumor, such as obstruction and pain, can also interfere with dietary intake. Furthermore, treatment for cancer may cause fatigue, taste changes, diarrhea, and nausea, which lead to a subsequent loss of appetite [4,5].

Currently prescribed appetite stimulatory drugs are corticosteroids, megestrol acetate, and metoclopramide. Although corticosteroids may increase appetite, their metabolic, infectious, and psychiatric side effects usually limit their use to the short term. Megestrol acetate has been found to improve appetite [6], but is associated with water retention and an increase in the risk of venous thromboembolism. Metoclopramide has been shown to improve chronic nausea [7], but it has no proven effect on appetite. Clearly, many patients are not helped by or cannot tolerate currently available treatments to stimulate appetite. A simple and nontoxic therapeutic strategy

Corresponding author: Takumi Kawaguchi, MD, PhD, Department of Digestive Disease Information & Research, Kurume University School of Medicine, 67 Asahi-machi, Kurume 830-0011, Japan. Tel: +81-942-31-7902 Fax: +81-942-31-7747 E-mail: takumi@med.kurume-u.ac.jp

Abbreviations: MH, mental health; QOL, quality of life; RE, role-emotional; SCC, squamous cell carcinoma; SF, social functioning; SF-36v2, medical outcomes study 36-item short-form health survey version 2; VT, vitality.
for increasing appetite is needed. The sensory properties of food regulate appetite. Several studies have been carried out to investigate the impact of food varying in sensory properties. Changes in taste, smell, and texture of foods can influence food intake [8,9]. An increase in the amount of pasta offered affects its' appearance, resulting in a decrease in the pleasure of eating [8]. The appearance of the food seems to be a notable factor in sensory-specific satiety. In other words, the appearance of food may influence appetite through visual information.

Patients with cancer are usually prescribed a high-calorie diet because cancer increases energy expenditure. High-calorie diet is accompanied by heavy appearance, which can provide a visual stress leading to a decrease in appetite. It is possible that the appearance of the food in a high-calorie diet spoils appetite in patients with advanced cancer.

In this report, we describe a case in which the appearance-specific satiety of food increased appetite and improved nutritional status and QOL as well. Arrangement for appearance of food may be a simple and nontoxic therapeutic strategy for patients with cancer suffering a loss of appetite.

**CASE REPORT**

A 46-year-old Japanese woman was referred to Kurume University Hospital for treatment of multiple metastatic liver tumors and obstructive jaundice. The patient was diagnosed at age 44 with cervical cancer and was treated with radiation and chemotherapy following a radical hysterectomy. Two years later, computed tomography revealed multiple hepatic metastases due to cervical cancer and a rapid growth of metastatic liver tumors. These tumors were treated with a continuous intrahepatic arterial injection of 5-fluorouracil (375 mg/day) and intermittent cisplatin (30 mg/day) via a reservoir system for 5 days [10]. With 2 periods of this regimen, the serum squamous cell carcinoma (SCC) antigen level (normal range < 1.5 ng/ml) decreased from 119.4 ng/ml to 30.1 ng/ml. Metastatic liver tumors were responsive to the chemotherapy.

The patient did not show any troublesome adverse effects of the anticancer drugs administered, such as vomiting and the patient’s liver function was preserved, however, she suffered from loss of appetite 2 weeks before admission, which resulted in 4 kg loss of body weight. The patient’s body mass index, arm muscle circumference, and triceps skin-fold thickness decreased to 14.6 kg/m², 16.3 cm, and 8 mm, respectively. The percentage of the age-adjusted standard value for Japanese women was 65.3%, 80.5%, and 47%, respectively. Laboratory data showed decrease in total lymphocyte count and levels of hemoglobin and albumin (Table 1). Thus, physical examination and laboratory data indicated a state of severe malnutrition.

**TABLE 1.**

<table>
<thead>
<tr>
<th>Characteristics of the patient on admission</th>
<th>% of standard value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Physiological measurements</strong></td>
<td></td>
</tr>
<tr>
<td>Height</td>
<td>158.5 cm</td>
</tr>
<tr>
<td>Weight</td>
<td>36.5 kg</td>
</tr>
<tr>
<td>Body mass index</td>
<td>14.5</td>
</tr>
<tr>
<td>Arm muscle circumference</td>
<td>16.3 cm</td>
</tr>
<tr>
<td>Triceps skin-fold thickness</td>
<td>8 mm</td>
</tr>
<tr>
<td>Loss of body weight in 2 weeks</td>
<td>4 kg</td>
</tr>
<tr>
<td><strong>Laboratory data</strong></td>
<td>(Normal range)</td>
</tr>
<tr>
<td>Hemoglobin</td>
<td>7.0 g/100ml (11-15)</td>
</tr>
<tr>
<td>Total lymphocyte count</td>
<td>435/µl (1200-3870)</td>
</tr>
<tr>
<td>Albumin</td>
<td>3.2 g/dl (4.0-5.0)</td>
</tr>
<tr>
<td>Total cholesterol</td>
<td>246 mg/dl (128-256)</td>
</tr>
<tr>
<td>Glucose</td>
<td>86 mg/dl (80-112)</td>
</tr>
<tr>
<td>Aspartate aminotransferase (U/l)</td>
<td>22 U/l (13-33)</td>
</tr>
<tr>
<td>Alanine aminotransaminase (U/l)</td>
<td>34 U/l (6-27)</td>
</tr>
<tr>
<td>Total bilirubin (mg/dl)</td>
<td>2.2 mg/dl (0.3-1.5)</td>
</tr>
<tr>
<td>Prothrombin time</td>
<td>96% (60-130)</td>
</tr>
</tbody>
</table>

Note. Standard values of physiological measurements were referred to Japanese anthropometric reference data.
Acute bowel toxicity is one of the common complications of chemotherapy that leads to malnutrition. Oral administration of glutamine reduces this anticancer drug-induced bowel toxicity. The patient was treated with glutamine via oral administration, however, her appetite did not increase. Granisetron is effective against nausea induced by anticancer drugs. Nevertheless, loss of appetite persisted after the patient received an infusion of 3 mg of granisetron. Corticosteroids and megestrol acetate are also known to increase appetite in patients with advanced cancer. On the other hand, the long term use of these agents is associated with decreased efficacy and increasingly unacceptable adverse effects. Therefore, corticosteroids and megestrol acetate were not used in our case.

The patient’s energy requirement was estimated to be 1400 to 1600 kcal/day, based on the Harris-Benedict equation [11]. Accordingly, the patient was prescribed a diet of 2000 or 1500 kcal/day. She understood the importance of nutritional therapy, however, her actual intake was only about 600 kcal/day. The sensory properties of the food play important roles in controlling the patient’s food intake. Appearance is one of the important sensory properties and heavy appearance of food spoils appetite. In order to improve the appearance of food, we reduced the diet to 1000 kcal/day (Fig. 1). On the new diet, the patient’s appetite significantly increased and she ate not only the prescribed diet but also snack. She maintained an intake of more than 1000 kcal/day (Figs 2A and B). Then, we followed her nutritional status until Day 76. Although total lymphocyte count showed no change on the new diet, there was a significant increase in serum albumin level (Figs 3A and B).

![Diagram of caloric intake](Fig. 2. (A) Time course of daily caloric intake. Metastatic liver tumors were treated with a continuous intrahepatic arterial injection of 5-fluorouracil (375 mg/day) and intermittent cisplatin (30 mg/day) via a reservoir system (□). Granisetron (3 mg) was administered by intravenous infusion at 30 min before chemotherapy (□). The patient’s energy requirement was estimated to be 1400 to 1600 kcal/day, based on the Harris-Benedict equation. (B) Caloric intake after improvement of the appearance of food in the prescribed diet. 2000 or 1500 kcal/day diet was prescribed during Day 0 to 33 (n=34; black bar). 1000 kcal/day diet was prescribed during Day 34 to 47 (n=14; white bar). Caloric intake was evaluated everyday and changes in caloric intake were statistically analyzed by the Mann-Whitney U test. *P<0.01.)
We also evaluated the effects of appearance-specific satiety on the patient's QOL by using the Medical Outcomes Study 36-Item Short-Form Health Survey version 2 (SF-36v2) on Day 18 and 46. By improvement in appearance of food, her scores for vitality (VT), mental health (MH), role-emotional (RE), and social functioning (SF) were markedly increased on a scale of 0 to 100 (Fig. 4A). In particular, the MH score reached to normal range (Fig. 4B). Appearance-specific satiety stimulated appetite and resulted in the improvement of nutritional status as well as in the QOL in this patient with metastatic liver tumors.

**DISCUSSION**

In this study, we describe a case in which the appearance-specific satiety of food increased appetite
and improved both nutritional status and QOL. Improvement in the sensory properties of food, including appearance, is a simple and nontoxic strategy to increase appetite and QOL in patients with advanced cancer suffering from a loss of appetite.

Loss of appetite is frequently associated with advanced cancer and its treatment. Multiple, interactive factors that are the probable cause of loss of appetite include direct interference of tumors with food intake, malabsorption and poor digestion, and treatment-related complications such as changes in smell and taste. No effective therapy has been established previously for improvement of anorexia in patients with advanced cancer. A simple nontoxic means to improve anorexia would be most beneficial in the supportive management of the cancer patient and also could possibly enhance the effectiveness of other therapeutic measures.

Sensory-specific satiety has an important influence on the amount of food eaten [12]. Invariable foods decrease the pleasure of eating even though the food are savory [13-16]. The same phenomenon occurs when eating a sweet food to satiety [13-15] or when drinking a weak-smelling tea compared to a strong-smelling tea [17]. On the other hand, varying the texture of the yogurt in the diet caused a 12.6% elevation of intake compared to the amount of the previously preferred yogurt eaten [14]. Taste, smell, and texture-specific satiety are important for regulation of appetite.

Appearance of food is also an important factor involved in sensory-specific satiety. Cancer increases energy expenditure and patients with cancer are normally prescribed a high-calorie diet with heavy appearance of food. In fact, our patient was prescribed a diet of 2000 or 1500 kcal/day, but achieved a caloric intake of only about 600 kcal/day. Since there was no obvious reason for loss of appetite, we assumed that heavy appearance of food spoiled her appetite. Although she was in a state of malnutrition, we reduced her diet to 1000 kcal/day in order to improve appearance of food. In results, the patient’s appetite was significantly increased. One would think that chemotherapy itself increased appetite through improvement in cachexia, however, she complained of persistent appetite loss after tumors showed partial remission. On the other hand, Marcelino et al. [18] reported that the desire to eat pizza depended on the visual quality of the pizza. Appearance-specific satiety is also related to areas of the brain that control motivation and the reward value of foods [19-21]. These reports suggest appearance-specific satiety stimulated appetite in our case.

Long-term effects of appearance-specific satiety on the patient’s nutritional status was evaluated by measuring total lymphocyte count, an indicator of visceral proteins, and serum albumin levels. We must be cautious in the interpretation of these results because there was no time-couise study in lymphocyte count and albumin levels. Although total lymphocyte count did not change, serum albumin levels were significantly increased. The discrepancy between total lymphocyte count and serum albumin levels may be due to adverse effects of chemotherapy. Bone marrow suppression is observed during the chemotherapy which is same regimen used in this case [22] and total lymphocyte count might not reflect the nutritional status adequately in our case. Serum albumin level is a standard marker for evaluation of nutritional status and is not influenced by anti-cancer drug itself. Since serum albumin levels were significantly increased, it is possible that appearance-specific satiety improved long-term status of nutrition in our case.

Appearance-specific satiety increased the scores of SF, ME, RE, and VT of the SF-36 score, which is widely used for evaluating QOL [23,24]. Although it was not clear how appearance-specific satiety increased QOL, following possibilities are exist. Increase in appetite improved the nutritional status. Nutritional status is closely related to liveliness, therefore, improvement of nutritional status may increase in lively aspect of QOL, such as VT. Alternatively, the patient could eat prescribed whole diet by changing the appearance of diet. Eating whole diet was an important achievement and it gave her great pleasure that caused an increase in mental aspects of QOL, such as MH, RE, and SF. Thus, appearance-specific satiety may increase QOL by improvement of lively and mental aspects in our case.

In conclusion, we report here a case in which appearance-specific satiety increased appetite and improved both nutritional status and QOL in patient with advanced cancer. Arrangement for the appearance of food in a diet may be a simple and nontoxic therapeutic strategy for patients who suffered from loss of appetite.

REFERENCES

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