Original Research

The Effectiveness of Chewing Gum versus Cryotherapy on Salivary Volume among Patient with Head and Neck Cancer Undergoing Radiotherapy

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ABSTRACT

Introduction: Hyposalivation is a common problem experienced by head and neck (H&N) cancer patients undergoing radiotherapy. Hyposalivation can cause negative effects on the physical aspects of making oral mucositis, pain during eating and talking as well as psychological effects that cause feeling of discomfort sadness and, ultimately, depression. Many nonpharmacological interventions can be done for hyposalivation that occur in patients, among which are chewing gum and cryotherapy because they are easy to do, easy to access, inexpensive and have minimal side effects. However, the effectiveness of these interventions is not yet clear. Hence, this study is aimed to determine the effectiveness of chewing gum versus cryotherapy to increase salivary volume in H&N cancer patients undergoing radiotherapy.

Methods: A quasi-experimental time series group design to determine the most effective time to influence the increase in salivary volume. This research was conducted on 36 respondents H&N cancer undergoing radiotherapy with four times measurement are pretest-posttest on the 3rd, 5th, and 7th day of intervention between February and March 2020. Subjects were chosen using consecutive sampling. Chewing gum group will chew gum six (6) pieces/day and cryotherapy group will suck on ice cubes five (5) minutes before and after radiotherapy. The spitting method was used to collect saliva and the data were analyzed using General Linear Model-Repeated Measure (GLMRM).

Results: Chewing gum is more effective to increase salivary volume than cryotherapy. The GLMRM within subjects at four (4) times measurement showed a significant difference between chewing gum and cryotherapy group with p value <0.05 on the 7th day. Subjects in the chewing gum group had better salivary volume increment than cryotherapy group.

Conclusion: This study showed that chewing gum is more effective to increase salivary volume on patient H&N cancer undergoing radiotherapy because chewing gum has higher salivary volume increment than cryotherapy groups.

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INTRODUCTION

Head and neck cancer is a tumor that arises in the nasal cavity, mouth, oropharynx, nasopharynx, salivary glands, paranasal sinuses, hypopharynx, and larynx (NIH, 2019). Radiotherapy is one of the most common treatments for head and neck cancer and requires discipline and a long time (Laursen et al., 2018). Radiotherapy is a cancer treatment that uses high-energy X-rays or other types of radiation to kill cancer cells or keep cancer cells from growing (NIH, 2019). The safe dose of the parotid gland is 26 Gy, the safe dose of the submandibular gland is 39 Gy and a 30 Gy dose for minor salivary glands remains safe (Siddiqui & Movsas, 2017). Radiotherapy doses of 60-70 Gy can cause prolonged and severe problems in the mouth (Villa & Sonis, 2015). Radiotherapy can shrink and kill tumor cells (Santoso, Surarso, & Kentjono, 2009), but it has the most frequent side effects experienced by patients, namely hyposalivation, thickened saliva, mucosal infections, pain and taste sensory dysfunction (Epstein et al., 2017). Epstein et al. (2017) state radiation can cause problems in the mouth.
Hyposalivation is a common problem experienced by head and neck cancer patients undergoing radiotherapy (Siddiqui & Movsas, 2017). The incidence of hyposalivation due to radiation was 87.5% - 100% experienced by patients undergoing radiotherapy of the head neck area (Marinna & Harijanti, 2017; (Surjadi & Amtha, 2012). Continuous exposure to radiation and cytotoxic agents have several direct effects on the oral epithelium that can cause damage to the salivary gland duct cells and cause hyposalivation (Eghbali, Aziz, Taherkhanch, & Bagheri, 2017). Hyposalivation is defined if salivary flow without stimulation is ≤0.2mL / min (Kaae, Stenfeldt, & Erikson, 2016). The volume of saliva produced per day ranges between 0.5 and 1.0L in normal physiological conditions, and the physiological pH range for saliva is 6.5-7.4 (Simões, Campos, Arana-Chavez, & Nicolau, 2015). Resting saliva flow rate (volume of saliva/collection time) is of 0.1mL/min or less and/or a stimulated whole saliva flow rate of 0.7mL/min or less (Ra’abung, Sudiana, & Hidayati, 2019). Saliva has decreased production in patients undergoing radiotherapy compared to normal people (Irina & Subita, 2008; Surjadi & Amtha, 2012). Hyposalivation could cause negative effects on the physical aspects of making oral mucositis, pain during eating and talking, papilla loss on chopped tongue and lips (Plemons et al., 2014) as well as psychological effects causing feelings of discomfort, sadness, and, eventually, depression (Traktama & Sufiawati, 2018).

Hyposaliva management in Saiful Anwar Malang hospital advises to drink sufficient water and clean the mouth, but hyposalivation is still often experienced to become oral mucositis. Based on observations and interviews with head and neck cancer patients undergoing radiotherapy, there are patients who drink only a little because of pain when swallowing, so that intervention is needed that can stimulate the salivary gland without swallowing. Several methods can be done to reduce the severity of hyposaliva, one of which is by stimulating the salivary glands to keep producing saliva. Some methods used to reduce hyposaliva are chewing gum, sucking ice cubes, increasing the consumption of mineral water and cleaning the mouth (Marinna & Harijanti, 2017). Research (Kaae et al., 2016) shows that chewing gum can stimulate saliva output that is seen at the beginning and at the end of an intervention. Findings by Epstein et al. (2017) show that cryotherapy can stimulated saliva. Previous research have carried out many studies of chewing gum or cryotherapy in patients undergoing chemotherapy (Didem, Ayfer, & Ferda, 2014; Utami & Hayati, 2018).

Given the importance of the role of saliva and the consequences arising from hyposalivation, it is necessary for nurses to help increasing salivary volume in head and neck cancer patients undergoing radiotherapy. Chewing gum and cryotherapy are easy, inexpensive, safe interventions done by patients to increase the volume of saliva and oral mucositis (Utami & Hayati, 2018). The use of cold therapy can make patients feel cold and toothache so that it requires criteria. teeth in a healthy condition (no history of sensitive teeth) (Katranç et al., 2012) and strong flavors, such as peppermint or lemon, are not favored in the early phase of recovery; effects can be minimized by choosing flavors of xylitol gum such as blueberries and strawberries, but its effectiveness is unclear. Nurses play an important role in helping patients protect and maintain their oral health. This study aimed was to determine the effectiveness of chewing gum versus cryotherapy to increase the volume of saliva in head and neck cancer patients undergoing radiotherapy.

**MATERIALS AND METHODS**

This research was a quasi-experimental time series group design to determine the most effective time to influence the increase in salivary volume. This study involved 36 respondents who were divided into chewing gum groups and cryotherapy groups (18/18) obtained by consecutive sampling. Respondents were taken based on inclusion criteria to reduce the effects of bias. The inclusion criteria in this study were: 1) patients having mucositis oral undergoing radiotherapy head and neck cancer; 2) Type squamous cell carcinoma because it is the most common type of cancer; 3) patients can chew gum or suck ice cubes, confirmed with interviews. Meanwhile, the exclusion criteria in this study are: 1) patients having sensitive tooth to minimize pain when sucking ice cubes; 2) patients having diabetes mellitus. The drop out criteria in this study include the patient dies and the patient not completing the therapy process. Data collection was carried out at Radiotherapy Installation Saiful Anwar Hospital Malang between February 2020 and March 2020.

The dependent variable was salivary volume and the independent variable was chewing gum and cryotherapy. Researchers prepared equipment such as xylitol gum, ice cube, measuring cup, mask, gloves, stationery, 3cc syringe, cellphone stopwatch, observation sheet and informed consent. Prior to the intervention, the respondent obtained an explanation of the purpose of the study and signed an informed consent as a sign of willingness to become a respondent. The researchers measured the patient’s saliva volume as pre-intervention data. The researchers divided the respondents into the chewing gum group and the cryotherapy group according to the patient’s condition at the beginning of the study meeting and continued for up to seven (7) days of radiotherapy. The researcher also involved the respondent’s family to be willing to help in the research, especially as the supervisor of the respondent in intervening correctly and routinely. Researchers explained the interventions to be provided and educated them to keep doing the hospital standard in the form of adequate drinking and cleaning the mouth.
Subjects in the chewing gum group were asked to chew six pieces of sugar-free gum xylitol a day (two pieces in the morning, afternoon and evening) each about 10 minutes respectively for a week after radiotherapy session. The ingredients contained in xylitol gum are natural ingredients and artificial flavors (sorbitol, maltitol, syrup, xylitol, aspartame, acesulfame K), rubber-based ingredients, binding agents (E903) and antioxidants (E321) (Jerniga, Chiang, Chen, & Sewell, 2014; Leede, Leersum, Kroon, Weel, & Sijp, 2018) so they are safe for consumption. Xylitol is anticaries because it is able to suppress the number of Streptococcus mutans colonies, inhibits the growth of plaque, suppresses saliva acidity and inhibits inflammation in the mouth because xylitol cannot be metabolized by oral bacteria, including Streptococcus mutans. and is a substance that plays a role in the process of glycolysis inhibition (Rodian et al., 2011).

Table 1. Characteristics of participants

| Characteristics of participants | Chewing Gum group (n=24) | Cryotherapy group (n=18) | Total |
|--------------------------------|--------------------------|--------------------------|-------|
|                                | n | %    | n | %    | n | %     |
| Gender                         |   |       |   |       |   |       |
| Male                           | 15 | 83.3 | 16 | 88.9 | 31 | 86.1  |
| Female                         | 3  | 16.7 | 2  | 11.1 | 5  | 13.9  |
| Age (year)                     |   |       |   |       |   |       |
| 17-25                          | 1  | 5.6  | 0  | 0    | 1  | 2.8   |
| 26-35                          | 1  | 5.6  | 0  | 0    | 1  | 2.8   |
| 36-45                          | 4  | 22.2 | 3  | 16.7 | 7  | 19.4  |
| 46-55                          | 5  | 27.8 | 7  | 38.9 | 12 | 33.4  |
| 56-65                          | 2  | 11.1 | 4  | 22.2 | 6  | 16.7  |
| >65                            | 5  | 22.2 | 4  | 22.2 | 9  | 25    |
| Diagnosis of Disease           |   |       |   |       |   |       |
| Nasopharyngeal cancer          | 7  | 38.9 | 13 | 72.2 | 20 | 59.5  |
| Oropharyngeal cancer           | 1  | 5.6  | 0  | 0    | 1  | 2.8   |
| Larynx cancer                  | 5  | 27.8 | 2  | 11.1 | 7  | 19.4  |
| Non-Hodgkin's lymphoma         | 1  | 5.6  | 0  | 0    | 1  | 2.8   |
| Tongue cancer                  | 3  | 16.7 | 0  | 0    | 3  | 8.3   |
| Lymphoma cancer                | 1  | 5.6  | 0  | 0    | 1  | 2.8   |
| Mandibula cancer               | 0  | 0    | 3  | 16.7 | 3  | 8.3   |
| Stage                           |   |       |   |       |   |       |
| Stage 1                        | 0  | 0    | 1  | 5.6  | 1  | 2.8   |
| Stage 2                        | 10 | 55.6 | 9  | 50   | 19 | 52.8  |
| Stage 3                        | 6  | 33.3 | 4  | 22.2 | 10 | 27.8  |
| Stage 4                        | 2  | 11.1 | 4  | 22.2 | 6  | 16.7  |
| Education status               |   |       |   |       |   |       |
| No school                      | 1  | 5.6  | 2  | 11.1 | 3  | 8.3   |
| Elementary school              | 7  | 38.9 | 4  | 22.2 | 11 | 30.6  |
| Middle school                  | 2  | 11.1 | 5  | 27.8 | 7  | 19.4  |
| High school                    | 6  | 33.3 | 6  | 33.3 | 12 | 33.3  |
| Bachelor                       | 2  | 11.1 | 1  | 5.6  | 3  | 8.3   |
| Employment status              |   |       |   |       |   |       |
| Farmers                        | 4  | 22.2 | 5  | 27.8 | 9  | 25    |
| Private job                    | 6  | 33.3 | 6  | 33.3 | 12 | 33.3  |
| Trader                         | 3  | 8.3  | 5  | 27.8 | 8  | 22.2  |
| Civil servants                 | 3  | 16.7 | 1  | 5.6  | 4  | 11.1  |
| Housewife                      | 2  | 11.1 | 1  | 5.6  | 3  | 8.3   |
| Marital status                 |   |       |   |       |   |       |
| Married                        | 16 | 88.9 | 16 | 88.9 | 32 | 88.9  |
| Not married                    | 2  | 11.1 | 1  | 5.6  | 3  | 8.3   |
| Divorced                       | 0  | 0    | 1  | 5.6  | 1  | 2.8   |
| Smoking habit                  |   |       |   |       |   |       |
| Not smoking                    | 3  | 16.7 | 3  | 16.7 | 6  | 16.7  |
| 1 pack/day                     | 12 | 66.7 | 10 | 55.6 | 22 | 61.1  |
| 2 pack/day                     | 2  | 11.1 | 4  | 22.2 | 6  | 16.7  |
| 3 pack or more/day             | 1  | 5.6  | 1  | 5.6  | 2  | 5.6   |
| Length of smoking              |   |       |   |       |   |       |
| Not smoking                    | 3  | 16.7 | 3  | 16.7 | 6  | 16.7  |
| 1-10 years                     | 9  | 50   | 4  | 22.2 | 13 | 36.1  |
| 11-20 years                    | 5  | 27.8 | 7  | 38.9 | 12 | 33.3  |
| 21-30 years                    | 1  | 5.6  | 4  | 22.2 | 5  | 13.9  |
morning, afternoon and evening for about 10 minutes on the radiotherapy schedule. Subjects in the cryotherapy group were asked to suck an ice cube before and after radiotherapy session for five (5) minutes for a week. The patients suck the ice cubes even in the mouth area. Ice cubes were provided by researchers to facilitate patients. Posttest was held on third, fifth and seventh day of intervention.

Saliva volume measurements were carried out by the researchers themselves using the spitting method. The patient bowed his head deeply and the subject allowed the saliva to collect and flow through the lower lip into the tube and spit out the remaining saliva that did not flow. Measurements were taken five (5) times in five (5) minutes. Ethical approval was obtained from Komisi Etik Penelitian Kesehatan (KEPK) Saiful Anwar Hospital Malang with the number 400/017/K.3/302/2020 on January 17, 2020.

Demographic data include gender, age, education, employment status and marital status, diagnosis of disease, stage of cancer and smoking habit. Statistical tests using the General Linear Model-Repeated Measured ANOVA within subjects to determine the difference in salivary volume values pretest and posttest in each group. General Linear Model Repeated Measured ANOVA between subjects was used for showing effect of the chewing gum and cryotherapy on salivary volume between two groups.

RESULTS

Descriptive statistical analysis of the respondent’s characteristics is shown in Table 1. This study was followed by 36 patients with head and neck cancer undergoing radiotherapy divided into chewing gum intervention and cryotherapy intervention. Table 2 describes the statistical test GLM RM ANOVA within subjects of the effects of treatment on each group. Table 3 describes the statistical test GLM RM ANOVA between subjects and the effect of treatment.

Table 1. Characteristics of radiotherapy patients.

Table 2. Salivary volume in the chewing gum and cryotherapy groups in GLMRM ANOVA within subject test

Table 3. Salivary volume in the chewing gum and cryotherapy groups in GLMRM ANOVA between subject test
Saliva is very important because it...goals of cold therapy include...Factors that can affect the...drugs consumed, sleep, reduces because...nursing care in head and neck...of the patients' salivary...study support...and, which...produces mucus (thick saliva, viscosity is higher)...the largest gland, then the submandibular gland...several glands, namely the parotid gland, which is...smoke, and alcohol consumption will reduce the...swallow food, using mouthwash-free mouthwash, avoiding carbonated drinks (such as soda), caffeine, tobacco, and alcohol, and using lanolin-based lip balm to comfort cracked or dry lips can reduce dryness in the mouth and stimulate saliva discharge. Increased salivary secretion leads to increased volume and thinning of saliva needed for ingestion and lubrication.

In this study, not all of the patients' salivary volumes increased. This is influenced by several factors. According to Samuels (2017) drugs, smoking, and alcohol consumption will reduce the flow rate of saliva. Most respondents were aged in the range 46-65 years. Old age will make the function of the salivary glands decrease, because the acinar element turns into fat and fibrous tissue (Baird, Donehower, Stalsbroten, & Ades, 1991).

The results of this study prove that the chewing gum and cryotherapy affect the stimulus production of saliva. Hopefully, this study can increase information about nursing care in head and neck cancer, so that the symptoms caused by radiotherapy of the head and neck area can be reduced or avoided.

The limitation of this study was the researcher cannot fully control the respondent's intervention because it is done at home or boarding so this can have an impact on the result of the study. The strength of this study was there is an effective nonpharmacological action nurses can take to increase the volume of saliva in head and neck cancer patients by chewing gum.
CONCLUSION
This study showed chewing gum is more effective to increase salivary volume than cryotherapy among patient head and neck cancer undergoing radiotherapy in Saiful Anwar Hospital Malang on 7th day intervention. The results from this recent study hope to be useful in future health therapies to increase the volume of saliva in radiotherapy patients in the head and neck area so that it can reduce side effects and make therapy successful. What must be considered when discussing clinical application is the suitability of the gum variant. Future research is expected to control the factors that influence saliva production and conduct research by taking patients from the beginning of radiotherapy until radiotherapy is completed.

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