Original Article

The efficacy of supragingival irrigation with chlorhexidine for plaque control in patients with hematologic malignancies: A randomized clinical trial

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Abstract

Objective: Oral and dental problems are important issues in patients suffering from hematologic malignancies. This study aimed to assess the efficacy of supragingival irrigation with chlorhexidine in improving the oral health status of patients with hematologic malignancies.

Methods: This randomized, single-blind, controlled clinical trial, included 32 patients suffering from blood dyscrasia and hospitalized in Imam-Reza Hospital, Mashhad, Iran. Participants were randomly allocated to intervention and control groups. The control subjects received routine dental care by cleaning their teeth daily with sterilized gauze soaked in normal saline. For the intervention group, supra-gingival irrigation with chlorhexidine was performed in addition to routine dental care. The Debris Index Simplified (DI-S) part of the Oral hygiene index-simplified (OHI-S) index was recorded in all patients at baseline (T0), one (T1), two (T2), and three (T3) weeks later. The World Health Organization (WHO) scale was used to assess oral mucositis.

Results: DI-S decreased significantly in the intervention group (P<0.001), and increased significantly in the control group (P=0.04) over the experiment. The study groups had comparable DI-S values at baseline (T0; P=0.48). However, DI-S scores were significantly lower in the experimental than in the control group at T1, T2, and T3 time points (P=0.002, P<0.001, and P<0.001, respectively). Oral mucositis was observed in only five patients in the control group.

Conclusions: Supra-gingival irrigation with chlorhexidine can improve oral hygiene during chemotherapy and may be used by patients and oral care providers in hospital settings.

Keywords: Chlorhexidine, Dental plaque, Gingivitis, Hematologic malignancies, Irrigation, Oral hygiene

Introduction

Hematological malignancies are cancers that affect the blood, bone marrow, and lymph nodes. Leukemia and lymphoma, are currently recognized as the most commonly diagnosed hematologic cancers (1,2).

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Accepted: 17 June 2023. Submitted: 9 February 2022.

DOI: 10.22038/JDMT.2023.69756.1547

The treatment for these malignancies is high-dose chemotherapy, which has significant side effects on oral tissues. About 40% of the patients with hematological malignancies treated with chemotherapy develop oral complications, a rate two to three times greater than that observed in patients with solid tumors (3, 4).

Oral complications in patients undergoing chemotherapy can be categorized as either oral infection, mucositis, or periodontal involvement. During the blast phase of leukemia, oral infections might be diagnosed in approximately one-third of patients (5). Mucositis is another clinically significant and probably the most debilitating complication in these patients (6). The development of mucositis is a possible sequel of the direct and indirect effects of chemotherapy on oral cells (7). Gingivitis and periodontitis are also common findings in patients with leukemia and have been reported in over 25% of all cases (5, 8).

Maintaining oral hygiene at a high level is one of the most effective measures in preventing oral mucositis and other life-threatening oral cavity-related complications

(OCRC). Several studies have shown that the severity of mucositis and oral candidiasis were directly correlated with the level of oral hygiene (9, 10). The typical oral hygiene protocol in hospitalized patients undergoing chemotherapy includes using a soft toothbrush presoaked in warm water and brushing the teeth with minimal trauma to avoid bacteremia and bleeding. It is necessary to search for an alternative method to further improve oral hygiene in this group of patients (11).

An oral irrigator is a device for rinsing the teeth, gingiva, and sub-gingival areas by applying water or other solutions at a mild pressure to ensure oral hygiene with minimal trauma. A supra-gingival irrigator is used to rinse the coronal and gingival surfaces of the teeth, thereby reducing gingival inflammation and preventing gingivitis (12-14). This study aimed to evaluate the efficacy of a supra-gingival irrigator containing 0.2% chlorhexidine in improving plaque control in hospitalized patients with hematologic malignancies.

Materials and Methods

Study design

The current study was designed as a randomized, single-blind, controlled clinical trial. The protocol of this research was approved by the ethics committee of Mashhad University of Medical Sciences (Ethical Code: IR.MUMS.REC.1389.93) and registered at clinicaltrial.gov under code NCT01974401. Guidelines of the declaration of Helsinki and Consort statement were followed in this research. Written informed consent was obtained from all subjects before enrollment.

Participants and randomization

Subjects were recruited from patients with a definite diagnosis of hematologic malignancies who were hospitalized at the Hematology Department of Imam-Reza Hospital, Mashhad, Iran between March 2015 to June 2017. Inclusion criteria involved an age range of 12-60 years, severe thrombocytopenia (platelet count $\leq$ 50,000/mm^3) and neutropenia (neutrophil count $\leq$ 1000/mm^3), and inability to brush their teeth. Cases with diabetes mellitus, complete or partial edentulism, periodontitis, or infiltrative lesions on the bone or gingiva were excluded. Patients who developed severe chemotherapy-induced mucositis during the study were also excluded. A hematologist confirmed that the consecutive patients were capable of participating in the study. Patients who finally met the above-mentioned inclusion and exclusion criteria were randomly allocated to intervention and control groups. Randomization was accomplished using the following website: http://www.randomizer.org.

Intervention

A precise examination of the oral cavity and teeth was performed on all subjects to identify any possible oral lesions before the trial. This was accomplished by the principal investigator (PMM). Oral health education was provided by the research assistant (PK) and patients were constantly motivated to maintain oral hygiene. The daily oral hygiene practice for both groups consisted of applying sterilized gauze soaked with normal saline on the teeth. This procedure was performed by the nursing staff of the hospital. In the control group, we were satisfied with the routine oral care protocol of the hospital and did not use any additional cleaning methods. The supra-gingival irrigator containing chlorhexidine was used once a day in the intervention group by the researcher (MRM).

The reservoir of the irrigator (Braun Oral-B Oxyjet, Kronnberg, Germany) was filled with 0.2% chlorhexidine gluconate mouthwash (Nazho Co., Iran) diluted in water with a 1:2 ratio. The researcher used the irrigator for 2-3 minutes in all the dentulous areas (30-40 seconds per dental quadrant). In cases with microstomia (abnormal smallness of the mouth), gag reflex, or poor patient cooperation, this time was extended if necessary.

Outcomes

Considering the mean hospitalization period, a three-week follow-up period was planned. Patients were evaluated at baseline (T0), and one (T1), two (T2), and three (T3) weeks later. The Debris Index Simplified (DI-S) part of the Oral hygiene index-simplified (OHI-S) index was utilized to evaluate the oral health status at the beginning of the study and after the intervention by a blind assessor.

In OHI-S, six surfaces are examined. These surfaces are selected from four posterior and two anterior teeth. The scored surfaces in OHI-S are usually the buccal surfaces of the upper first molars (teeth numbered 16 and 26), the lingual surface of lower first molars (teeth numbered 36 and 46), and the labial surfaces of the upper right (tooth numbered 11) and the lower left central incisors (tooth number 31). The adjacent teeth would be considered if those teeth were missing. OHI-S consists of two parts including DI-S and CI-S (Calculus Index Simplified). We evaluated only DI-S in this study.

The DI-S was measured by identifying the present debris or stain on the teeth surfaces mentioned above. For this purpose, a dental explorer was placed on the distal part of the selected surface and explored towards the mesial (15). The DI-S was scored from 0 to 3, as explained in Table 1. The DI–S score per person was obtained by

summing the scores obtained from the selected teeth and dividing it by the number of examined surfaces. In this regard, oral hygiene was classified into three levels including good (DI-S = 0-0.6), fair (DI-S = 0.7-1.8), and poor (DI-S = 1.9-3). Additionally, the World Health Organization (WHO) scale was used to assess oral mucositis, as described in Table 1 (16).

Statistical analysis

Data analysis was conducted via SAS, version 9.4 (SAS Institute, Inc., Cary, NC). A repeated measures test and independent-sample t-test were used to analyze the results. A P-value less than 0.05 was considered statistically significant.

Results

A total of 32 subjects completed the study. Their demographic data and oral health status are displayed in Table 2. The control and intervention groups were not significantly different in terms of the demographic status at baseline (P> 0.05; Table 2).

Figure 1 displays the changes in mean DI-S values over the study period in each group. The repeated measures analysis revealed that DI-S decreased significantly in the intervention group (P< 0.001) and increased significantly in the control group (P=0.04) throughout the experiment. A steep slope was observed in the curve between the first visit and the first follow-up in both groups.

The study groups had comparable DI-S values at baseline (T0; P = 0.480). However, DI-S scores were significantly lower in the experimental than in the control group at T1, T2, and T3 time points (P=0.002, P<0.001, and P<0.001, respectively; Table 3).

Oral mucositis was measured as the secondary outcome variable. While none of the cases in the intervention group developed oral mucositis; a total of five patients in the control group experienced chemotherapy-induced mucositis. Two, one, and two patients experienced grades 1, 2, and 3 of oral mucositis; respectively.

Further observations demonstrated that none of the patients in the intervention group needed anti-fungal or anti-bacterial therapy for oral problems but 10 patients in the control group required anti-fungal treatments for oral candidiasis.

Table 1: The scoring of Debris Index Simplified (DI-S) to evaluate oral hygiene and the World Health Organization (WHO) scale to assess oral mucositis

		Clinical Status
DI-S scores	0	No debris or stain is present on the tooth surface.
	1	Presence of soft debris covering not more than one-third of the tooth surface, or the presence of extrinsic stains without other debris.
	2	The presence of soft debris covering more than one-third, but not more than two-thirds, of the tooth surface.
	3	The presence of soft debris covers more than two-thirds of the tooth surface.
Grades of the WHO scale for the assessment of oral mucositis	0	No oral mucositis
	1	Oral soreness and erythema
	2	Oral erythema and ulcers, able to eat solid food
	3	Oral ulcers, able to eat a liquid diet only
	4	Oral ulcers in which chewing is not possible

Table 2: The characteristics of the study groups

		Intervention group	Control group	P-value
Sex Number (%)	Male Female	9 (60%) 7 (41.2%)	6 (40%) 10 (58.8%)	0.28
Age Mean ± SD		29 ± 12.8	31 ± 11.4	0.622

SD: standard deviation

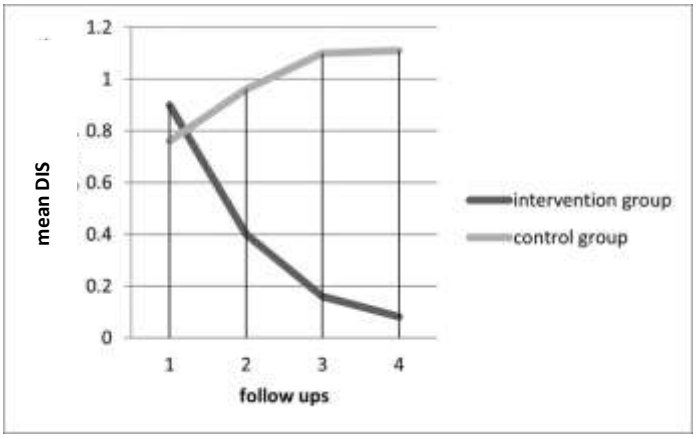

Figure 1: Comparison of the Debris Index Simplified (DI-S) between the study groups over the experiment

Table 3: Mean and standard deviation (SD) of the Debris Index Simplified (DI-S) in the study groups during the experiment

	T0	T1	T2	T3	P-value
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	
Intervention group	0.91 ± 0.44	0.41 ± 0.39	0.16 ± 0.19	0.081 ± 0.12	< 0.001
Control group	0.76 ± 0.69	0.96 ± 0.53	1.10 ± 0.5	1.11 ± 0.49	0.04
P-value	0.48	0.002	<0.001	<0.001	

Discussion

The present study evaluated the efficacy of a supra-gingival irrigator containing chlorhexidine in improving plaque control in hospitalized patients with hematologic malignancies. The DI-S (Debris Index Simplified) part of the OHI-S index was used to assess oral hygiene during the experiment. The OHI-S consists of two parts including DI-S and CI-S (Calculus Index Simplified). After scoring each part, OHI-S is calculated by the sum of DI-S and CI-S. As the duration period of the study was short, the CI-S was not evaluated and only DI-S values were recorded and compared between groups and intervals.

The current recommended oral hygiene protocol for hospitalized patients is using an ultra-soft toothbrush soaked in hot water or cleaning the teeth with a damp sterilized gauze. Since manual toothbrushes are difficult to use by hospitalized patients, adopting an automatic and user-friendly device for mechanical plaque removal, can be of great clinical significance (17). A dental water jet is a home care device that uses a stream of pulsating water to remove plaque and food debris.

The findings of this study showed that the DI-S index decreased by 91% in the intervention group and increased by about 46% in the control group throughout the experiment. Although the two groups showed no significant difference in DI-S at the beginning of the study, the experimental group showed significantly lower DI-S values at 1, 2, and 3 weeks after treatment compared to the control group. These findings imply that supra-gingival irrigation with chlorhexidine was indeed effective in improving oral hygiene during chemotherapy and may be recommended to be used by patients and oral care providers in hospital settings.

Since the introduction of the first oral irrigator in 1962, several studies have been conducted to evaluate the effectiveness of irrigation in improving oral health indices (5). A study at the University of Southern California reported that a three-second treatment with pulsating water (1200 pulses per minute) at a medium pressure of 70 psi removed 99.9% of the plaque biofilm from the treated areas (12). Another study indicated an improvement in the plaque index of pregnant women who used ozonated water irrigation and were educated about proper oral hygiene by health care professionals (18). Similarly, studies conducted by Dodwad et al. (19), Kshitish and Laxman (20), and Issac et al. (21), showed that utilizing ozonated water as a gingival irrigator was able to improve gingival health. Other studies reported that the use of oral irrigators is not associated with an increased risk of bacteremia (22.23). Using a pulsating oral irrigator, the incidence of bacteremia ranges from 7% in gingivitis to 50% in people with periodontitis. These values are similar to those of other self-care devices, i.e., tooth brushing and flossing (20% to 68%), the use of wooden toothpicks or sticks (20% to 40%), and mastication (7% to 51%) (22, 23).

In the present study, none of the patients in the intervention group experienced mucositis during the study, but 31.25% of the patients in the control group suffered from this complication. Mucositis is a common debilitating side effect among patients undergoing chemotherapy (8). The occurrence and severity of

mucositis and oral infections are related to the patient's oral health (2, 24). In the present research, not only the cases of oral ulcers and mucositis were not observed in the intervention group, but other oral complications, including fungal, bacterial, and viral infections, were seldom found. This difference could be associated with the antimicrobial effects of chlorhexidine in addition to the mechanical plaque removal by the irrigator.

The limitation of this study was the small sample size. For this reason, it was not possible to directly correlate oral hygiene status to the rate of mucositis in the sample. Further studies with larger sample sizes are warranted to assess the effect of irrigation with different mouthwashes on decreasing the incidence of oral complications in hospitalized patients undergoing chemotherapy.

Conclusions

Supra-gingival irrigation with chlorhexidine improves oral hygiene and may decrease the risk of oral complications during chemotherapy. This approach could be considered a practical, and effective method for mechanical plaque control in patients with hematologic malignancies in hospital settings.

Acknowledgement

The authors appreciate the support of the vice chancellor for research at Mashhad University of Medical Sciences.

Conflicts of interest

The authors declare no competing interests.

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