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Mitigating chemotherapy-induced oral mucositis: a comparative trial of cryotherapy and normal saline

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ABSTRACT

Introduction: Oral mucositis is one of the most prevalent and serious complications of chemotherapy that causes physical discomfort and impacts patients' functional ability, emotional well-being, and quality of life. It can also delay treatment, prolong hospitalization, and contribute to psychological issues. This study aimed to compare the effects of cryotherapy and regular saline mouthwash on oral mucositis in cancer patients resulting from chemotherapy.

Methods: A quasi-experimental study design was used, involving a sample of 64 cancer patients who were recruited from the Oncology Center at Mansoura University Hospital, Mansoura, Egypt, over 6 months. Two equal groups of thirty-two cancer patients each were randomly selected into study and control groups from the study population. This study used a single tool divided into two sections: demographic data, a health-related data sheet, and the World Health Organization (WHO) mucositis scale. The Monte Carlo exact test was used to obtain an accurate p-value.

Results: Incidence of severe and moderate mucositis was lower in the cryotherapy group on the 21st day, where the p-value was 0.004. On the 7^{th-} and 14th-day measurements, there were no statistical differences.

Conclusions: The positive effect of cryotherapy on lowering chemotherapy-induced oral mucositis in cancer patients validated our research hypothesis.

Keywords: chemotherapy, cryotherapy, ice, oral mucositis, saline mouthwash

Introduction

Key advancements in cancer management encompass surgery, radiotherapy, chemotherapy, immunotherapy, hormone therapy, targeted therapy, and gene therapy. These treatments may be administered individually or in combination, based on the specific type and stage of the cancer (Liu *et al.*, 2024).

Chemotherapy is a systemic therapy that uses anticancer agents to target and suppress the rapid proliferation and division of neoplastic cells. It has a variety of negative consequences that vary based on the drug type, dose, administration frequency rate, and whether chemotherapy is used in conjunction with or without other treatments, including nausea, vomiting, diarrhea, weight loss, infertility, oral mucositis (OM), hair loss, anemia, neuropathy, and chronic fatigue (Tamang, Prajapati and Maharjan, 2025)

Chemotherapy induces atrophy and degradation of the oral mucosal lining, resulting in the formation of ulcers and erythematous lesions. These conditions can elicit sensations of burning, pain, and restriction in eating, drinking, and speaking. Furthermore, the presence of oral lesions compromises the integrity of the mucosal barrier, increasing the risk of secondary local or systemic infections. Additionally, a diminished appetite contributes to a decline in nutritional status (Alsulami & Shaheed, 2022; Rastogi, 2025).

Chemotherapy-induced oral mucositis (CIOM) is one of the most common and debilitating side effects of chemotherapy, which typically manifests within 3–7 days

following treatment initiation and peaks around 10 days after treatment. Approximately forty percent of patients receiving chemotherapy experience oral mucositis, with this prevalence rising to 90% in individuals receiving both chemotherapy and radiotherapy (Wei *et al.*, 2025).

Clinical guidelines and various approaches for managing OM in cancer patients undergoing treatment have been released by the International Society of Oral Oncology (ISOO) and the Multinational Association of Supportive Care in Cancer (MASCC/ISOO): mechanical cleansing via non-pharmaceutical mouth rinses, such as saline solutions and sodium bicarbonate preparations; cryotherapy; adequate hydration of the mouth; low-level laser therapy; dietary modifications; anti-inflammatory agents, such as benzydamine mouthwash; and pain management with analgesics to improve patient comfort(Alshammari *et al.*, 2024).

Oral cryotherapy is widely recognized as a primary intervention due to its favorable cost profile, established safety, and minimal adverse effects. The underlying mechanism involves the application of ice chips or cubes to the oral cavity, which induces local vasoconstriction. This physiological response limits the exposure of the oral mucosa to chemotherapeutic agents by decreasing local blood flow, thereby reducing the concentration of cytotoxic substances in the tissue. Furthermore, cryotherapy is thought to lower the metabolic activity of the oral epithelial cells, which may contribute to a decreased risk of inflammatory responses (Correa *et al.*, 2020; Al-Rudayni *et al.*, 2021).

Furthermore, saline mouthwash is one example of a natural remedy that has many advantages. Saline rinses are an effective way to maintain proper oral hygiene, as they help remove loose food particles and necrotic cells from the oral cavity. Moreover, saline rinses promote simple wound healing via vasodilation (Gupta et al., 2024; Nokam Kamdem et al., 2022). The American Society of Clinical Oncology and healthcare providers recommend saline mouthwash as part of oral care protocols, particularly for patients at high risk for developing OM (Harris *et al.*, 2022).

OM is a common adverse effect associated with chemotherapy, often characterized by significant pain that can interfere with essential daily functions such as eating, speaking, and other routine activities (Kamulegeya, Rwenyonyi, and Orem, 2023). Additionally, severe oral mucositis might lead 19 percent of these patients to stop their anti-cancer medication, which can lower their quality of life, exacerbate their prognosis, and shorten their life spans (Wei *et al.*, 2025).

The prevention and management of oral mucositis are essential in oncology care, as its development is associated with poorer clinical outcomes, reduced quality of life, and greater economic burden than in patients who do not experience these lesions (Parra-Rojas et al., 2025). Since OM is associated with poorer clinical outcomes, a lower quality of life, and a higher cost burden than patients without such lesions, prevention is essential in oncology therapy. Therefore, this study aimed to identify the most effective approach to oral health to prevent oral mucositis in patients receiving chemotherapy.

Materials and Methods

It was hypothesized that patients who received cryotherapy would exhibit a lower mean oral mucositis score than those in the normal saline group.

Study design and setting

A quasi-experimental, pre-post intervention research design was consistently employed throughout this study. This study was conducted at Mansoura University's Oncology Center in the chemotherapy installation unit, Egypt, from May 2024 to November 2024.

Sample Size calculation

The sample size was calculated using research software (https://clincalc.com). Based on the results of a similar previous study by Soliman (2019), with a level of significance of 5%, Power (1-β error probability) = 0.80, and α error probability = 0.05. Therefore, 32 patients were required in each group in the study (Soliman, 2019).

Subjects

All sixty-four cancer patients approached met the eligibility criteria and agreed to participate, resulting in a 100% response rate. The participants were recruited using a purposive sampling technique from the setting described earlier. Eligible patients receiving chemotherapy were identified from the clinic's patient lists and then approached in person by the researcher responsible for enrolling the patients. After a brief explanation provided to the patients about the study purpose and inclusion criteria, interested patients who met the criteria were enrolled in the study sample until the required sample number was reached, after that, they were randomized into two equal groups (32 cancer patients for each). The patients were selected based on specific eligibility criteria: they received their first chemotherapy during the study, were between the ages of 20 and 60, consented to participate in the study, and were able to communicate. Patients with an allergy to ice or regular saline mouthwash, any oral ulcers, mucositis that developed before starting chemotherapy, and critical illness were excluded.

Instruments

A structured interview was utilized to collect data pertinent to this study, by an independent, trained, qualified researcher, blinded to group assignment, who performed all assessments in a private clinical setting; it is divided into two sections:

Section I: Demographic characteristics & health-relevant datasheet

The researcher developed this section after reviewing related and latest research (Correa *et al.*, 2020; Singh and Singh, 2020; López-González *et al.*, 2021; Patel *et al.*, 2021; Ferreira *et al.*, 2022; Amiri Khosroshahi *et al.*, 2023). The researcher evaluated the socioeconomic background and related health data of cancer patients. Data on sociodemographic background included the patient's identification, age, gender, marital status, level of education, occupation, payment method for treatment, and telephone number. Patient's health relevant data was covered: diagnosis, cancer type and stage, length of the disease, types of chemotherapy, number of chemotherapy cycles, and interval between them, comorbidity, and oral assessment guide (OAG).

Section II: oral assessment guide (OAG):

This assessment guide, created by Eilers et al. (1988), is used to assess the degree of stomatitis and the state of the oral cavity. Voice, swallow, lips, tongue, saliva, mucous membranes, gingiva, and teeth or dentures are its eight categories. A scale of 1 to 3 is used to rate each category, ranging from normal results (1) to severe abnormalities (3). A total score ranging from 8 (normal findings) to 24 (severe alterations) is determined by summing the scores across the eight categories (Eilers and Berger, 1988; Eilers and Epstein, 2004).

Section III: The World Health Organization (WHO) mucositis scale:

This section, developed by WHO (1979), measures both subjective and objective signs and symptoms of OM. It consists of 4 grades: Grade zero is the absence of OM (normal oral membrane); Grade I can be identified by mild OM (erythema in mucous membranes) and soreness; Grade II is characterized by moderate OM (painful ulcers and erythema) and the ability to chew solid foods; Grade III is painful edema, which permits a liquid diet. Grade IV is characterized by severe stomatitis that restricts the ability to eat. With ulcers and a poor quality of life, grade III and IV OM are regarded as severe, intolerable mucositis. Both *Section II* and III were forward–backward translated into Arabic.

Validity and reliability

A panel of seven professionals reviewed the data collection tool for clarity, relevance, comprehensiveness, understanding, and applicability. Five of the professionals were from the Faculty of Nursing at Mansoura University, which specializes in medical-surgical nursing, and two were internal medicine oncologists. The panel also tested and revised the tool for its content validity. The content validity of the tool was assessed for knowledge accuracy, relevance, and comprehensiveness, and no modifications were made. The study tool's reliability was assessed using test-retest and showed satisfactory test-retest reliability (r = 0.83).

Pilot study

A pilot study involving 7 patients, which represents ten percent of the total participants, was conducted to assess the feasibility and objectivity, clarify the applicability of the developed tool, and calculate the needed time to fill in the data collection sheets. There were no modifications, and those patients were excluded from the study sample.

Preparation Phase

Formal written authorization to carry out the study was secured from the vice dean of the Postgraduate Studies and Research, Faculty of Nursing, Mansoura University, and also the manager of the Oncology Center, Mansoura University. Following approval from the head nurse of the chemotherapy unit, the researcher provided documentation outlining the study's purpose and methodology. Informed consent was subsequently obtained from participants after confirming their eligibility, ensuring they received a comprehensive explanation of the study's aims and procedures, and receiving assurances of confidentiality.

Patients' socio-demographic data and health-relevant data were obtained from their records using part I of the tool. All equipment needed for the procedure was prepared by the researcher, including ice, normal saline, a flashlight, a tongue depressor, a syringe, and a single-use cup. Patients underwent an oral assessment using a flashlight and a tongue depressor for optimal visualization of the oral cavity.

Implementation Phase

The researcher visited the chemotherapy installation unit 3 days/week from 9 am to 12 pm to collect data until the sample size reached the pre-determined number. For the cryotherapy group, the researcher prepared ice cubes of suitable size and shape, then stored them in the installation unit's refrigerator. Specially prepared, appropriately sized, and rounded ice cubes were used for cryotherapy to facilitate easy movement within the oral cavity. Each ice cube weighed approximately 10 g and measured about 2 cm^3. Participants with dental prostheses were instructed to remove them before cryotherapy. Patients held the ice cubes in their mouths for five minutes before chemotherapy initiation and replaced them with fresh cubes during the session. The practice continued for an additional 5 minutes after chemotherapy was completed. For chemotherapy sessions lasting longer than one hour, ice cubes were replenished continuously. Compliance was objectively assessed by weighing the prepared ice mass before and after each session, and adherence was determined as the proportion of the prepared ice mass used during the treatment.

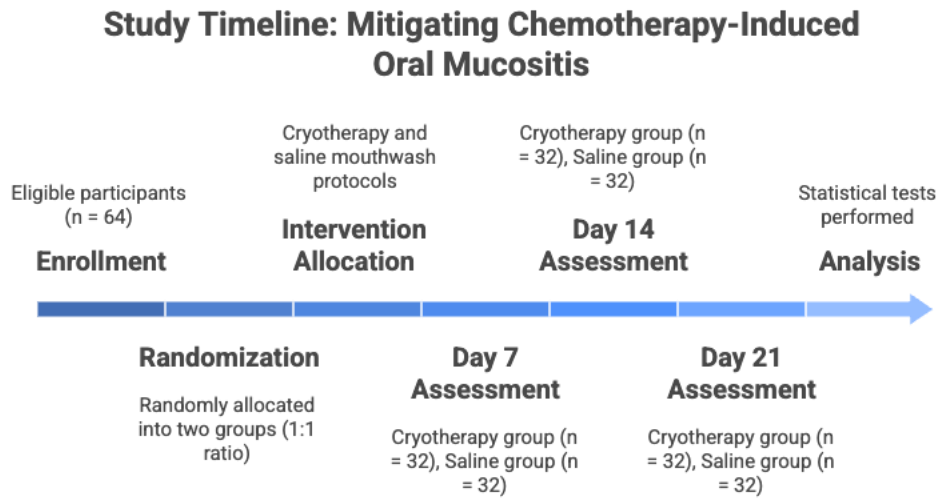

Figure 1. Patient flow diagram

For the saline group, the normal saline was prepared by pulling a suitable amount (about 30 ml) of 0.9% standard saline solution using a syringe and transferring it into a disposable cup. To ensure the fluid reached every part of the mouth cavity, the patient was instructed to gargle with regular saline solution for 30 seconds every 10 minutes, then spit it out after finishing. The total volume used per session was 150 ml, administered 5 times during treatment. These processes were repeated before, during, and following chemotherapy treatment.

Evaluation Phase

Posttest measurements were taken from the two groups on three occasions: 7, 14, and 21 days after each chemotherapy cycle using part II of the tool. The posttest was administered to the patients by phone. At the end of the study, four test measurements (baseline, at 7, 14, & 21 days) were applied to the two groups. An independent nursing researcher, blinded to group assignment, performed all outcome assessments. To prevent observer bias, participants were identified using coded numbers, and allocation details were withheld during data collection and analysis. A comparative study was conducted to compare the effects of cryotherapy against regular saline mouthwash on oral mucositis among cancer patients undergoing chemotherapy.

Ethical approval

Ethical approval was granted by the Research Scientific Ethics Committee of the Faculty of Nursing at

Table 1. Distribution of the study subjects according to their personal characteristics (n=64)

Variable	Cryotherapy group		Saline group		X^2 / Mc (P)
	N=32	%	N=32	%	
Age (Years)					
20 to less than 30	4	12.5	2	6.3	1.525
30 to less than 40	4	12.5	7	21.9	(0.677)
40 to less than 50	11	34.4	11	34.4	
50 to 60	13	40.6	12	37.5	
Mean ± SD	43.05±10.34		42.68±10.14		t= 0.141 (0.881)
Sex					
Male	12	37.5	14	43.8	0.259
Female	20	62.5	18	56.2	(0.611)
Marital status					
Single	5	15.6	7	21.9	0.725
Married	25	78.1	22	68.8	(0.696)
Divorced	2	6.3	3	9.4	
Educational level					
Illiterate	5	15.6	3	9.4	1.468
Read and write	7	21.9	5	15.6	(0.690)
Secondary education	14	43.8	15	46.9	
Higher education	6	18.8	9	28.1	
Occupation					
Governate work	7	21.9	6	18.8	1.696
Private work	8	25.0	9	28.1	(0.791)
Student	3	9.4	2	6.3	
Housewife	11	34.4	14	43.8	
Hand work	3	9.4	1	3.1	
Payment method for treatment					
Government's expense	13	40.6	14	43.8	1.567
Own expense	9	28.1	8	25.0	(0.589)
Health insurance	10	31.3	10	31.3	

X2: Pearson Chi-Square, Mc: Monte Carlo test, t: Student t test, P < 0.05 (Significant),
More than one answer, X2: Pearson Chi-Square, Mc: Monte Carlo test

Table 2. Distribution of the study subjects according to their Health Relevant Data (n=64)

Variable	Cryotherapy group		Saline group		X^2 / Mc (P)
	N=32	%	N=32	%	
Cancer type					
Breast cancer	13	40.6	12	37.5	4.084
Colorectal cancer	7	21.9	5	15.6	(0.537)
Pancreatic cancer	5	15.6	4	12.5	
Lung cancer	4	12.5	6	18.8	
Uterine cancer	3	9.4	2	6.3	
Cervical cancer	0	0.0	3	9.4	
Cancer stage					
Stage I	17	53.1	13	40.6	1.019
Stage II	9	28.1	11	34.4	(0.601)
Stage III	6	18.8	8	25.0	
Length of the disease					
Since 3 months	16	50.0	21	65.6	5.494
3 to 9 months	12	37.5	4	12.5	(0.064)
More than 9 months	4	12.5	7	21.9	
Type of chemotherapy					
Taxotel	11	34.4	9	28.1	4.234
Folfox	5	15.6	6	18.8	(0.516)
Taxol	6	18.8	7	21.9	
Xelon	5	15.6	1	3.1	
Plantinol	3	9.4	6	18.8	
Gemezar	2	6.3	3	9.4	
Number of cycles of chemotherapy					
2-3	13	40.6	14	43.8	0.366
4-5	11	34.4	12	37.5	P=0.833
>5	8	25.0	6	18.8	
Interval between cycles					
2 weeks	6	18.8	8	25.0	0.366
3 weeks	26	81.2	24	75.0	(0.545)
Chronic diseases					
No	21	65.6	18	56.3	1.903
Diabetes Mellitus	7	21.9	10	31.3	(0.593)
Hypertension	4	12.5	3	9.4	
Cardiac disease	0	0.0	1	3.1	

X2: Pearson Chi-Square, Mc: Monte Carlo test, t : Student t test, P < 0.05 (Significant)

Mansoura University (number 0776). Before obtaining verbal informed consent, all participants enrolled in the trial were provided with complete information concerning the study's aims, interventions, modalities, potential benefits, and possible risks. To ensure adherence to ethical standards, the anonymity and confidentiality of the collected data were strictly maintained. Participants were explicitly informed that their involvement was both voluntary and anonymous. Each participant had the right to withdraw from the study at any time without consequences or responsibility.

Data analysis

The gathered data were systematically structured, coded, tabulated, and statistically analyzed utilizing SPSS software (version 22). The normality assumption was accepted. Numbers and percentages represented categorical data. Quantitative data were expressed as mean ± standard deviation (SD). Comparisons between two variables with continuous data were made using the independent sample Student's t-test. The Chi-square test was used to compare categorical variables. $p<0.05$ was the cutoff point for statistical significance.

Results

The study sample is described in Table 1. The study enrolled 64 patients without lapses. Mean (SD) ages of the patients in the cryotherapy and saline groups were 43.05±10.34 and 42.68±10.14 years, respectively. When comparing the two groups' personal characteristics, no

Table 3: The grade of oral mucosities by time point for both groups

Time	WHO Mucositis Grade	Cryotherapy Group (n = 32)			Saline Group (n = 32)			X^2 / Mc (P)
		No	%	(95% CI)	No	%	(95% CI)	
Day 7	Grade 0	22	68.8	(51.5%–81.9%)	21	65.6	(48.4%–79.6%)	0.071
	Grade I	10	31.3	(18.1%–48.5%)	11	34.4	(20.4%–51.6%)	(0.790)
	Grade II	0	0.0	(0.0%–10.9%)	0	0.0	(0.0%–10.9%)	
	Grade III	0	0.0	(0.0%–10.9%)	0	0.0	(0.0%–10.9%)	
	Grade IV	0	0.0	(0.0%–10.9%)	0	0.0	(0.0%–10.9%)	
Day 14	Grade 0	18	56.2	(39.3%–71.8%)	13	40.6	(25.9%–57.2%)	2.429
	Grade I	14	43.8	(28.2%–60.7%)	17	53.1	(36.4%–69.1%)	(0.119)
	Grade II	0	0.0	(0.0%–10.9%)	2	6.3	(1.7%–20.2%)	
	Grade III	0	0.0	(0.0%–10.9%)	0	0.0	(0.0%–10.9%)	
	Grade IV	0	0.0	(0.0%–10.9%)	0	0.0	(0.0%–10.9%)	
Day 21	Grade 0	18	56.2	(39.3%–71.8%)	8	25.0	(13.2%–42.2%)	10.615
	Grade I	11	34.4	(20.4%–51.6%)	15	46.9	(30.9%–63.6%)	(0.004)**
	Grade II	3	9.4	(3.3%–24.1%)	5	15.6	(6.7%–32.1%)	
	Grade III	0	0.0	(0.0%–10.9%)	4	12.5	(4.9%–28.1%)	
	Grade IV	0	0.0	(0.0%–10.9%)	0	0.0	(0.0%–10.9%)	

statistically significant variations were found ($p < 0.05$). The majority of both the cryotherapy and saline groups were females (62.5% and 56.2%, respectively) and married (78.1% and 68.8%, respectively).

Table. It shows that grades II, III, and IV were not observed at Day 7 in both groups, while on Day 14, grade II appeared in the saline group by 6.3%. Finally, on day 21, grade II and III appeared in the saline group (15.6%,

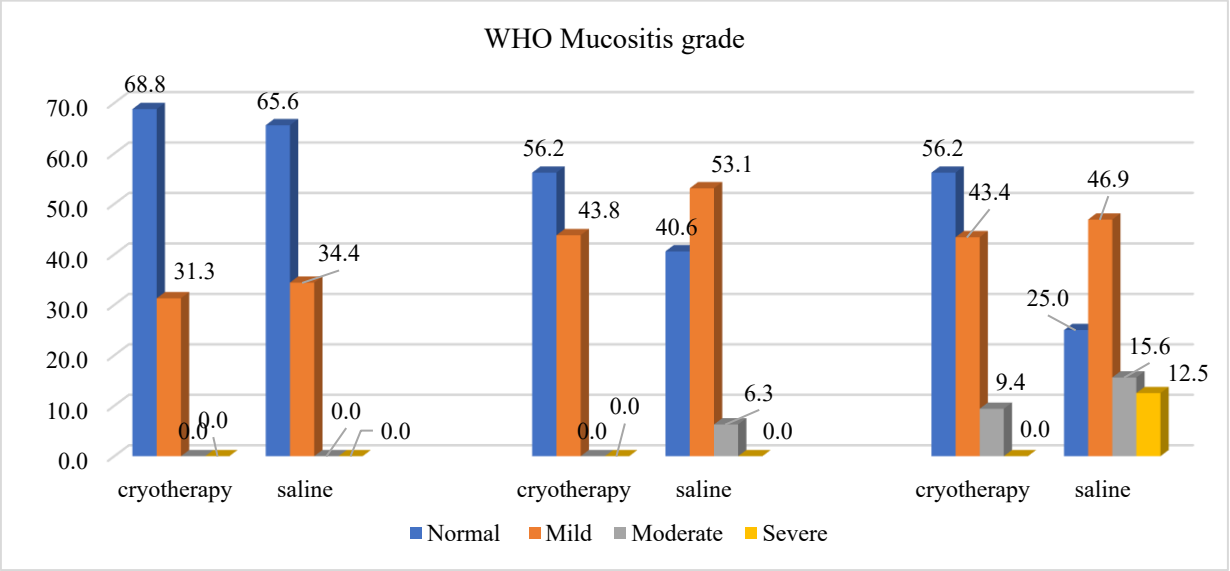

Figure 3. Oral mucositis severity on the 7th, 14th, and 21st days of assessment according to the WHO mucositis scale during the study phase.

More than two-fifths (43.8%, 46.9%) of the cryotherapy and saline groups were secondary level, respectively. Above one-third (34.4%) in the cryotherapy group and above two-fifths (43.8%) in the saline group were homemakers. The highest percentage of patients in the cryotherapy and saline groups (40.6% and 43.8% respectively) were treated at the government's expense.

Furthermore, the changes between the two groups are not significant in terms of cancer type, cancer stage, length of the disease, type of chemotherapy, number of cycles of chemotherapy, interval between cycles, and chronic diseases, as shown in Table 2. The grade of oral mucosities by time point at day (7,14, and 21), with confidence intervals for all percentages presented in the

12.5%), respectively, compared with 9.4% Grade II only in the cryotherapy group.

When considering stomatitis severity according to the oral assessment guide, there were no statistically significant differences between the cryotherapy and the saline groups on the 7th and 14th days of assessment. But on the 21st day, there were highly statistically significant changes between the cryotherapy and saline groups, having a P value of 0.003, as the highest mean ± SD was found in the saline group (12.91 ± 4.73), while the lowest mean ± SD (9.88 ± 3.06) was in the cryotherapy group, as shown in Figure 2.

Figure 3 compares the two groups' oral mucositis severity on the seventh, fourteenth, and twenty-first days

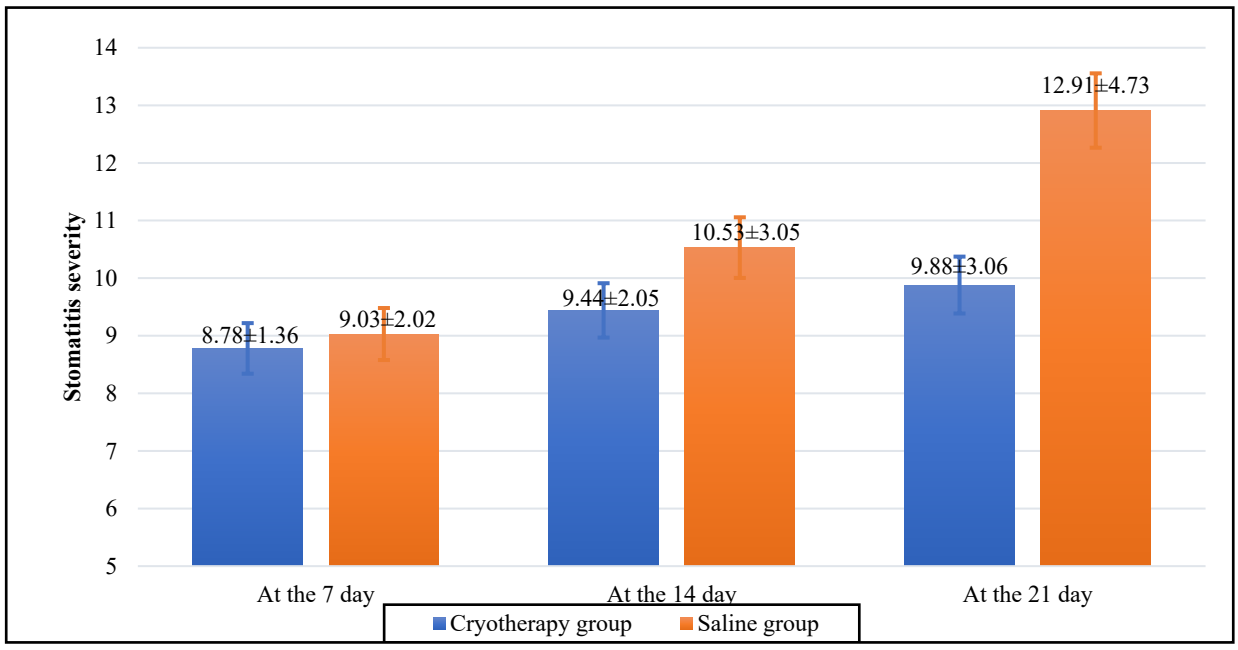

Figure 2. Stomatitis severity among the studied samples according to the oral assessment guide throughout the study period (n=64)

after chemotherapy delivery using the WHO mucositis scale. They show that on the seventh and fourteenth days of assessment, there were no statistically significant variations in the severity of OM between both groups; however, on the twenty-first day, the incidence and severity of OM varied significantly between the samples under study, with a p-value of 0.004.

At baseline, all participants were free of OM based on the WHO mucositis scale. By day 14, mucositis incidence increased in both groups with no significant difference between them. However, by day 21, the cryotherapy group showed a significantly higher proportion of participants without mucositis (56.2%) and fewer cases of moderate (9.4%) to severe mucositis compared to the saline group, indicating a clear therapeutic advantage of cryotherapy at this stage.

Discussions

The purpose of the current study was to compare the effects of cryotherapy and regular saline mouthwash on chemotherapy-induced oral mucositis in cancer patients. The study's results reveal that the patients in the cryotherapy group and the saline group had a similar distribution, and no statistically significant changes were observed between both groups regarding demographic characteristics & health-relevant data before the intervention. Despite similar baseline demographic and health data between groups, the cryotherapy group consistently exhibited superior outcomes, particularly in mucositis severity reduction over time.

The current research found that, following the completion of the interventions, there were highly statistically significant differences in the incidence and severity of mucositis on days 7, 14, and 21 between the cryotherapy and saline groups. According to the WHO mucositis scale, the findings showed that the proportion of normal oral mucosa in the cryotherapy group was more than half at the end of the 21 st day, which was more than two- thirds on the 7 th measurment day, and similarly in the normal saline group, it was one -fifth at 21st day which was more than two thirds in 7th day. Therefore, there is definitive evidence that the cryotherapy group mucositis grade improved compared to the normal saline group.

These findings suggest that while both interventions were initially practical in preventing mucositis, cryotherapy demonstrated a superior protective effect over time. By day 21, participants in the cryotherapy group were significantly more likely to remain free of mucositis, and none developed severe mucositis, whereas participants in the saline group did. This indicates that cryotherapy may be a more effective strategy for reducing the incidence and severity of oral mucositis during the study period.

The finding of this study aligns with the conclusion published by Dash et al. (2025), who found that the reduction in mucositis grade was significantly greater in the cryotherapy group compared to the normal saline group, indicating a notable association between treatment group and mucositis outcomes.

Similarly, Kurt et al. (2025) reported that oral cryotherapy (OC) was superior to gargling with cold water (GCW) during the first 21 days of OM management and treatment. For 21 days, the OC group's grade 0 is significantly higher than those of the GCW and control groups.

Another study conducted by Tharwat Mohamed et al. (2024) added that applying ice chips (oral cryotherapy) is a common, low-cost, easy-to-use technique that helps reduce OM from developing and is unlikely to have any adverse side effects as there were highly statistically significant changes that were observed between the study and control groups at the end of the 1st, 2nd & 3rd weeks of intervention with a significant P value. A marked decline was also observed in the OM symptom mean scores in the study group compared to the control group at the end of the 1st, 2nd & 3rd weeks of intervention.

Similarly, a study by Elarabi and Anoop (2024) supported our results, reporting that the mean total scores varied significantly and that the clinical manifestations of OM were mild in those given oral ice cubes. It illustrates how applying oral ice cubes to cancer patients after chemotherapy was successful in reducing clinical manifestations of OM.

A comprehensive review of the literature demonstrates that oral cryotherapy, specifically the use of ice cubes, is mainly effective in both preventing and diminishing the severity of oral mucositis, supporting this study's results. A systematic review adhered to PRISMA guidelines and involved searches across five major electronic databases—PubMed, ScienceDirect, Cochrane, Scopus, and Springer Link—for articles published between 2017 and 2022 using targeted keywords. The findings consistently indicate that oral cryotherapy is a beneficial intervention for managing oral mucositis, as supported by the majority of included studies (Novianti and Dewi, 2023).

Notably, no cases of severe mucositis were reported in the cryotherapy group—a significant milestone that positions this intervention as a promising, safe preventive measure for oral mucositis. The fact that cryotherapy has a vasoconstriction effect, reducing blood flow and limiting cytotoxic drug exposure to oral tissues, can explain this.

The sample included 64 patients from a single clinical setting, which would limit the extent to which the results can be generalized to other chemotherapy regimens or larger cancer populations. Moreover, the single-center design may introduce institutional or regional biases that could affect adherence and patient management practices.

Conclusion

The findings of this study demonstrate that cryotherapy is significantly more effective than regular saline mouthwash in managing chemotherapy-induced oral mucositis, as evaluated using the WHO mucositis grading scale. This superiority was particularly evident on the 21st day following intervention. Based on these results, cryotherapy can be advocated as a safe, cost-effective, and practical approach for both the prevention and treatment of oral mucositis in patients undergoing cancer chemotherapy.

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Availability of data and materials

All data sharing is subject to ethical guidelines and patient confidentiality agreements. Data will only be shared in a manner that maintains participant anonymity.

Authors' contributions

H.A.S.: manuscript writing and editing, paraphrasing, methodology, study supervision; revisions for all study content; E.M.A: draft of the introduction and methodology, references, agreed to the final version of the manuscript; T.R.E.: study supervision, read the final version of the manuscript; and H.M.M.S.: conceptualization; study supervision; critical revisions for important intellectual content. reviewed the manuscript.

Conflict of Interest

The authors declared that they have no conflicts of interest.

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