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Use of a menthol popsicle in managing postoperative thirst in patients undergoing radical prostatectomy: A randomized clinical trial

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Abstract

Background and aim: Thirst is a real bother that most patients feel in the immediate postoperative period when they still need to fast. Many approaches regarding symptomatic relief strategies have been described in the literature, but strategies with cold water and/or menthol are effective in quenching thirst, as they act on pre-absorptive mechanisms. This study aims to evaluate the effectiveness of using menthol popsicles in relieving postoperative thirst in patients undergoing radical prostatectomy. **Material and methods:** This is a randomized controlled clinical trial with a quantitative approach. In all, 44 patients were evaluated in the immediate postoperative period of radical prostatectomy, with the intensity and discomfort of thirst being evaluated initially and subsequently. The study consisted of two groups: (1) the placebo group, popsicles without the addition of menthol substrates and (2) the experimental group, popsicles with the addition of 0.05% minty substrates. **Results:** The results demonstrate that the sociodemographic and clinical characteristics were homogeneous at the $\alpha = 5\%$ significance level, except the occupation variable. The test detected changes in the intensity and discomfort of thirst in relation to the pre- and post-intervention times for the primary outcome when the groups were analyzed separately and for the interaction of the group versus time, there was no statistical difference between the groups. **Conclusion:** It was possible to prove that both the menthol popsicle and the popsicle without the addition of menthol were effective in relieving postoperative thirst in patients undergoing radical prostatectomy, but there was no statistically significant difference when comparing the two groups.

Trial registration: The Brazilian Registry of Clinical Trials (RBR-8c3chr7).

Keywords

Thirst, postoperative care, clinical trial, menthol, nursing care

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Introduction

Thirst is a tormenting experience that most patients feel in the immediate postoperative period (IPO) when they still need to fast. Research has shown that this discomfort can be severe from the patient's point of view and lead to anxiety, dehydration, irritability, weakness, and despair.[1,2]

An analysis of the concept of perioperative thirst was conducted, and then a nursing diagnostic structure was developed, constituting a factor that shows the worldwide prevalence of the problem. In addition, antecedents that emphasize the surgical patient as vulnerable to this diagnosis were highlighted through observation of signs and symptoms

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and qualitative aspects that negatively interfere with the anesthetic-surgical experience.[3]

Due to its subjective nature, thirst in surgical patients should be adequately diagnosed and treated perioperatively. The thirst during this period can negatively affect the surgical experience, affecting up to 89.6% of adult patients and 89.5% of children.[1,2]

It is also believed that new strategies need to be investigated and scientifically proven to relieve the thirst of IPO patients since thirst management is still incipiently addressed in the national and international literature as the most important obstacle that exists in practice: the fear that the patient will develop complications, such as bronchoaspiration, during anesthesia.

As a result, the individual remains fasting for a long time before and after the surgical procedure. Thus, even with the advances presented in conducted studies, some points are raised as opportunities for improvement to support clinical application in critically managing perioperative thirst.

This study is justified by the possibility of providing relief from thirst to cancer patients who need radical prostatectomy due to the long fasting period they undergo (between 6 pm and midnight) as part of the institution's surgical protocol. These patients were chosen as a population since the institution still does not have a protocol for thirst relief although it is a major surgery for prostate cancer. In this perspective, the institution and the main researcher agreed to perform the study in a major surgery that did not involve abdominal surgeries, as they present a greater risk of gastrointestinal intercurrences in the perioperative period.[4]

It is already known that the anterior cortex region is activated when there is thirst–satiety, which is responsible for the perception of this sensation by the individual.[4] After the onset of thirst, the body uses two different mechanisms to restore satiety, namely post-absorptive and pre-absorptive.[5,6]

Post-absorptive satiety is triggered after water absorption by the body and restoration of osmotic and/or hypovolemic levels,[6] whereas pre-absorptive satiety is related to receptors located in the oropharynx and stomach which act as ingested volume meters, even before there is absorption of the liquid.[5,6] When cold substances stimulate oropharyngeal receptors, the body's response to satiety tends to happen in a shorter time. This information is established because it is known that pre-absorptive factors stimulate thirst–satiety in a shorter period than post-absorptive factors.[7]

Before TRPM8 mapping, researchers claimed that the nerve fibers of the trigeminal ganglia and the glossopharyngeal nerve seemed to receive stimuli from cold temperatures, transmitting the electrical impulse to brain regions, and that mentholated substances also provided these stimuli.[8]

However, it was only in 2002 that two different groups of researchers described and mapped TRPM8, associating them with previous findings.[9]

When activated, the TRPM8 receptor opens the ion channels, causing a non-selective influx of calcium ions that result in activating the electrical impulse and provides a cooling sensation.[10]

In short, due to the presence of TRPM8 in the oral cavity and taking into account the anatomical path of the glossopharyngeal and trigeminal nerves, the presence of these receptors is associated with the speed of generating pre-absorptive satiety. These receptors help control and decrease the thirst intensity provided by the low temperature of the liquid, however, without the need to drink liquids in large quantities.[6,7]

Thus, many approaches have been described in the literature regarding relief strategies, but strategies with cold water and/or menthol are more effective in quenching thirst, as they act on pre-absorptive mechanisms.[3,11] Thus, the use of menthol substances has become a widely used strategy for quenching thirst, as menthol and cold temperatures enable the activation of receptors located in the oral cavity which contributes to thirst–satiety.[11]

In view of the above, the question is: how effective is the use of menthol popsicles in relieving postoperative thirst in patients undergoing radical prostatectomy? Is the use of menthol popsicles more effective in relieving thirst compared to popsicles without menthol addition?

In view of the above, this study aims to evaluate the effectiveness of using a menthol popsicle in the relief of postoperative thirst in patients undergoing radical prostatectomy.

Material and methods

Study type

This is an experimental randomized clinical trial (RCT) controlled type with a quantitative approach in compliance with the standards recommended by the Consolidated Standards of Reporting Trials.[12]

Study location

The present study was conducted in an oncological hospital located in the city of Natal, Rio Grande do Norte (RN), Brazil.

Sample determination

The study sample was probabilistic and simple and randomly included patients who underwent elective radical prostatectomy surgery. The sample calculation was established using the G Power version 3.1.9.2 software program (Erdfelder, Faul & Buchner, 1996, Germany) considering a Cohen's effect size of 0.40, a test power of 0.80, and a significance level of 5% (p-value < 0.05). Therefore, it was estimated that the sample required was 22 patients for each group (placebo and experimental), totaling 44 patients.

Study groups

The placebo group (PG) consisted of patients who received a filtered water popsicle without the addition of 0.05% menthol substrate. The experimental group (EG) consisted of patients who received the filtered water popsicle with the addition of 0.05% menthol substrate. The two formulations had the addition of 13 drops of green food coloring to standardize the appearance of the popsicle.

Study eligibility criteria

The inclusion criteria were as follows: being 18 years of age or older; fasting for at least 6 h; and approval in the assessment of the Safety Protocol for Thirst Management (*Protocolo de Segurança no Manejo da Sede—PSMS*), specifically elaborated and validated for application in surgical patients who report thirst in the IPO, allowing a careful assessment of the following items: level of consciousness, airway protection in the presence of coughing and swallowing, and absence of nausea and vomiting.[13] The exclusion criteria were as follows: having water restriction when ingesting or swallowing and/or having some type of allergy or hypersensitivity to menthol or green dye.

Randomization

The study consisted of two groups: a PG and an EG. Randomization was established in a simple random manner through the online virtual platform 'Research Randomizer' (https://www.randomizer.org). It should be noted that all patients had the same chance of being allocated to either the CG or the EG, guaranteeing randomization of the study (Figure 1).

Preparation of menthol popsicle

The menthol popsicle formulation was established through the American Pharmacopoeia, which recommends menthol levels below 0.1% as a safe limit for human intake. This measure was adopted due to a lack of national records on the use of menthol, with the National Health Surveillance Agency (*Agência Nacional de Vigilância Sanitária—ANVISA*) deliberating Resolution No. 37 of July 2009, which addresses the use of foreign recommendations in the absence of national records.

The formula for preparing the menthol popsicle was defined based on the results shown in other studies,[14] in which the formulation used was composed of 0.05% menthol, 0.05% saccharin, 30 ml of filtered water, and 2% grain alcohol. It was decided to adopt a formulation with a filtered water volume of 50 ml in the present study, as it was considered that ingestion of this volume poses no risks in the IPO of radical prostatectomy after anesthetic recovery and referral to the ward.

The menthol popsicle was supported by a resistant plastic stick to support 50 ml of solution, allowing the patient to taste it comfortably. The popsicles were stored in the freezer of the nutrition sector of the institution selected for the study.

The popsicle freezing process took place in 10 steps: (1) proper hand hygiene; (2) wear procedure gloves; (3) using the pre-established list, the researcher must pay attention to which numbers belong to the CG solution and the EG solution; (4) identify the popsicle sticks with the numbers established by the listing; (5) with a sterile 20 ml syringe, add 50 ml of solution to each popsicle mold unit. There were two different six-unit molds for each solution to prevent the researcher from accidentally mixing the solutions, and they must handle one mold at a time; (6) add the toothpick identified with the pre-established numbering; (7) store the molds in sealed packaging and place them in the nutrition sector's freezer; (8) after the popsicles are frozen, remove them from the freezer and the sealing package, remove the popsicles from the individual mold, checking if they are homogeneous and visually the same; (9) remove the popsicles from the mold and add an individual's protective package; and (10) store the individual's ready-to-eat popsicles in a sealing bag and place them back in the freezer.

Blinding

The study development was composed of two researchers: (1) the lead/main researcher (R1) is a nurse and responsible for the research; (2) the collaborating researcher (R2) is also a nurse at the institution where the study was carried out and was responsible for freezing the solution in popsicle format.

The popsicle solutions were prepared and frozen by R2 and randomly specified with numeric codes from 1 to 44 for both the EG and PG. In addition, the popsicles of both groups were packaged in plastic, thus maintaining the same appearance and preventing the spread of odors; however, the study cannot be considered blind as there was no guarantee that R1 did not identify which popsicle reached the EG or PG by the characteristic odor of menthol. Despite this, all popsicles had 13 drops of green food coloring added, ensuring all popsicles looked identical.

Data collection instrument

The data collection instrument is subdivided into three parts: (1) patient identification, clinical data, and sociodemographic data; (2) data regarding the surgical procedure and anesthetic process; and (3) data regarding the intensity of thirst using the Numerical Scale (NS) and thirst discomfort using the Perioperative Thirst Discomfort Scale (*Escala de Desconforto da Sede Perioperatória—EDESP*), which is a scale that evaluates thirst characteristics: dry mouth, dry lips, thick tongue, thick saliva, dry throat, bad taste, and a desire to drink water. These items are quantified using a three-point ordinal scale with the following definitions: 0—no discomfort, 1—little discomfort, and 2—a lot of discomfort. The

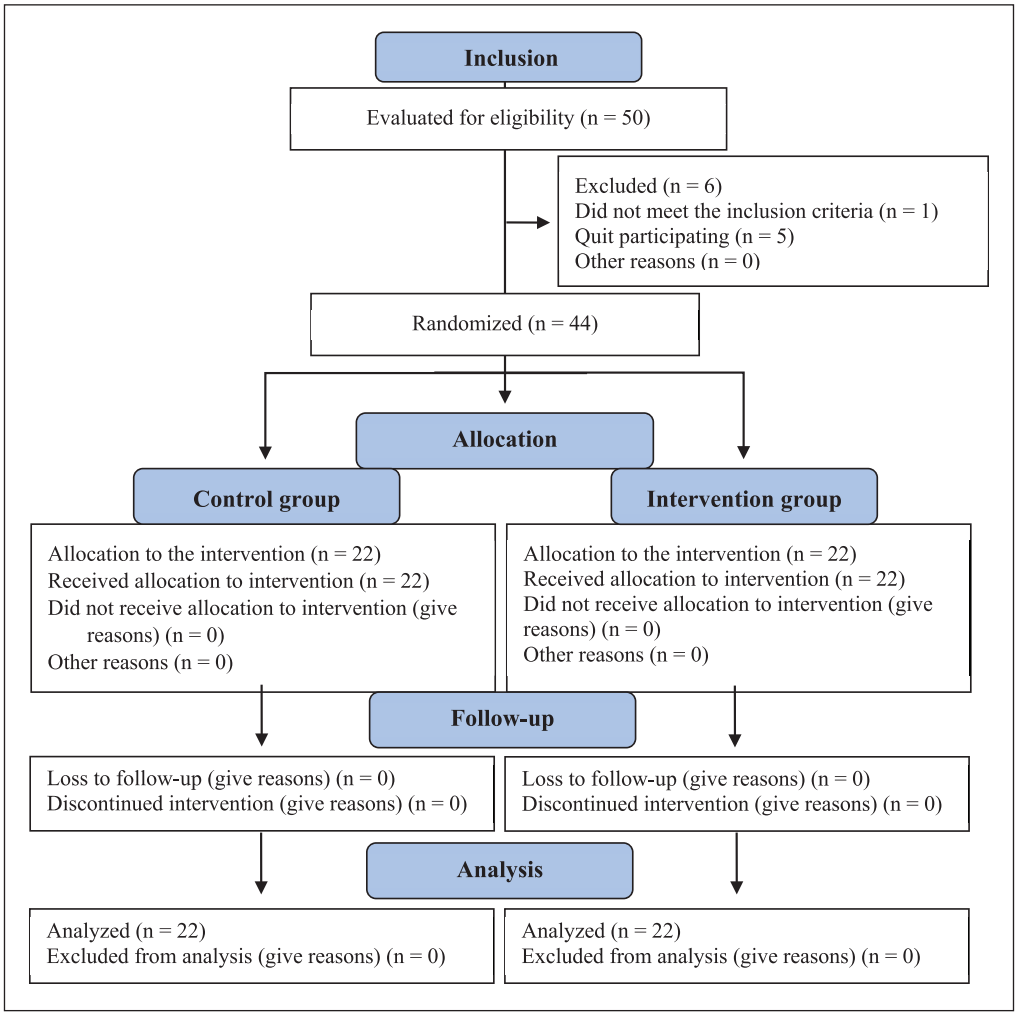

Figure 1. Study follow-up flowchart adapted from consolidated standards of reporting of trials (CONSORT, 2010).

final *EDESP* score ranges from zero to 14 points, with 14 referring to the most intense discomfort and zero corresponding to the absence of thirst discomfort. The *EDESP* evaluated the clarity and intelligibility of its items, with a content validity index of 0.98 for items and attributes, and a reliability index was 1, determining that the instrument is considered valid based on the analysis of 11 specialists.[15]

Statistical analysis. The collected data were stored and processed in a computerized database using the Microsoft Excel 2016 program, Microsoft Office. Descriptive analysis was used to profile the sample used in this study, presented through graphs and tables. The Shapiro–Wilk test was used to verify the normality of the quantitative data, and the chi-squared and Fisher's exact tests were used to verify the homogeneity between the PG and EG. The repeated measures analysis of variance (ANOVA) test was used to perform the comparison between groups (experimental versus placebo), in addition to the pre- and post-intervention. The value $\alpha = 0.05$ was used as the significance level. The analyses presented were performed using the R language.[16]

Results

The present study was carried out from July 2022 to May 2023, a period corresponding to the elaboration of the project until the final manuscript writing.

The results are presented in tables and figures. In addition, they are subdivided into three topics: (1) sociodemographic and clinical characteristics; (2) primary outcome (NS); and (3) secondary outcomes (*EDESP*).

Sociodemographic and clinical characteristics

Table 1 contains information regarding sociodemographic variables and information related to the patient's surgical procedure. The patients in the sample had a mean age of approximately 66.7 years with a standard deviation of 7.0. These values remained very close in both groups. More than

Table 1. Baseline sociodemographic and clinical characteristics of study participants.

Characteristics	Complete sample	Group		*p*-Value
	(*n* = 44[a])	Experimental (*n* = 22[a])	Placebo (*n* = 22[a])	
Age	66.7 (7.0)	66.4 (7.4)	67.0 (6.6)	0.78
Race/skin color				0.72
Brown	33 (75.0%)	18 (81.8%)	15 (68.2%)	
White	9 (20.5%)	3 (13.6%)	6 (27.3%)	
Black	2 (4.5%)	1 (4.5%)	1 (4.5%)	
Civil status				0.49
Married/stable union	33 (75.0%)	18 (81.8%)	15 (68.2%)	
Single/divorced/widower	11 (25.0%)	4 (18.2%)	7 (31.8%)	
Education				1.00
Illiterate	6 (13.6%)	3 (13.6%)	3 (13.6%)	
Elementary	31 (70.5%)	15 (68.2%)	16 (72.7%)	
High school	5 (11.4%)	3 (13.6%)	2 (9.1%)	
University/post-secondary	2 (4.5%)	1 (4.5%)	1 (4.5%)	
Profession				0.01
Retired	15 (34.1%)	6 (27.3%)	9 (40.9%)	
Farmer	8 (18.2%)	1 (4.5%)	7 (31.8%)	
Other	21 (47.7%)	15 (68.1%)	6 (27.2%)	
Fasting time				0.86
12 h–17 h 59 min	30 (68.2%)	16 (72.7%)	14 (63.6%)	
18 h–23 h 59 min	12 (27.3%)	5 (22.7%)	7 (31.8%)	
24 h or more	2 (4.5%)	1 (4.5%)	1 (4.5%)	
Surgery time				0.33
1 h–1 h 59 min	5 (11.4%)	4 (18.2%)	1 (4.5%)	
2 h–2 h 59 min	28 (63.6%)	14 (63.6%)	14 (63.6%)	
3 h–3 h 59 min	9 (20.5%)	4 (18.2%)	5 (22.7%)	
4 h or more	2 (4.5%)	0 (0.0%)	2 (9.1%)	

[a]Mean (standard deviation); *n* (%).

half of the patients had brown skin (75.0%) and were married (70.0%). Half of the sample had incomplete primary education (50.0%), and about 34.1% of patients were retired. The most prevalent surgery time in the study was between 2 h and 2 h 59 min (63.6%).

Through the tests, it was possible to verify that the groups were homogeneous (except the profession variable) at the significance level $\alpha = 5\%$.

Primary outcome

The primary outcome refers to the assessment of the thirst intensity using the NS. Figure 2 presents the boxplot for evaluating the data distribution for pre- and post-intervention NS in each of the randomization groups.

Visually, the graphs suggest the following information:

The boxplot boxes are very similar at the pre-intervention moment, practically one within the other, suggesting that there was no difference in the scores given by the patients, regardless of which randomization group this patient belonged to. Then in the post-intervention moment, it is noticed that the boxes are very close, but they are not contained in each other. Next, when comparing the two groups (experimental versus placebo), there was no statistical difference in pre- and post-intervention scores.

Therefore, with regard to the primary outcome, the test detected changes in the scale score in relation to pre- and post-intervention times when the groups were analyzed separately ($p < 0.0001$; $\eta_p^2 = 0.8479$) and for the group versus time interaction ($p = 0.0021$; $\eta_p^2 = 0.0713$), but there was no statistical difference between groups (experimental versus placebo) ($p < 0.2045$; $\eta_p^2 = 0.0269$). Thus, it is possible to verify that the scores presented before and after the intervention were considered different from the statistical point of view, providing evidence that the use of menthol popsicles and placebo popsicles had a positive effect on thirst relief; however, no statistical difference was found among the groups per se (i.e., experimental versus placebo).

Secondary outcomes

Secondary outcomes refer to the assessment of thirst discomfort by the Perioperative Thirst Discomfort Scale (*EDESP*), both in terms of the final score and the individual sub-items (Figure 3).

Thus, the graphs visually suggest the following information:

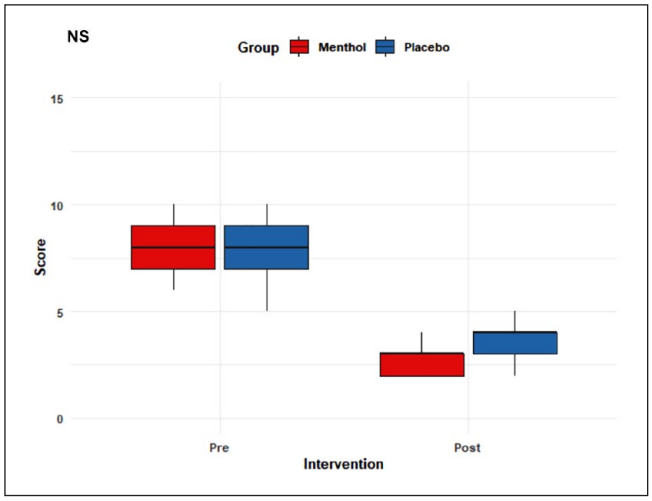

Figure 2. Boxplot of comparisons between the EG versus PG for pre- and post-intervention NS data.

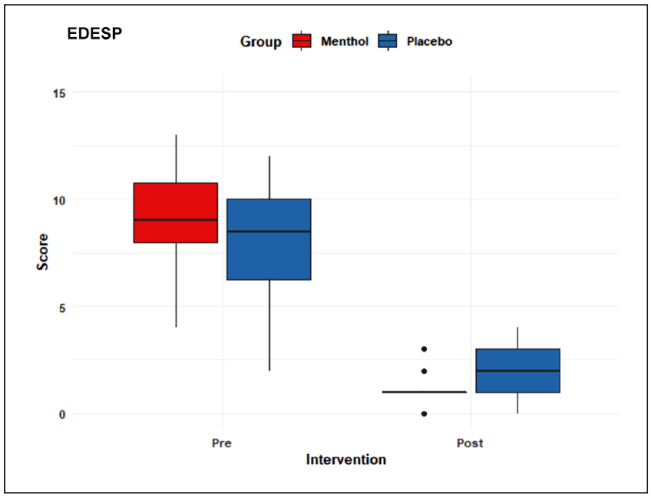

Figure 3. Boxplot of comparisons between the EG versus PG for pre- and post-intervention *EDESP* data.

The boxplot boxes are quite similar at the pre-intervention moment, despite the first quartile being higher than the PG, suggesting that there was no difference in the scores given by patients regardless of which randomization group this patient belonged to.

In the post-intervention moment, it is noticed that the minimum, first quartile, second quartile, third quartile, and maximum in the menthol group correspond to the same value (1), and there is the presence of three outliers (0, 0, 2, 0, 3, 0). Despite the visual difference in the post-intervention moment, the boxes are very close but not contained within each other, suggesting that even if there is no statistically significant difference, there is the possibility that a clinical difference is found, or even that a statistically significant difference may be found by increasing the sample size. However, when comparing the two groups (experimental versus placebo), there was no difference in pre- and post-intervention scores as shown below in the summarized data.

Thus, with regard to the secondary outcome (*EDESP*—final score), the test detected a change in the scale's score in relation to the pre- and post-intervention times when the groups are analyzed separately (*EDESP:* $p < 0.0001$; $\eta_p^2 = 0.7862$) and for the group versus time interaction (*EDESP:* $p = 0.0014$; $\eta_p^2 = 0.0706$), but there was no statistical difference between groups (experimental versus placebo) (*EDESP:* $p = 0.9630$; $\eta_p^2 = 0.0001$). Therefore, it is possible to verify that the scores presented before and after the intervention are considered different from the statistical point of view, providing evidence that the use of menthol popsicles and placebo popsicles had a positive effect on thirst discomfort; however, no statistical difference was found among the groups per se (i.e., menthol versus placebo). Because the effect is small, especially on the *EDESP* scale ($\eta_p^2 = 0.0001$), it is possible that no clinical difference was found either.

The effect sizes are shown in Table 2. Thus, the test presents evidence that patients who received menthol and placebo had different scores with regard to the pre- and post-intervention time.

Discussion

The data exposed in the results of this study regarding the demographic and clinical characteristics of the study participants corroborate the profile in the literature, as well as in relation to the age group presented by this study. In an epidemiological study of prostate cancer in Brazil over the last 10 years, it was shown that men aged 50 years or older accounted for the largest number of cases, with ages between 60 and 69 years accounting for 38.21% of cases.[4]

There was a predominance of patients aged between 61 and 70 years in the present study, followed by patients aged between 71 and 80 years, thus corroborating the literature in which approximately 65% of cases are diagnosed in patients aged over 65 years.[5] International studies have observed that the risk of this pathology increases progressively with aging.[6,7]

The data are explained since the prevalence of this cancer increases progressively with age, knowing that it is generally a slowly developing disease with a long pre-symptomatological phase duration. Thus, the development of symptoms and clinical diagnosis mainly occur in older men, with many dying from other causes before any symptoms clinically manifest themselves.[8]

Furthermore, the adverse effects of fasting are amplified considering the metabolic characteristics of the older adult population predominant in the present study, increasing the consumption of metabolic stocks and aggravating surgical trauma. Other reasons for extending fasting are delays and interruptions in operations, which can extend fasting

Table 2. ANOVA table for NS and *EDESP* (final score and sub-items). Natal/RN, Brazil, 2023.

Variable	Df	SS	MS	*F*	ES	*p*-Value
Numeric scale						
Group	1	2.5570	2.5570	1.6610	0.0269	0.2045
Time	1	515.6000	515.6000	777.8000	0.8479	<0.0001
Group × time	1	7.1020	7.1020	10.7100	0.0713	0.0021
EDESP						
Group	1	0.0114	0.0114	0.0021	< 0.0001	0.9630
Time	1	1113.0000	1113.0000	562.0000	0.7862	< 0.0001
Group × time	1	23.0100	23.0100	11.6200	0.0706	0.0014
Patient is thirsty						
Group	1	0.2841	0.2841	3.6210	0.0413	0.0639
Time	1	13.9200	13.9200	177.4000	0.6787	< 0.0001
Group × time	1	0.2841	0.2841	3.6210	0.0413	0.0634
Spontaneous thirst complaint						
Group	1	<0.0001	<0.0001	<0.0001	<0.0001	1.0000
Time	1	5.5000	5.5000	35.7900	0.2526	<0.0001
Group × time	1	0.0454	0.0454	0.2958	0.0027	0.5894
Mouth is dry						
Group	1	0.1023	0.1023	0.3187	0.0039	0.5754
Time	1	23.0100	23.0100	79.7800	0.4735	<0.0001
Group × time	1	1.3750	1.3750	4.7670	0.0509	0.0346
Lips are dry						
Group	1	1.3750	1.3750	5.4650	0.0701	0.0242
Time	1	13.9200	13.9200	76.3400	0.4330	<0.0001
Group × time	1	1.9200	1.9200	10.5300	0.0953	0.0023
Tongue is thick						
Group	1	0.1818	0.1818	0.6537	0.0097	0.4234
Time	1	10.2300	10.2300	63.4200	0.3566	<0.0001
Group × time	1	<0.0001	<0.0001	<0.0001	<0.0001	10,000
Saliva is thick						
Group	1	0.1023	0.1023	0.2775	0.0046	0.6011
Time	1	6.0110	6.0110	38.9800	0.2150	<0.0001
Group × time	1	0.1130	0.1130	0.0736	0.0005	0.7874
Throat is dry						
Group	1	0.0113	0.0113	0.0308	0.0005	0.8614
Time	1	39.5600	39.5600	275.9000	0.6479	<0.0001
Group × time	1	1.9200	1.9200	13.3900	0.0820	0.0007
Bad taste in the mouth						
Group	1	0.1818	0.1818	0.8660	0.0127	0.3574
Time	1	55.6800	55.6800	443.5000	0.7980	<0.0001
Group × time	1	0.0454	0.0454	0.3621	0.0032	0.5506
Desire to drink water						
Group	1	0.7273	0.7273	2.4260	0.0423	0.1268
Time	1	30.7300	30.7300	334.0000	0.6513	<0.0001
Group × time	1	0.4091	0.4091	4.4470	0.0242	0.0410

Df: degrees of freedom; ES: effect size; F: *F* value; MS: mean square; SS: sum of squares.

beyond what is scheduled.[17] This may have been one of the reasons for the high mean absolute fasting time in this study.

Thirst is one of the most important organic effects of prolonged fasting. Thus, this scenario in which the surgical patient faces chronic intake restriction reinforces the need to include thirst care in clinical practice and reiterates the importance of researching strategies to alleviate these symptoms in surgical patients.

Thirst is a symptom with multiple factors and aspects, and so it is not appropriate to only be evaluated in terms of intensity. In the experience of surgical patients, this can lead to intense and negative discomfort, which can generate fear, anxiety, and stress.[18–20] If a patient experiences thirst without

treatment, this condition can have negative physical and emotional consequences, as well as lead to higher levels of anxiety. In turn, this will potentiate the organic effects of thirst, mainly the discomforts related to the sensation of dry mouth and dryness of the oral cavity.[20]

Therefore, there was an assessment of the intensity and discomfort related to thirst through the NS and *EDESP* regarding the primary and secondary outcomes of this study, respectively, showing that the scores before and after the intervention showed a statistically significant difference in the two groups; however, no statistical difference was found in comparing the two groups (CG versus EG). This can be explained by the possibility that the two interventions (popsicles without the addition of menthol and popsicles with the addition of menthol) had similar and positive effects on the effectiveness of decreasing thirst in patients undergoing surgery, as corroborated by the following studies.

The use of ice has been studied in the literature as a strategy which may have a beneficial effect on thirst quenching in surgical patients. In a study with a quasi-experimental design, the authors evaluated the effects of ice, wet gauze, and frozen saline gauze on increasing satiety and thirst in post-cholecystectomy patients ($n = 53$). The results showed that there was a statistically significant difference ($p < 0.001$) between the three test groups in thirst intensity reduction after applying each strategy twice in each group, indicating that the use of cold temperatures reduces the discomfort and thirst severity, contrary to the wet gauze strategy.[21]

Furthermore, the use of two interventions was tested in a clinical trial carried out in the post-anesthetic recovery room of the surgical center of a public teaching hospital in southern Brazil: ice popsicles and mineral water at room temperature, both with 10 ml, to improve thirst saturation in subjects aged 18–65 years. The results showed that popsicles were 37.8% more effective than room temperature water in promoting satiety ($p < 0.01$), and participants who used popsicles needed fewer interventions to achieve satiety, which they did faster than drinking cold water. It was concluded that popsicles allow administering small volumes of liquid as they provide a feeling of satiety in advance, which increases patient comfort and the safety of the team that administers it.[22]

In an RCT performed on patients admitted to the intensive care unit at a tertiary medical center in the state of California, the authors evaluated the effects of combining measures on thirst intensity. To do so, they examined an aggregation of three methods: ice water spray, menthol lip hydration, and oral swabs, compared to not performing specific care for thirst. The results showed that the mean thirst intensity in the EG significantly decreased by 2.3 points on the scale, while the reductions in the PG were lower and only 0.6 points.[13]

Furthermore, it is possible to find intervention studies in the literature in which investigators tested the use of menthol to quench thirst, but with an emphasis on preoperative care. For example, researchers performed an RCT during the preoperative period with a sample of 40 adult patients, comparing the use of a 30 ml menthol popsicle in the EG and the usual fasting in the PG. The outcomes showed that the use of menthol popsicles significantly reduced the thirst intensity (measured by NS) and discomfort (measured by the *EDESP*) compared to usual care (both scores $p < 0.001$).[14]

In another RCT developed by nurses at the State University of Londrina, Brazil, 102 patients aged between 12 and 65 years were randomly assigned to an EG (menthol gum) and a PG (habitual fasting) before surgery. When evaluating the thirst severity and bother through the NS and *EDESP*, respectively, chewing menthol significantly reduced the severity ($p < 0.0001$) and the bother of the thirst symptom ($p < 0.0001$) compared to the conventional treatment.[15]

Furthermore, in an RCT involving patients undergoing elective bariatric surgery by videolaparoscopy, the researcher evaluated a menthol-based measure (10 ml of menthol popsicle and menthol lip balm) versus the PG, consisting of non-menthol measures (10 ml of ice pops and common lip balm) in relation to its ability to reduce intense thirst, lip hydration, reduce dryness, and improve taste in the oral cavity. As in the present study, the results showed that the four evaluated characteristics were reduced in both groups, but not statistically significant, and the authors believe that this finding is due to the activation of oropharyngeal stimulatory receptors located in the oral and pharyngeal cavities, also known as TRPM8 and TRPA1, due to the drop in temperature found in both intervention strategies.[16]

The thirst intensity and discomfort outcomes were evaluated in an RCT carried out with older adult patients using a 20 ml menthol popsicle for the EG. It was found that the use of menthol popsicles significantly reduced the intensity and discomfort of thirst in the population, with a large effect size.[21]

Given the above, the reduction in thirst intensity and discomfort through the use of menthol strategies is physiologically explained, since this strategy uses small volumes of frozen liquids and menthol associatively. These properties combine to activate proactive mechanisms that promote preabsorbed satiety so that large amounts of volume are not required to relieve symptoms, providing greater confidence to implement this strategy in clinical practice.[22]

Finally, as a limitation of this study, it is believed that the presented results refer to the specific population of adult/older adult patients in the IPO of radical prostatectomy in a single moment after the surgical procedure. Thus, it is necessary that other studies be carried out to monitor the patient at different times of the postoperative period, providing a prolonged follow-up and analysis of the intensity and discomfort levels related to thirst. In addition to studies with a larger number of participants, other types of surgeries and with other populations should be conducted, given that the audience for this investigation is limited to adults and men so that the statistical analysis reflects the clinical application of thirst relief strategies.

Conclusion

Through the analysis carried out, it was possible to prove that both the menthol popsicle and the popsicle without menthol addition were effective in relieving postoperative thirst in patients undergoing radical prostatectomy, but there is no statistically significant difference when comparing the two groups.

Finally, as a limitation of this study, it is believed that the presented results refer to the specific population of adult/older adult patients in the IPO of radical prostatectomy in a single moment after the surgical procedure. Thus, it is necessary that other studies be conducted to monitor the patient at different times of the postoperative period, providing a prolonged follow-up and analysis of the intensity and discomfort levels related to thirst. In addition to studies with a larger number of participants, other types of surgeries and with other populations should also be conducted, given that the audience for this investigation is limited to adults and men so that the statistical analysis reflects the clinical application of thirst relief strategies.

Author contributions

TTMS and RAND conceived the presented idea and supervised the implementation and results of this work. The other authors contributed to the review, writing, and editing of the final version of the manuscript. All authors read and approved the final manuscript.

Declaration of competing interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Consent to participate

All participants in this study were aware of the risks and benefits of the research that participation was completely voluntary and had the right to withdraw from the study at any time without prejudice. Written informed consent was obtained from all subjects before the study. The consent from the illiterate subjects was obtained by fingerprinting.

Ethics approval

Ethical approval for this study was obtained from the Committee of Ethics and Research of the Liga Norteriograndense Contra O Cancer (APPROVAL NUMBER: 5.462.098). The research project was sent to the Research Ethics Committee (CEP) obtaining approval through CAAE: 59006122.9.0000.5293. It is registered on the Brazilian Clinical Trials Registry (ReBEC) virtual platform with approval and publication under number RBR-8c3chr7 (https://ensaiosclinicos.gov.br/rg/RBR-8c3chr7/1). All patients consciously signed the Informed Consent Form (ICF).

Informed consent

Written informed consent was obtained from all subjects before the study. The consent from the illiterate subjects was obtained by fingerprinting.

Trial registration

The Brazilian Clinical Trials Registry (REBEC): RBR-8c3chr7—link: https://ensaiosclinicos.gov.br/rg/RBR-8c3chr7

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