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Comparison of Warm Sitz Bath and Ice Therapy for Postoperative Management After Hemorrhoidectomy

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ABSTRACT

Background: Hemorrhoidectomy is a common surgical procedure for grade 3 and 4 hemorrhoids, often associated with significant postoperative pain and wound healing challenges. This study aimed to compare the efficacy of warm sitz bath and ice therapy in postoperative pain management and wound healing after hemorrhoidectomy.

Methods: A prospective comparative study was conducted at KLE Co-operative Hospital and affiliated KAHER institutes in Hubballi, North Karnataka. One hundred twenty patients (60 in each group) aged 18-75 years with grade 3 or 4 external hemorrhoids undergoing Ferguson's hemorrhoidectomy were randomized to receive either warm sitz bath or ice therapy postoperatively. Pain was assessed using the Visual Analog Scale (VAS), and wound healing was evaluated using the REEDA scale (Redness, Edema, Ecchymosis, Discharge, Approximation) at 24 hours, 3 days, 7 days, and 14 days postoperatively. Secondary outcomes included analgesic consumption, patient satisfaction, and time to return to normal activities.

Results: Patients in the ice therapy group experienced significantly lower pain scores at 24 hours (mean VAS: 5.2±1.3 vs. 6.8±1.5, $p<0.001$) and 3 days (mean VAS: 3.8±1.1 vs. 4.9±1.3, $p<0.001$) compared to the sitz bath group. However, the sitz bath group demonstrated better wound healing parameters at 7 days (mean REEDA score: 3.1±0.9 vs. 4.2±1.1, $p<0.001$) and 14 days (mean REEDA score: 1.2±0.6 vs. 2.3±0.8, $p<0.001$). Analgesic consumption was significantly lower in the ice therapy group during the first 3 days ($p=0.002$), while patient satisfaction scores were comparable between groups at the end of the follow-up period ($p=0.346$).

Conclusion: Ice therapy provides superior early postoperative pain control and reduces analgesic requirements following hemorrhoidectomy, while warm sitz bath promotes better wound healing in the later recovery phase. A sequential approach of ice therapy in the immediate postoperative period followed by warm sitz bath after 3-4 days may optimize both pain

management and wound healing outcomes.

Keywords: *Hemorrhoidectomy, postoperative pain, sitz bath, ice therapy, wound healing*

1. INTRODUCTION

Hemorrhoidal disease is one of the most common anorectal conditions encountered in clinical practice, affecting approximately 4.4% of the adult population worldwide, with an estimated prevalence of 39% in individuals over 50 years of age [1]. While the majority of hemorrhoidal cases can be managed conservatively or with minimally invasive procedures, surgical hemorrhoidectomy remains the gold standard treatment for grade 3 and 4 external hemorrhoids [2]. Despite its effectiveness in addressing the underlying pathology, hemorrhoidectomy is associated with significant postoperative morbidity, particularly in terms of pain, bleeding, and delayed wound healing.

Postoperative pain following hemorrhoidectomy represents a significant clinical challenge, with pain scores often reported in the moderate to severe range during the first week after surgery [3]. The etiology of this pain is multifactorial, stemmin g from surgical trauma to the highly innervated anoderm, sphincter spasm, and inflammatory processes. Additionally, the unique anatomical location of the surgical site presents challenges for wound healing due to constant moisture, potential fecal contamination, and mechanical stress during defecation [4]. These factors not only contribute to patient discomfort but may also delay recovery and return to normal activities, with consequent socioeconomic implications.

Postoperative management strategies following hemorrhoidectomy have evolved considerably over the years, with various interventions aimed at alleviating pain and promoting wound healing. These include pharmacological approaches such as analgesics, anti-inflammatories, and local anesthetics, as well as non-pharmacological modalities including dietary modifications, stool softeners, and topical treatments [5]. Among the non-pharmacological interventions, thermotherapy in the form of warm sitz baths and cryotherapy in the form of ice application have gained particular attention due to their simplicity, cost-effectiveness, and relatively low risk of adverse effects.

Warm sitz bath, involving immersion of the perineal area in warm water (typically 40-45°C) for 10-15 minutes multiple times daily, has long been a cornerstone of post-hemorrhoidectomy care. The purported benefits of sitz baths include improved local blood circulation, reduction of edema through hydrostatic pressure, relaxation of the internal anal sphincter, and enhanced cleansing of the perianal region [6]. The improved blood flow is thought to accelerate the inflammatory process and promote tissue repair, while the cleansing effect may reduce the risk of local infection. Several studies have demonstrated the efficacy of warm sitz baths in reducing pain scores and improving patient satisfaction following anorectal surgeries [7].

Conversely, ice therapy or cryotherapy involves the application of cold temperature to the surgical site, typically in the form of ice packs or cold compresses. The therapeutic effects of cold application are attributed to vasoconstriction, which reduces blood flow, edema, and inflammatory mediators at the surgical site [8]. Additionally, the cold temperature has a direct analgesic effect by decreasing nerve conduction velocity and raising the pain threshold. Previous research has shown that ice therapy can effectively reduce acute postoperative pain, particularly in the early postoperative period, and may decrease the requirement for analgesic medications [9].

Despite the widespread use of both warm sitz baths and ice therapy in clinical practice, there is a paucity of high-quality evidence directly comparing these two modalities in the context of post-hemorrhoidectomy care. The existing literature shows conflicting results, with some studies favoring warm therapy for enhanced wound healing and others suggesting superior pain control with cold therapy. Moreover, most previous studies have focused on either pain management or wound healing in isolation, without comprehensive assessment of both parameters along with other clinically relevant outcomes such as analgesic consumption, patient satisfaction, and time to return to normal activities.

The timing of thermotherapy application is another aspect that warrants investigation, as the physiological processes occurring in the surgical wound evolve over time. The immediate postoperative period is characterized by hemostasis and inflammatory response, which may respond differently to temperature modulation compared to the later proliferative and remodeling phases of wound healing. Understanding the differential effects of warm and cold therapy at various timepoints could potentially lead to more targeted and effective postoperative care protocols.

Furthermore, patient factors such as age, gender, body mass index (BMI), hemorrhoid grade, and comorbidities may influence the response to different thermotherapy modalities. Personalized approaches based on patient characteristics and surgical variables could optimize outcomes and enhance recovery after hemorrhoidectomy. The identification of specific patient subgroups that might benefit more from one modality over the other would be of significant clinical value in guiding individualized postoperative care.

In this context, the present study was designed to comprehensively compare the efficacy of warm sitz bath and ice therapy in postoperative management following hemorrhoidectomy, with specific emphasis on both pain control and wound healing outcomes. By evaluating these interventions across multiple timepoints and incorporating various outcome measures, this study aims to provide evidence-based guidance for optimizing post-hemorrhoidectomy care. The findings could potentially

influence clinical practice by informing the development of standardized protocols that maximize patient comfort and accelerate recovery after hemorrhoidectomy.

Given the high prevalence of hemorrhoidal disease and the considerable impact of postoperative morbidity on patient quality of life and healthcare resource utilization, optimizing post-hemorrhoidectomy care represents an important clinical priority. This study addresses a significant gap in the current literature and has the potential to contribute valuable insights to the field of colorectal surgery and postoperative care management.

2. AIMS AND OBJECTIVES

The primary aim of this study was to compare the efficacy of ice therapy and warm sitz bath in postoperative pain management and wound healing after hemorrhoidectomy. The study sought to determine whether there were significant differences in pain scores, analgesic requirements, wound healing parameters, patient satisfaction, and time to return to normal activities between patients treated with these two modalities. Additionally, the study aimed to identify any temporal patterns in the effectiveness of these interventions at different postoperative timepoints and to explore potential associations between treatment outcomes and patient characteristics. By comprehensively evaluating these aspects, the investigation intended to provide evidence-based recommendations for optimizing postoperative care protocols following hemorrhoidectomy, potentially enhancing patient comfort and accelerating recovery.

3. MATERIALS AND METHODS

Study Design and Setting

A prospective comparative study was conducted by the Department of General Surgery at KLE Co-operative Hospital under KLE JGMM Medical College and other affiliated colleges of KAHER Institutes in Hubballi, North Karnataka. The study was carried out over a period of 5 months, including 4 months for patient recruitment and 1 month for data analysis. The study protocol was approved by the Institutional Ethics Committee (IEC) of KAHER's JGMM Medical College (Approval No: KAHER/IEC/2023-24/003) and was conducted in accordance with the principles of the Declaration of Helsinki.

Sample Size Calculation

The sample size was calculated based on previous similar studies, considering a mean difference in pain scores (VAS) of 1.5 between the two groups, with a standard deviation of 2.0, at 80% power and 5% significance level. Allowing for a 10% non-response rate, the final sample size was determined to be 120 patients, with 60 patients in each treatment group.

Study Population and Sampling

Patients aged 18-75 years diagnosed with grade 3 or grade 4 external hemorrhoids undergoing Ferguson's hemorrhoidectomy were eligible for inclusion in the study. Probability Proportional to Size sampling was employed to include 120 patients from 6 KAHER institutes in Hubballi. Patients were randomized to either the ice therapy group or the warm sitz bath group using computer-generated random numbers in a 1:1 ratio.

Inclusion and Exclusion Criteria

Inclusion criteria encompassed patients aged 18-75 years diagnosed with grade 3 or grade 4 external hemorrhoids undergoing Ferguson's hemorrhoidectomy.

Exclusion criteria were: pregnant or lactating women; known allergy to cold or warm therapy; coagulation disorders or receiving anticoagulant therapy; severe organ dysfunction (cardiac, pulmonary, hepatic, renal, etc.); immunocompromised or receiving immunosuppressive therapy; other anorectal surgery within the past 1 month; concomitant anorectal diseases (e.g., anal fistula, anal fissure) requiring additional surgical treatment; cognitive impairment, psychiatric illness, or language barrier preventing compliance; currently participating in another clinical trial; and grade 1 and grade 2 external hemorrhoids and internal hemorrhoids.

Study Protocol

After obtaining written informed consent, detailed patient history was recorded, including demographic data, presenting symptoms, duration of symptoms, and previous treatments. Preoperative assessment included physical examination, digital rectal examination, and proctoscopy to confirm the diagnosis and grade of hemorrhoids. Preoperative laboratory investigations included complete blood count (CBC), random blood sugar (RBS), bleeding time (BT), clotting time (CT), renal function tests (RFT), and screening for HIV, hepatitis B virus (HBV), and hepatitis C virus (HCV).

All patients underwent Ferguson's hemorrhoidectomy under spinal anesthesia by experienced surgeons following a standardized surgical technique. The procedure involved excision of the hemorrhoidal tissue, ligation of the vascular pedicle, and primary closure of the wound with absorbable sutures.

Postoperatively, patients were randomized to receive either ice therapy or warm sitz bath according to the following protocols:

Ice Therapy Group: Patients were provided with ice packs covered in a thin cloth to be applied to the perianal region for 15-20 minutes, 4-6 times daily for the first 7 days after surgery. The first application was initiated within 2 hours

postoperatively.

Warm Sitz Bath Group: Patients were instructed to sit in a plastic sitz bath filled with warm water (40-42°C) for 15-20 minutes, 3-4 times daily for 14 days. The first sitz bath was performed 24 hours after surgery.

All patients received a standardized postoperative regimen including oral analgesics (tablet diclofenac 50 mg twice daily for 3 days, followed by as needed), stool softeners (syrup lactulose 15 ml twice daily), and dietary advice (high-fiber diet and adequate fluid intake). Additional analgesics (injection tramadol 50 mg) were administered on patient request and were documented.

Outcome Measures

The primary outcomes measured were postoperative pain and wound healing. Pain was assessed using the Visual Analog Scale (VAS) ranging from 0 (no pain) to 10 (worst imaginable pain) at 24 hours, 3 days, 7 days, and 14 days postoperatively. Wound healing was evaluated using the REEDA scale, which assesses five parameters: Redness, Edema, Ecchymosis, Discharge, and Approximation, each scored from 0-3, with a total score ranging from 0-15. Lower scores indicate better wound healing.

Secondary outcomes included:

1. Analgesic consumption (number of additional analgesic doses required)
2. Time to first bowel movement
3. Urinary retention requiring catheterization
4. Postoperative bleeding requiring intervention
5. Patient satisfaction (assessed using a 5-point Likert scale at the end of follow-up)
6. Time to return to normal activities
7. Wound complications (infection, dehiscence)

Follow-up Protocol

Patients were followed up at 24 hours, 3 days, 7 days, and 14 days postoperatively. During each follow-up visit, pain scores, wound healing parameters, analgesic consumption, and any complications were assessed and documented. Patients were contacted by telephone if they were unable to attend in-person follow-up visits.

Statistical Analysis

Data were entered in Microsoft Excel and analyzed using SPSS version 29.0. Continuous variables were presented as mean and standard deviation, while categorical variables were expressed as frequencies and percentages. The normality of data distribution was assessed using the Shapiro-Wilk test. For normally distributed data, independent t-tests were used to compare continuous variables between the two groups, while the Mann-Whitney U test was employed for non-normally distributed data. Categorical variables were compared using the Chi-square test or Fisher's exact test as appropriate. Repeated measures ANOVA was used to analyze changes in pain scores and wound healing parameters over time within and between groups. Post-hoc analysis with Bonferroni correction was applied for multiple comparisons. Subgroup analyses were performed based on age, gender, BMI, and hemorrhoid grade. A p-value < 0.05 was considered statistically significant for all analyses.

4. RESULTS

Demographic and Clinical Characteristics

A total of 120 patients undergoing Ferguson's hemorrhoidectomy were enrolled in the study, with 60 patients in the ice therapy group and 60 patients in the warm sitz bath group. The demographic and baseline clinical characteristics of the study participants are presented in Table 1. Both groups were comparable in terms of age, gender distribution, BMI, hemorrhoid grade, and duration of symptoms, with no statistically significant differences observed ($p>0.05$).

Table 1: Demographic and Baseline Clinical Characteristics of Study Participants

Characteristic	Ice Therapy Group (n=60)	Warm Sitz Bath Group (n=60)	p-value
Age (years), mean ± SD	42.7 ± 12.4	44.3 ± 11.8	0.458
Gender, n (%)			0.714
Male	38 (63.3)	36 (60.0)	

Female	22 (36.7)	24 (40.0)	
BMI (kg/m²), mean ± SD	26.2 ± 3.8	25.9 ± 4.1	0.682

Characteristic	Ice Therapy Group (n=60)	Warm Sitz Bath Group (n=60)	p-value
Hemorrhoid grade, n (%)			0.855
Grade 3	33 (55.0)	34 (56.7)	
Grade 4	27 (45.0)	26 (43.3)	
Duration of symptoms (months), mean ± SD	14.2 ± 8.6	15.3 ± 9.2	0.497
Comorbidities, n (%)			
Constipation	42 (70.0)	44 (73.3)	0.683
Sedentary lifestyle	37 (61.7)	39 (65.0)	0.705
Previous anorectal procedures	4 (6.7)	5 (8.3)	0.730
Operative time (minutes), mean ± SD	43.2 ± 9.7	42.6 ± 10.3	0.739

SD: Standard Deviation; BMI: Body Mass Index; p<0.05 considered statistically significant

Pain Assessment

Postoperative pain scores assessed using the Visual Analog Scale (VAS) at different timepoints are presented in Table 2. Patients in the ice therapy group experienced significantly lower pain scores at 24 hours (5.2 ± 1.3 vs. 6.8 ± 1.5, p<0.001) and 3 days (3.8 ± 1.1 vs. 4.9 ± 1.3, p<0.001) compared to the warm sitz bath group. However, at 7 days, the difference in pain scores between the two groups was not statistically significant (2.9 ± 0.9 vs. 3.2 ± 1.1, p=0.097). By day 14, patients in the warm sitz bath group reported marginally lower pain scores than those in the ice therapy group, though this difference did not reach statistical significance (1.1 ± 0.7 vs. 1.3 ± 0.8, p=0.142).

Repeated measures ANOVA revealed a significant time effect (F=1245.6, p<0.001), group effect (F=17.8, p<0.001), and time-by-group interaction (F=29.5, p<0.001) for pain scores. This indicates that while pain decreased over time in both groups, the pattern of decrease differed between the ice therapy and warm sitz bath groups, with ice therapy providing superior early pain relief and warm sitz bath showing a trend toward better late pain control.

Table 2: Comparison of Visual Analog Scale (VAS) Pain Scores Between the Two Groups at Different Timepoints

Timepoint	Ice Therapy Group (n=60) Mean ± SD	Warm Sitz Bath Group (n=60) Mean ± SD	Mean Difference (95% CI)	p-value
24 hours	5.2 ± 1.3	6.8 ± 1.5	-1.6 (-2.1 to -1.1)	<0.001*
3 days	3.8 ± 1.1	4.9 ± 1.3	-1.1 (-1.5 to -0.7)	<0.001*
7 days	2.9 ± 0.9	3.2 ± 1.1	-0.3 (-0.7 to 0.1)	0.097
14 days	1.3 ± 0.8	1.1 ± 0.7	0.2 (-0.1 to 0.5)	0.142

SD: Standard Deviation; CI: Confidence Interval; *p<0.05 considered statistically significant

Wound Healing Assessment

Wound healing was evaluated using the REEDA scale, with results presented in Table 3. At 24 hours post-surgery, there was no significant difference in REEDA scores between the two groups (7.6 ± 1.4 vs. 7.8 ± 1.5, p=0.457). By day 3, patients in the ice therapy group had slightly lower REEDA scores, but the difference was not statistically significant (6.3 ± 1.2 vs. 6.7 ± 1.3, p=0.082). However, at 7 days and 14 days, the warm sitz bath group demonstrated significantly better wound healing parameters compared to the ice therapy group, with lower REEDA scores at both timepoints (3.1 ± 0.9 vs. 4.2 ± 1.1, p<0.001

at 7 days; 1.2 ± 0.6 vs. 2.3 ± 0.8, p<0.001 at 14 days).

Repeated measures ANOVA showed a significant time effect (F=987.3, p<0.001), group effect (F=12.6, p<0.001), and time-by-group interaction (F=22.7, p<0.001) for REEDA scores. This suggests that while wound healing improved over time in both groups, the pattern of improvement differed significantly, with warm sitz bath showing superior wound healing outcomes in the later postoperative period.

Table 3: Comparison of REEDA (Redness, Edema, Ecchymosis, Discharge, Approximation) Scores Between the Two Groups at Different Timepoints

Timepoint	Ice Therapy Group (n=60) Mean ± SD	Warm Sitz Bath Group (n=60) Mean ± SD	Mean Difference (95% CI)	p-value
24 hours	7.6 ± 1.4	7.8 ± 1.5	-0.2 (-0.7 to 0.3)	0.457
3 days	6.3 ± 1.2	6.7 ± 1.3	-0.4 (-0.9 to 0.1)	0.082
7 days	4.2 ± 1.1	3.1 ± 0.9	1.1 (0.7 to 1.5)	<0.001*
14 days	2.3 ± 0.8	1.2 ± 0.6	1.1 (0.8 to 1.4)	<0.001*

SD: Standard Deviation; CI: Confidence Interval; *p<0.05 considered statistically significant

Analgesic Consumption

The requirement for additional analgesics (beyond the standard postoperative regimen) was assessed as a secondary outcome measure (Table 4). During the first 3 days postoperatively, patients in the ice therapy group required significantly fewer additional analgesic doses compared to those in the warm sitz bath group (1.2 ± 0.8 vs. 1.9 ± 1.1, p=0.002). However, there was no significant difference in analgesic consumption between the two groups from day 4 to day 7 (0.8 ± 0.7 vs. 0.9 ± 0.8, p=0.482) and from day 8 to day 14 (0.3 ± 0.5 vs. 0.2 ± 0.4, p=0.256).

Table 4: Comparison of Additional Analgesic Requirements Between the Two Groups

Period	Ice Therapy Group (n=60) Mean ± SD	Warm Sitz Bath Group (n=60) Mean ± SD	Mean Difference (95% CI)	p-value
Day 0-3 (doses)	1.2 ± 0.8	1.9 ± 1.1	-0.7 (-1.1 to -0.3)	0.002*
Day 4-7 (doses)	0.8 ± 0.7	0.9 ± 0.8	-0.1 (-0.4 to 0.2)	0.482
Day 8-14 (doses)	0.3 ± 0.5	0.2 ± 0.4	0.1 (-0.1 to 0.3)	0.256
Total doses	2.3 ± 1.4	3.0 ± 1.7	-0.7 (-1.3 to -0.1)	0.021*

SD: Standard Deviation; CI: Confidence Interval; *p<0.05 considered statistically significant

Postoperative Complications and Recovery Parameters

Table 5 presents the comparison of postoperative complications and recovery parameters between the two groups. The time to first bowel movement was similar in both groups, with no statistically significant difference (2.3 ± 0.7 vs. 2.4 ± 0.8 days, p=0.468). The incidence of urinary retention requiring catheterization was slightly higher in the warm sitz bath group compared to the ice therapy group, but this difference was not statistically significant (8.3% vs. 5.0%, p=0.464).

Postoperative bleeding requiring intervention occurred in 3.3% of patients in the ice therapy group and 5.0% of patients in the warm sitz bath group (p=0.648). The incidence of wound infection was significantly higher in the ice therapy group compared to the warm sitz bath group (8.3% vs. 1.7%, p=0.049), while wound dehiscence was observed in 5.0% of patients in the ice therapy group and 1.7% of patients in the warm sitz bath group (p=0.305).

Patients in the warm sitz bath group returned to normal activities slightly earlier than those in the ice therapy group, but this difference was not statistically significant (10.2 ± 2.4 vs. 11.3 ± 3.1 days, p=0.076).

Table 5: Comparison of Postoperative Complications and Recovery Parameters Between the Two Groups

Parameter	Ice Therapy Group (n=60)	Warm Sitz Bath Group (n=60)	p-value
Time to first bowel movement (days), mean ± SD	2.3 ± 0.7	2.4 ± 0.8	0.468
Urinary retention requiring catheterization, n (%)	3 (5.0)	5 (8.3)	0.464
Postoperative bleeding requiring intervention, n (%)	2 (3.3)	3 (5.0)	0.648
Wound infection, n (%)	5 (8.3)	1 (1.7)	0.049*
Wound dehiscence, n (%)	3 (5.0)	1 (1.7)	0.305
Time to return to normal activities (days), mean ± SD	11.3 ± 3.1	10.2 ± 2.4	0.076

SD: Standard Deviation; *p<0.05 considered statistically significant

Patient Satisfaction

Patient satisfaction was assessed at the end of the follow-up period using a 5-point Likert scale, with results presented in Table 6. Overall, there was no significant difference in patient satisfaction scores between the two groups (3.9 ± 0.8 vs. 4.1 ± 0.7, p=0.346). However, when stratified by satisfaction levels, a higher proportion of patients in the warm sitz bath group reported being "very satisfied" compared to the ice therapy group (35.0% vs. 26.7%), though this difference did not reach statistical significance (p=0.533).

Table 6: Comparison of Patient Satisfaction Between the Two Groups

Satisfaction Level	Ice Therapy Group (n=60) n (%)	Warm Sitz Bath Group (n=60) n (%)	p-value
Very dissatisfied	0 (0.0)	0 (0.0)	0.533
Dissatisfied	2 (3.3)	1 (1.7)	
Neutral	14 (23.3)	10 (16.7)	
Satisfied	28 (46.7)	28 (46.7)	
Very satisfied	16 (26.7)	21 (35.0)	
Mean satisfaction score ± SD	3.9 ± 0.8	4.1 ± 0.7	0.346

SD: Standard Deviation

5. DISCUSSION

The management of postoperative pain and promotion of wound healing following hemorrhoidectomy remain significant clinical challenges. This prospective comparative study evaluated the efficacy of two commonly used non-pharmacological interventions – ice therapy and warm sitz bath – in the postoperative management of patients undergoing Ferguson's hemorrhoidectomy. The findings revealed distinct temporal patterns in the effectiveness of these modalities, with ice therapy demonstrating superior early pain control while warm sitz bath promoted better wound healing outcomes in the later recovery phase.

The demographic and baseline clinical characteristics of the study participants were comparable between the two treatment groups, indicating effective randomization and minimizing potential confounding factors. The mean age of patients was in the fifth decade of life, consistent with the epidemiological data on hemorrhoidal disease, which typically peaks between 45-65 years of age [11]. The male predominance observed in our study (approximately 60%) aligns with previous reports suggesting a higher prevalence of hemorrhoids requiring surgical intervention in males, potentially attributable to differences in occupational and lifestyle factors [12].

Pain assessment using the Visual Analog Scale (VAS) demonstrated significantly lower pain scores in the ice therapy group

compared to the warm sitz bath group at 24 hours and 3 days postoperatively. This finding corroborates the work of Balta et al. [13], who reported a significant reduction in early postoperative pain with cold application following hemorrhoidectomy. The analgesic effect of ice therapy can be attributed to several physiological mechanisms, including decreased nerve conduction velocity, reduced release of inflammatory mediators, and local vasoconstriction leading to diminished edema [14]. Additionally, the cooling effect may induce local anesthesia by elevating the pain threshold and reducing muscle spasm, which is particularly relevant in the context of anal sphincter spasm following hemorrhoidectomy.

Interestingly, the superiority of ice therapy in pain control was limited to the early postoperative period (first 3 days), with no significant difference observed at 7 days, and a trend toward better pain control with warm sitz bath by day 14, though this did not reach statistical significance. This temporal pattern suggests that the mechanisms underlying postoperative pain may evolve over time, with different interventions targeting different aspects of the pain pathway. The early predominance of nociceptive and inflammatory pain, which responds well to cold therapy, may gradually shift toward neuropathic elements and pain related to the healing process, which might benefit more from the improved circulation associated with warm therapy [15].

The requirement for additional analgesics mirrored the pain score findings, with significantly lower analgesic consumption in the ice therapy group during the first 3 days postoperatively. This is a clinically relevant finding, as reduced analgesic requirements, particularly opioids, may translate to fewer medication-related side effects such as constipation, nausea, and sedation, which can be particularly problematic in the context of anorectal surgery [16]. However, the total analgesic consumption over the entire follow-up period showed only a modest reduction in the ice therapy group, emphasizing that the analgesic advantage of ice therapy is primarily confined to the immediate postoperative period.

In contrast to the pain outcomes, wound healing parameters assessed using the REEDA scale showed a different pattern. While there was no significant difference between the two groups at 24 hours and 3 days postoperatively, patients in the warm sitz bath group demonstrated significantly better wound healing at 7 days and 14 days compared to the ice therapy group. This finding is consistent with the study by Hsu et al. [17], who reported enhanced epithelialization and wound contraction with warm therapy in a randomized controlled trial of patients undergoing perianal surgery.

The superior wound healing observed with warm sitz bath in the later postoperative period can be explained by several mechanisms. Warm water immersion induces local vasodilation, enhancing blood flow to the perianal region and subsequently improving oxygen and nutrient delivery to the healing tissues [18]. Additionally, the hydrostatic pressure exerted during sitz bath may reduce local edema, while the cleansing effect helps remove debris and exudate, creating an optimal environment for wound healing [19]. Furthermore, warm therapy has been shown to stimulate the activity of leukocytes and macrophages, accelerating the inflammatory phase of wound healing and promoting earlier transition to the proliferative phase [20].

The higher incidence of wound infection observed in the ice therapy group (8.3% vs. 1.7%, p=0.049) further supports the wound healing benefits of warm sitz bath. The cleansing effect of warm water immersion, combined with improved local circulation, may contribute to a reduced risk of infection. Moreover, the vasoconstriction induced by cold therapy, while beneficial for reducing early inflammation and pain, may potentially impair the delivery of immune cells and antimicrobial agents to the wound site, particularly if used for an extended period [21].

Time to return to normal activities was slightly shorter in the warm sitz bath group compared to the ice therapy group, though this difference did not reach statistical significance. This trend aligns with the better wound healing outcomes observed in the warm sitz bath group, as improved wound healing generally facilitates earlier resumption of daily activities. However, the multifactorial nature of recovery, influenced by individual patient factors, pain management, and psychological aspects, may explain the lack of a statistically significant difference in this parameter [22].

Patient satisfaction was comparable between the two groups, with no significant difference in mean satisfaction scores or the distribution of satisfaction levels. This finding suggests that despite the differences observed in specific outcome parameters, both interventions provided acceptable overall postoperative management from the patients' perspective. The subjective nature of patient satisfaction, influenced by factors beyond clinical outcomes such as expectations, communication, and previous experiences, may contribute to this result [23].

The findings of this study have important clinical implications. The distinct temporal patterns in the effectiveness of ice therapy and warm sitz bath suggest that a sequential approach combining both modalities might optimize postoperative outcomes following hemorrhoidectomy. Ice therapy could be recommended during the first 3-4 days postoperatively to provide superior pain control and reduce analgesic requirements, followed by warm sitz bath in the later recovery phase to enhance wound healing and potentially reduce the risk of wound complications. This approach would leverage the specific benefits of each modality at the most appropriate time during the recovery process [24].

Several limitations of this study warrant consideration. First, the open-label design, necessitated by the nature of the interventions, may have introduced potential bias in subjective outcome measures such as pain scores and patient satisfaction.

Second, while efforts were made to standardize the application of both interventions, variations in adherence and technique might have occurred, particularly for home-based applications. Third, the follow-up period was limited to 14 days, and longer-term outcomes such as recurrence rates and chronic pain were not assessed. Finally, the study population was limited to patients undergoing Ferguson's hemorrhoidectomy, and the findings may not be generalizable to other hemorrhoidectomy techniques or minimally invasive procedures for hemorrhoidal disease.

Future research directions include longer-term studies to evaluate the impact of different postoperative management strategies on chronic pain and recurrence rates, investigation of combined or sequential approaches using both cold and warm therapy, exploration of patient factors that might predict differential responses to these interventions, and development of standardized protocols with specific timing and duration recommendations for thermotherapy applications.

6. CONCLUSION

This prospective comparative study demonstrated that ice therapy provides superior early postoperative pain control and reduces analgesic requirements following hemorrhoidectomy, while warm sitz bath promotes better wound healing in the later recovery phase. The distinct temporal patterns in the effectiveness of these interventions suggest that a sequential approach, with ice therapy in the immediate postoperative period followed by warm sitz bath after 3-4 days, may optimize both pain management and wound healing outcomes. This tailored approach could potentially enhance patient comfort, accelerate recovery, and reduce postoperative complications following hemorrhoidectomy. Further research is warranted to evaluate the long-term outcomes of such sequential thermotherapy protocols and to identify patient-specific factors that might influence the response to different modalities.

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