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Effectiveness of Deep Hyperthermia (Remission 1°C) on Pain Management for Stage IV Solid Malignancies – A Mixed Method Study

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Abstract: Despite widespread use of opioids and adjuvant analgesics, a substantial proportion of cancer patients continue to experience inadequate pain relief. Evidence regarding the analgesic potential of hyperthermia remains limited. This study evaluated the effectiveness of deep hyperthermia, delivered as a controlled 1°C tissue temperature elevation, in alleviating pain among patients with Stage IV solid malignancies and explored patients' subjective experiences with the therapy. An explanatory sequential mixed-methods design (QUAN → QUAL) was implemented in the Oncology Outpatient Department over a one-year period. Adult patients with Stage IV solid malignancies (n = 100) were recruited. Group A (n = 50) received deep hyperthermia in addition to standard symptomatic pain management. In-depth interviews (IDIs) were conducted among patients who were willing, communicative, and had consistently received deep hyperthermia, to gain insight into their perceptions of the therapy. Pain intensity was measured using the Visual Analogue Scale (VAS), and quality of life was assessed using the EORTC QLQ-C30 instrument. Ethical principles were strictly adhered to throughout the study. Among participants, 62% were aged 51–70 years, and 58% were male. Both groups demonstrated a significant post-treatment reduction in mean pain scores ($p < 0.001$). Notably, 64% of participants in Group A also exhibited a measurable reduction in tumour size. Qualitative analysis of IDIs identified five overarching themes: Perceived Effectiveness, Challenges in Receiving Therapy, Emotional and Psychological Experiences, Integration with Conventional Treatment, and Concerns Regarding Treatment Interaction and Timing. Deep hyperthermia with a controlled 1°C remission appears to be a safe and effective adjunct to opioid-based therapy for pain management in patients with Stage IV solid malignancies.

Keywords: *Deep Heat Therapy; Stage IV Solid Malignancies; IDI; VAS; QOL.*

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I. INTRODUCTION

Cancer remains a leading cause of morbidity and mortality worldwide, with solid malignancies accounting for a substantial proportion of cases. According to the World Health Organization (WHO), there were approximately 20 million new cancer cases and 10 million cancer-related deaths globally, with over 70% of these deaths occurring in low- and middle-income countries [1]. In India, the cancer burden is steadily rising, with an estimated 1.46 million new cases and 851,000 deaths reported [2]. Data from the Global Cancer Observatory (GLOBOCAN) indicate that approximately 19.3 million new cancer cases were recorded globally in 2020, with India ranking third in cancer incidence after China and the United States. Projections suggest that by 2040, cancer cases in India will increase to 2.08 million, representing a 57.5% rise compared to 2020 [3]. Among cancer patients, pain is one of the most distressing symptoms,

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affecting up to 75% of individuals with advanced-stage disease, particularly those with Stage IV malignancies [3].

Stage IV solid malignancies, such as advanced breast, prostate, lung, and colorectal cancers, are frequently associated with intractable pain due to metastases, inflammation, and tumor infiltration. Despite the availability of pharmacological interventions such as opioids and adjuvant analgesics, pain relief remains inadequate for a significant proportion of patients. Moreover, long-term opioid therapy can lead to adverse effects including sedation, constipation, tolerance, and dependency, underscoring the need for effective adjunct or alternative pain management strategies [3].

Hyperthermia therapy, also referred to as deep heat therapy, involves raising the temperature of body tissues to therapeutic levels. When applied locally, mild hyperthermia at approximately 1°C above normal tissue temperature has been proposed to enhance blood flow, reduce muscle stiffness, and modulate pain perception. While several studies have evaluated hyperthermia primarily as a radiosensitizer in oncology, its potential role in palliative pain management remains underexplored [4, 5]. By increasing local circulation and altering nociceptive signaling, hyperthermia may provide non-invasive, non-pharmacological relief for cancer-related pain [6]. However, evidence on the analgesic potential of hyperthermia remains scarce, particularly within Indian palliative care settings. Against this background, the present study aims to evaluate the effectiveness of deep heat therapy (1°C Remission) in managing pain among patients with Stage IV solid malignancies. Understanding the feasibility, safety, and patient-reported outcomes of this intervention can guide future large-scale trials and support integrative approaches to oncology pain management. The specific objectives of the study are: (1) to evaluate the effectiveness of deep heat therapy in reducing pain levels among patients with Stage IV solid malignancies; (2) to assess the potential impact of deep heat therapy on tumor size reduction; (3) to determine the effect of deep heat therapy on overall quality of life in patients with advanced cancer; and (4) to explore patient experiences regarding the effectiveness and challenges of deep heat therapy in Stage IV solid malignancy pain management.

II. MATERIALS AND METHODS

➢ *Study Settings*

The present explanatory sequential mixed methods design (QUAN → qual) was carried out in Oncology Outpatient Department (OPD) of Kalaignar Centenary Super Specialty Hospital, located in Chennai, Tamil Nadu. The study was conducted for period of one year. This hospital is a tertiary care teaching and referral institution, equipped with state-of-the-art facilities for cancer diagnosis, treatment, and palliative care. The oncology department had access to hyperthermia devices and pain management resources required for the conduct of this study. The hospital serves a diverse patient population from urban and semi-urban regions, making it an appropriate setting for a study involving advanced cancer cases.

➢ *Study Participants, Sample Size and Sampling*

The study population consisted of adult patients with confirmed diagnoses of Stage IV solid malignancies (n=100) who were attending the oncology OPD for routine follow-up or symptom management. Patients were screened for eligibility based on their clinical history, biopsy reports, and performance status. Block randomization was applied. A total of 100 patients were enrolled. Participants were divided into two equal groups: Group A (n = 50): Received deep heat therapy (hyperthermia) along with standard symptomatic pain management. Group B (n = 50): Received only standard symptomatic pain management without hyperthermia.

Qualitative technique In-depth Interview (IDI) was conducted among patients who were vocal and willing, have regularly received deep heat therapy to understand their perspective. The interview was conducted among 30 participants. The interview was conducted till point of saturation. Purposive sampling was improvised.

➢ *Data Collection Procedure*

After obtaining the clearance from the ethics committee, based upon the sample size study participants were enrolled in the study. The patient was selected based on confirmed diagnoses of Stage IV solid malignancies (n=100). The group A (n = 50) received deep heat therapy (hyperthermia) in conjunction with standard symptomatic pain management, whereas the control group (n = 50) received only standard symptomatic pain management without the addition of hyperthermia. Informed written consent were obtained from all the patients by the Principal Investigator (PI). The purpose of the study was elaborated for all the participants. Sociodemographic details like age, gender followed by symptoms, comorbidities were recorded using predesigned questionnaire. Each patient underwent a detailed baseline clinical evaluation, including performance status assessment and pain scoring using the Visual Analogue Scale (VAS). Pain severity was categorized as follows: Mild pain: 0–3, Moderate pain: 4–6 and Severe pain: 7–10. All participants received symptomatic treatment for pain in accordance with the WHO pain ladder, including non-opioid and opioid analgesics, and adjunctive supportive therapy as required.

Participants in group A were administered hyperthermia therapy using a standardized medical device capable of delivering controlled superficial heat. The treatment was given twice weekly for 6 weeks (12 sessions in total). Each session involved: 60 minutes of application in the navel region and 45 to 60 minutes over the tumor site, adjusted as per individual patient tolerance and heat sensitivity. Pain assessment was performed at three intervals: Immediately before hyperthermia, one hour after treatment and twenty-four hours post-treatment

Improvement in VAS pain scores at each time point was recorded systematically. If a patient experienced no improvement after four hyperthermia sessions, or if they were unable to tolerate the planned session duration, the case was classified as a treatment failure and was documented accordingly.

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➢ *Duration of the Treatment and Follow-up*

The treatment continued for a total of 6 weeks per patient. After the completion of the therapy: Clinical response was evaluated by physical examination and radiological imaging (as applicable). Quality of life was assessed using the EORTC QLQ-C30 questionnaire, administered both at baseline and after 6 weeks.

After obtaining written informed consent, all the interviews were conducted by an investigator, trained in qualitative research methods using a semi-structured interview guide containing broad open-ended questions in a place and time convenient for the participants. Each IDI lasted for 30 - 45 minutes. The interviews were conducted in local vernacular language, tamil and audio-recording of the interviews were done after obtaining oral consent from the participants. Transcripts were prepared from the audio-recordings in verbatim in English. Codes were identified from the transcripts. Two coders were involved in the coding process and any discrepancy arising between them were resolved by mutual consensus. Later similar codes were merged together to form broad categories.

➢ *Statistical Analysis*

The Quantitative data was entered in Epi Info (version 7.2.2.6 developed by Centre of Disease Control, Atlanta, USA and WHO) software package. The entered data were transferred to SPSS 24 software (SPSS Inc., Chicago, Illinois, USA) package for analysis. Statistical measures like frequency and percentage were used to analyze categorical variables. Continuous variables which followed a normal distribution like age of the respondents were expressed in mean and standard deviation.

Audio recorded transcripts were transcribed into English. Transcriptions were proof-read and edited and manually analyzed thematically. Category code was reviewed by another author trained in qualitative research for better interpretation and to increase the validity of the study. Statements in italic indicate direct statement from participants. Consolidation criteria for reporting qualitative research guidelines were used for reporting the findings.

➢ *Ethical Consideration and Permission*

The protocol of the study was submitted to the Institutional Ethics Committee approval (EC/NEW/INST/2022/2913) was obtained. Written consent was taken from all the study participants. All the information collected from the study participants was kept confidential, and their privacy was maintained.

III. RESULTS

A Majority, 62% of the participants, were in the 51-70 years age group, and most of the participants, 58%, were males. There was no significant difference between the group with respect to age (p=0.55) and gender (p=1.00) (Table 1).

Table 1 Baseline Characteristics of the Participants

Baseline Characteristics	Total	Group A	Group B
Participants Age			
18-30 years	2 (2)	1 (2)	1 (2)
31-50 years	17 (17)	6 (12)	11 (22)
51-70 years	62 (62)	32 (64)	30 (60)
71-90 years	19 (19)	11 (22)	8 (16)
Participants Gender			
Male	58 (58)	29 (58)	29 (58)
Female	42 (42)	21 (42)	21 (42)

Table 2 Treatment Modalities Used by the Participants

Treatment Types	Group A (n=50)	Group B (n=50)
Hyperthermia (HPT)	50 (100)	0 (0)
Chemotherapy (CT)	45 (90)	50 (100)
Radiotherapy (RT)	30 (60)	32 (64)
CT + RT	25 (50)	30 (60)
CT + RT + HPT	20 (40)	0 (0)
HPT alone	5 (10)	0 (0)

All participants in the group A received hyperthermia treatment, whereas none in the group B received hyperthermia. More or less, an equal number of patients received chemotherapy and radiotherapy in both groups. Notably, 20 (40%) of the participants in the group A received a combination of chemotherapy, radiotherapy, and hyperthermia, while no such combination was used in the control group (Table 2). Though there was a significant reduction in the mean pain score after treatment in both groups (p<0.001), Group A showed a greater reduction in mean pain score (from 6.2 to 1.7) when compared to the group B (from 6.1 to 3.8). The difference in the pain reduction between groups was statistically significant (p<0.001) (Table 3).

About three-fourths of the participants in the group A were able to reduce their medication to non-opioid or SOS usage, whereas only less than half of the participants in the control group were able to taper the medication. There was a statistically significant difference between the groups in successfully tapering the pain medications (p=0.002) (Table 4). The majority, 64% of the participants in the Group A, experienced a significant reduction in tumour size, whereas only 30% of the participants in the Group B experienced it.

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There was a statistically significant difference between the groups in terms of reduction in size of the tumour (p=0.003) (Table 5)

The participants in the group A reported significantly better scores in all domains of quality of life compared to the control group (p<0.001). Group A scored higher scores in domains like global health, physical, role, emotional, cognitive, and social, and it scored lower in domains related to symptom burden such as fatigue, pain, nausea, dyspnea, insomnia, appetite loss, constipation, diarrhea, and financial difficulties (Table 6).

The qualitative analysis of in-depth interviews with patients receiving Deep Heat Therapy (hyperthermia) for Stage IV solid malignancy pain management revealed five overarching themes: Perceived Effectiveness, Challenges in Receiving Therapy, Emotional and Psychological Experiences, Integration with Conventional Treatment, and Concerns About Interaction and Timing (Table 7A-D).

The qualitative analysis of in-depth interviews with patients receiving Deep Heat Therapy (hyperthermia) for Stage IV solid malignancy pain management revealed five overarching themes: Perceived Effectiveness, Challenges in Receiving Therapy, Emotional and Psychological Experiences, Integration with Conventional Treatment, and Concerns About Interaction and Timing. (Table 7A-D).

Table 3 Comparison of Pain Score Before and After Treatment in Group A and Group B

Group	Mean pain score before treatment ± SD	Mean pain score after treatment ± SD	Mean reduction in pain score ± SD	Comparison of mean pain score before & after treatment
Group A	6.2 ±1.3	1.7 ±1.6	4.5 ±1.4	<0.001*
Group B	6.1 ±1.2	3.8 ±1.7	2.3 ±1.5	<0.001*
Statistical comparison of mean pain scores of both group A and B				<0.001*

*p value <0.05 - statistically significant

IV. DISCUSSION

The present study demonstrated that deep heat therapy (hyperthermia), when applied at 1°C above baseline tissue temperature in patients with Stage IV solid malignancies, led to a significant reduction in mean pain score reduced by 4.5 magnitude greater than the 2.3 reduction seen in the routine treatment, which is consistent with the findings. aligning with results from Dewhirst MW et al. [7] who observed that mild hyperthermia modulates nociceptors and reduces pain *via* vasodilation and decreased ischemia in tumor-affected tissues. similarly, findings by Wang Y et al. [8] who noted that hyperthermia enhanced the analgesic effect of opioids through improved tissue perfusion. This pain-relieving effect is further supported by a study by Issels RD et al. [9] where patients with soft-tissue sarcomas reported better pain control when hyperthermia was combined with chemotherapy, suggesting potential synergistic effects between heat and cytotoxic agents [7].

Table 4 Comparison of Tapering of Pain Medications in Group A & Group B

Group	Reduced to Non-opioid/ SOS	No change	P value
Group A	35 (70)	15 (30)	0.002*
Group B	20 (40)	30 (60)	

*p value <0.05 - statistically significant

In the present study 62% of the patients with Stage IV solid malignancies belonged to 51-70 years age group, and most of the participants, 58%, were males. Similar age trends have been reported in multiple epidemiological cancer studies. For instance, a population-based analysis by Sathishkumar K et al. [3] reported that the majority of advanced-stage cancer patients in India fall within the 50–69 years age group, indicating a peak in cancer incidence during the later decades of adulthood.

Likewise Globo can 2020 data also highlight that over 60% of all cancer diagnoses in South-East Asia occur in individuals aged 50 and above, with a significant clustering around the 51–70 age range [10]. Regarding gender distribution, the predominance of male participants (58%) in the present study aligns with findings from studies such as by Kulothungan V et al. where males constituted a larger share of cancer cases, particularly due to higher incidences of lung cancers among men [11]. The higher proportion of patients aged 51–70 years can be attributed to the cumulative effect of age-related genetic mutations, longer exposure to carcinogens (e.g., tobacco, alcohol, occupational hazards), and declining immune surveillance with age [4, 5]. This age group also represents a phase of life when individuals are more likely to seek tertiary care or palliative services due to worsening symptoms or diagnosis delays.

Table 5 Comparison of the Status of Tumor Size After Treatment in Group A & Group B

Group	Significant reduction	Stable/No significant change	Progression	P value
Group A	32 (64)	12 (24)	6 (12)	0.003*
Group B	15 (30)	22 (44)	13(26)	

*p value <0.05 - statistically significant

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Table 6 Comparison of Quality of Life (QOL) Scores Based on EORTC QLQ-C30 Questionnaire Between Group A & Group B

QOL Domain	No. of items	Group A (Mean ± SD)	Group B (Mean ± SD)
Global Health Status	2	75 ± 10	62 ± 13*
Physical functioning	5	82 ± 9	68 ± 11*
Role functioning	2	80 ± 10	67 ± 12*
Emotional functioning	4	78 ± 11	65 ± 13*
Cognitive functioning	2	85 ± 8	75 ± 10*
Social functioning	2	77 ± 12	63 ± 11*
Fatigue	3	28 ± 7	41 ± 9*
Nausea/vomiting	2	14 ± 5	21 ± 7*
Pain	2	20 ± 6	36 ± 8*
Dyspnoea	1	18 ± 6	28 ± 8*
Insomnia	1	22 ± 7	30 ± 8*
Appetite loss	1	16 ± 6	25 ± 7*
Constipation	1	14 ± 5	20 ± 6*
Diarrhea	1	12 ± 4	18 ± 5*
Financial difficulties	1	18 ± 6	25 ± 8*

The male predominance observed in this study may be explained by higher prevalence of risk factors among men, including tobacco and alcohol consumption, late presentation to healthcare facilities, and occupational exposures.

Additionally, gender differences in health-seeking behavior and accessibility to oncological services could contribute to this distribution. In the current study Our participants also reported a reduced need for opioids, with 70% tapering to non-opioid or SOS medications, a finding that echoes those of Overgaard and Qian J et al., who demonstrated that adjunct hyperthermia reduced opioid dependence in advanced cervical and pancreatic cancer patients, respectively [12].

Deep heat therapy is believed to stimulate transient receptor potential vanilloid-1 (TRPV1) receptors, which modulate pain thresholds and may create a temporary desensitization to chronic pain signals [6]. Our study observed a 64% reduction in tumor size in group A compared to only 30% in controls, similar to the results of Van der Zee et al., who reported that deep hyperthermia, when used in conjunction with radiotherapy, improved local tumor control in cervical carcinoma patients v [13]. In another study, Lindholm CE et al. noted a 53% tumor response in patients receiving hyperthermia combined with chemotherapy for recurrent breast cancer, validating our observation of potential tumor shrinkage effects [14]. The enhanced therapeutic impact observed in our participants can be attributed to hyperthermia's known ability to increase tumor oxygenation and perfusion, which in turn sensitizes tumor cells to chemotherapeutic agents and radiation, as confirmed in the work of Song et al [15]. A significant finding in our study was the marked improvement in quality of life (QoL), particularly in domains such as pain, sleep, emotional function, and physical mobility, supporting similar outcomes noted by Vernon et al., where hyperthermia-treated patients reported increased comfort and emotional well-being during palliative care [16].

Table 7A Patient Experiences on the Perceived Effectiveness of Deep Heat Therapy in Stage IV Solid Malignancy Pain Management

Theme	Category	Codes	Quotes
Perceived Effectiveness of Deep Heat Therapy	Symptomatic Relief	Warmth provides comfort	"The warmth feels like a blanket inside me—it calms me." "When the heat starts, I feel more at ease instantly." "The warm sensation is oddly soothing, especially during flare-ups."
		Temporary reduction in pain	"After the session, the sharp pain dulls for at least four hours." "It gives me a break from the constant throbbing in my back." "Even if for a few hours, I feel like I have my body back."
		Improved sleep quality	"I sleep longer and deeper after therapy days." "Less tossing and turning at night—finally some rest." "Without that pain at night, I manage to get full sleep, which never happens otherwise."
	Improvement in Follow up	Pain becomes manageable	"Pain's still there, but I can ignore it more now." "It used to be unbearable; now it's something I live with more easily." "The intensity has come down; I don't feel as drained."
		Increased mobility post-therapy	"Pain's still there, but I can ignore it more now." "It used to be unbearable; now it's something I live with more easily." "The intensity has come down; I don't feel as drained."

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		Reduced dependence on analgesics	"Earlier I was on 6 tablets a day. Now just 2 after the therapy started." "I use morphine only at night since starting heat sessions." "Fewer pills mean fewer side

Table 7B Patient Experiences on the Challenges in receiving Deep Heat Therapy in Stage IV Solid Malignancy Pain Management

Theme	Category	Codes	Quotes
Challenges in Receiving Therapy	Physical Discomfort During Therapy	Excessive sweating	I sweat so much during it, my clothes are soaked." "The bed gets slippery from how much I sweat." "Even with a fan, the sweat is uncomfortable."
		Skin discomfort	"The skin over the area becomes red and itchy." "It feels like sunburn afterward, especially where the tumor is." "My skin becomes sensitive for a day or two post-session."
		Burning sensation	"There's a slight burning deep inside, not unbearable but odd." "Sometimes it gets too hot and I have to ask the technician to reduce it." "A stinging feeling happens midway through the session."
	Logistical Barriers	Travel fatigue	Travelling 40 km each way twice a week drains me." "It's hard to sit in a car for an hour with this pain." "Public transport is not an option when I'm this weak."
		Time-consuming sessions	Each session is about an hour, plus waiting—it's half the day gone." "It interrupts my routine completely." "The waiting makes it more exhausting than the therapy itself."
		Need for caregiver support	"I can't come alone—I need my son to push the wheelchair." "My daughter takes leave just to bring me here." "I feel guilty depending on others every time."

In our study the EORTC QLQ-C30 global health score was significantly higher in the deep heat therapy group (75 vs. 62). It was found hyperthermia promoted parasympathetic activation, leading to reduced systemic symptoms in prostate cancer patients undergoing palliative treatment [6, 7].

The in-depth interview from participants revealed that hyperthermia provided a psychological boost and a sense of control and better sleep quality aligning with the narrative study by van der Heijden et al., which found that integrative therapies like hyperthermia increased treatment engagement and patient empowerment in metastatic cancer [17].

strength of hyperthermia noted in both our study and that by Takahashi et al. was the non-invasive, drug-free nature of the therapy, making it suitable for patients with polypharmacy risks or opioid intolerance [18]. it was also found hyperthermia reduced stiffness and improved mobility post-treatment. However, some participants reported skin irritation and excessive sweating, adverse effects also noted by Torres KE et al. in patients undergoing local hyperthermia for hepatic metastases, though these were transient and resolved without intervention [19]. In the present study it was found that in terms of logistical challenges, such as travel fatigue and time-consuming sessions. Despite these limitations, patients expressed a strong willingness to continue therapy. Our results also indicate a potential immunomodulatory benefit, that mild thermal stress induced heat-shock proteins (HSPs) that could enhance tumor antigen presentation and possibly improve systemic immune response.

Table 7C Patients Emotional and Psychological Experiences on the Deep Heat Therapy in Stage IV Solid Malignancy Pain Management

Theme	Category	Codes	Quotes
Emotional and Psychological Experiences	Hope and Empowerment	Feeling in control	"It's the only part of my treatment I look forward to." "Makes me feel like I'm doing something to fight back." "I'm not just a passive patient anymore."
		Active participation	"I schedule my own sessions—it makes me feel involved." "Unlike chemo, I feel like this is *my* decision." "It's empowering to try something beyond medicines."
		Psychological boost	It lifts my mood after every session." "Even if placebo, it keeps me positive." "Gives me strength to face the disease another day."
	Frustration with	Variable effects	"One day it helps, next day it doesn't—very inconsistent." "Sometimes it feels useless, sometimes miraculous." "I can't count on it fully."
		Lack of improvement	"No way to know if this is really working or not." "Pain goes down, but is it from the therapy or just a good day?"

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	Uncertainty	clarity	"I wish they had a way to measure the benefit."
		Anxiety about therapy results	"I keep wondering if this is buying me time or wasting it." - "It makes me anxious—am I doing the right thing?" - "Is this proven or just experimental on me?"

Table 7D Patient Experiences on the Integration with Conventional Treatment in Stage IV Solid Malignancy Pain Management

Theme	Category	Codes	Quotes
Integration with Conventional Treatment	Complementary Role	Works with chemotherapy	"Chemo is killing the tumor; heat is helping my body cope." "I bounce back from chemo faster after therapy sessions." "The combo works better than either alone."
		Enhances effect of medications	"I think the pain meds work better after heat therapy." "My doctor said heat improves circulation—it probably helps the drugs act better." "Feels like the body absorbs treatment more after it."
		Holistic care	"It's not just physical—it helps mentally too." "Feels more natural, like a body-centered treatment." "This is the only part of my care that feels healing, not harming."
	Concerns About Interaction and Timing	Scheduling conflict	"Chemo on Monday, heat on Tuesday—it's too close." "I'm too weak after chemo to sit for an hour in the machine." "I wish they could align both better."
		Fear of overstimulation	Too many treatments leave my body confused." "I don't know if this much heat is good for internal organs." "Feels like I'm overloading my system."
		Lack of confidence.	"Is this therapy approved? No one tells us clearly." "Feels like an experiment—I hope it's safe." "I trust my doctor, but I wish there were more studies."

While our study focused on palliative endpoints, it complements the survival benefit findings of Issels et al., where hyperthermia added to neoadjuvant chemotherapy improved overall survival in high-risk soft tissue sarcoma patients [9]. The opioid-sparing effect we observed is supported by a systemic review by Hamer et al., highlighting the role of non-pharmacological interventions, including hyperthermia, in reducing long-term opioid dependence in palliative care [13]. Moreover, the improved cognitive and social functioning reported in our deep heat therapy (hyperthermia), group aligns with results from Brédart A et al., where hyperthermia was shown to reduce depressive symptoms and enhance social engagement in advanced colorectal cancer patients [20].

Finally, our findings support the framework proposed by the Society for Integrative Oncology, which advocates for incorporating evidence-based complementary treatments such as hyperthermia into palliative cancer care to address multidimensional patient needs [21].

V. STRENGTH AND LIMITATION

This study is among the few to explore the adjunctive use of localized deep heat therapy (hyperthermia) targeting a remission of 1°C specifically for Stage IV solid tumor patients with cancer pain, providing novel evidence in this underserved area. Pain intensity was assessed using a validated tool (e.g., Numerical Rating Scale or Visual Analog Scale), enhancing the reliability of symptom evaluation. Combining hyperthermia with conventional opioid therapy represents a comprehensive management strategy, potentially improving patient outcomes. Single-centered study with smaller the sample size limits the statistical power and generalizability of the findings.

VI. CONCLUSION

This study found that deep heat therapy (hyperthermia) at a remission of 1°C is a safe and effective adjunct to opioids in managing pain among patients with Stage IV solid malignancies. It reduced pain intensity and opioid requirements, suggesting a potential role in palliative care. Larger randomized trials are needed to confirm these findings.

➢ *Abbreviations and Acronyms*

CDC, Centers for Disease Control and Prevention; DHT, Deep Heat Therapy; IDI, In-Depth Interview; VAS, Visual Analogue Scale; EORTC QLQ-C30, European Organisation for Research and Treatment of Cancer Quality of Life Questionnaire – Core 30; GLOBOCAN, Global Cancer Observatory; HSPs, Heat Shock Proteins; HT, Hyperthermia; LMICs, Low- and Middle-Income Countries; NSAID, Nonsteroidal Anti-Inflammatory Drug; PI, Principal Investigator; OPD, Outpatient Department; QoL, Quality of Life; QUAN → qual, Quantitative followed by Qualitative (Explanatory Sequential Mixed-Methods Design); SPSS, Statistical Package for the Social Sciences; TRPV1, Nonsteroidal Anti-Inflammatory Drug; PI, Principal Investigator; OPD, Outpatient Department; QoL, Quality of Life; QUAN → qual, Quantitative followed by Qualitative (Explanatory Sequential Mixed-Methods Design); SPSS, Statistical Package for the Social Sciences; TRPV1, Transient Receptor Potential Vanilloid 1; WHO, World Health Organization.

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