Original Article

The Effectiveness of Heat Therapy and Cold Therapy in Labor Pain Intensity in Primiparous Women: A Randomized Controlled Trial

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Abstract

Background: Labor pain (LP) is one of the most severe types of pain among women, and hence, effective LP management is a main goal of maternity care. **Objectives:** The aim of this study was to compare the effects of heat therapy (HT) and cold therapy (CT) on LP intensity among primiparous women. **Methods:** This randomized controlled trial was conducted in 2017–2018 on 99 primiparous women purposively selected from a teaching hospital in Iranshahr, Iran. Participants were allocated, through simple randomization, to an HT, a CT, and a control group. Participants in the HT group received HT using a warm-water bottle with a temperature of 38°C–40°C, and participants in the CT group received CT using an ice pack with a temperature of 0°C–5°C. HT and CT were applied to the lumbar area in the first phase of labor and to the perineal and suprapubic areas in the second phase. LP intensity was measured using the Visual Analog Scale at five time points, namely at a cervical dilation of 4 cm (i.e., before intervention onset), at a cervical dilation of 4–5, 6–7, and 8–9 cm (i.e., during the active labor phase), and in the second stage of labor. The SPSS software (v. 16.0) was used to analyze the data through the Chi-square test, the one-way analysis of variance, and the repeated measures analysis of variance. **Results:** A total of 93 participants completed the study. There was no significant difference among the groups respecting LP intensity at different measurement time points, except at the cervical dilation of 8–9 cm in which LP intensity in the CT group was significantly less than both the HT and the control groups ($P < 0.05$). **Conclusion:** CT is effective in significantly reducing LP intensity among primiparous women.

Keywords: *Cold therapy, Heat therapy, Labor, Pain intensity*

Introduction

Vaginal delivery is a spontaneous process with minimal complications.[1] However, labor pain (LP) can negatively affect this process. LP is one of the most severe types of pain among women.[2] It is associated with many different adverse consequences for both women and their fetus,[3] including diminished blood flow to the uterine and the placenta, fetal acidosis, abnormal fetal heart rate, bleeding, low Apgar score, delayed gastric emptying, increased probability of pulmonary aspiration among women, pelvic muscle contractions, altered labor progress, and altered fetal descent.[4] Accordingly, most women have great fear and anxiety over LP which negatively affect their choice of delivery type.[5] Fear and anxiety over LP may make women resort to elective cesarean section that puts them at risk for different surgical complications.[6,7]

Given the multiplicity of LP-related complications, effective LP management is a main goal of maternity care services. Pharmacological LP management techniques usually have negative effects on

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woman, fetus, and labor progress, and hence, nonpharmacological LP management techniques have received great attention, particularly in recent years.[8,9] Nonpharmacological techniques for LP management not only reduce LP perception but also prevent care-related psychological suffering.[8] Examples of these techniques are positioning, physical exercises, massage therapy, hydrotherapy, music therapy, acupuncture, acupressure, aromatherapy, transcutaneous electrical nerve stimulation, hypnosis, birthing balls, heat therapy (HT), and cold therapy (CT).[10] These techniques are often used in most hospitals though some of them may have some side effects.[11]

HT and CT include the use of heat and cold for pain management.[12] According to the gate control theory of pain management, heat and cold reduce pain perception[13] through closing the gates for pain signal transmission.[13-16] Both HT and CT are among the commonly used techniques for pain management.[17,18] Some studies reported the effectiveness of HT in lowering LP[11,12,19-21] and some studies found that the effects of HT on pain were stronger than other nonpharmacological techniques.[3,22,23] A study also reported that the alternate use of HT and CT significantly reduced LP and shortened the duration of the first and the second stages of labor.[20] Similarly, some studies reported the significant positive effects of CT on LP.[6,24] A study also showed that HT was more effective than CT in reducing LP in the first stage of labor.[25] However, a study showed that HT in the first stage of labor had no significant effects on LP.[5]

The growing prevalence of elective cesarean section and the contradictory results of previous studies into the effects of HT and CT on LP highlight the necessity of further studies.

Objectives

The aim of this study was to compare the effects of HT and CT on LP intensity among primiparous women.

Methods

Design and participants

This randomized controlled trial was conducted in 2017–2018 on 99 primiparous women with low-risk pregnancy. They were purposively selected from Iran Hospital affiliated to Iranshahr University of Medical Sciences, Iranshahr, Iran. Inclusion criteria were primiparity, basic literacy skills, active phase of labor with a cervical dilation of 4 cm after induction, cephalic presentation, gestational age of 37–41 weeks, normal singleton pregnancy, normal amniotic fluid index, normal fetal heart rate, no affliction by psychiatric disorders, no cephalopelvic disproportion, and no skill lesions on the lumbar, perineal, and suprapubic areas. Exclusion criteria were fetal death, use of narcotic and sedative agents, delivery through cesarean section, and any case of emergency. Participants were allocated to an HT, a CT, and a control group through simple randomization using numbered cards in a container. Based on the mean scores of LP intensity in a previous study[11] and with a power of 0.80 and a confidence level of 0.95, the sample size was determined to be 27 per group [Figure 1]. However, the sample size was increased to 33 per group to ensure sampling adequacy.

Data collection instruments

Data were collected using a demographic questionnaire, a clinical characteristics questionnaire, and the Visual Analog Scale. The demographic questionnaire had items on age and educational level and the clinical characteristics questionnaire had items on gestational age, duration of the first and the second stages of labor, neonatal birth weight, 1-and 5-min Apgar scores, severity of perineal injury, and neonatal gender. The visual Analog Scale is a widely used instrument for the measurement of subjective feelings. It is a 100-mm ruler with 0 (“no pain”) at the one end and 100 (“most severe pain”) at the other end.[26] The validity of this scale was confirmed through content validity assessment and its reliability was assessed through the inter-rater method in which two raters simultaneously rated LP intensity for fifteen eligible primiparous women. The inter-rater correlation coefficient was 0.88.

Intervention

The first author of the study implemented the study intervention which was HT for participants in the HT group and CT for participants in the CT group. Study intervention was started with the onset of the active labor phase, i.e., a cervical dilation of 4 cm. In the CT group, an ice pack with a temperature of 0°C–5°C was wrapped in gauze and was placed on the lumbar area in the first active phase of labor and on the perineal and suprapubic areas in the second active phase. In the HT group, a warm-water bottle with a temperature of 38°C–40°C was wrapped in a thin towel or gauze and placed on the lumbar area in the first active phase of labor and on the perineal and suprapubic areas in the second active phase. HT and CT were applied every 10 min for 15 min for at least 60 min in the first phase. The duration of the study intervention in the second phase of labor was at least 5 min.[27] Participants in the control group just received maternity care services routinely provided to all women in the study setting. LP intensity was measured at five time points, namely at a cervical dilation of 4 cm (i.e., before intervention onset), at a cervical dilation of 4–5, 6–7, and 8–9 cm

(i.e., during the active labor phase), and in the second stage of labor.

Data analysis

Normality of the data was tested through the Shapiro–Wilk test which indicated the normal distribution of the data. Therefore, the paired samples *t*-test and the repeated measures analysis of variance were used for within-group comparisons and the Chi-square test and the one-way analysis of variance were used for among-group comparisons. The data were analyzed using the SPSS software (v. 16.0, SPSS, Inc., Chicago, IL, USA) and at a significance level of <0.05.

Ethical considerations

This study has the approval of the Ethics Committee of Iranshahr University of Medical Sciences, Iranshahr, Iran (code: IR.IRSHUMS.REC.1396.3). Moreover, the study was registered in the Iranian Registry of Clinical Trials (code: IRCT20180624040219N1). We provided participants with the necessary explanations about the study, its aim, and confidential data management, and obtained informed consent from all of them.

Results

A total of 99 women in three 33-person groups participated in this study. Six participants from the HT group were excluded from the study due to their voluntary withdrawal, and the study was finished with 27 participants in the HT group, 33 participants in the CT group, and 33 participants in the control group [Figure 2].

$$N = \frac{(z_{1-\alpha/2} + z_{1-\beta})^2 (s_1^2 + s_2^2)}{(\bar{x}_1 - \bar{x}_2)^2}$$

$$n = \frac{(1.96 + 0.85)^2 [0.99 + 1.20]}{[8.96 - 8.14]^2} = 27$$

Figure 1: Sample size calculation

The means of participants' age and gestational age were 22.87 ± 5.23 years and 39.60 ± 0.86 weeks in the control group, 22.29 ± 4.87 years and 39.70 ± 0.72 weeks in the HT group, and 21.87 ± 4.14 years and 39.84 ± 0.50 weeks in the CT group. There were no significant differences among the study groups respecting participants' demographic and clinical characteristics including age, gestational age, educational level, and duration of the first and the second labor stages, as well as their neonates' gender, birth weight, and Apgar score [$P > 0.05$; Table 1].

No significant difference was observed among the groups respecting the pretest mean score of LP intensity ($P = 0.62$). After the intervention, among-group difference respecting LP intensity was significant only at the cervical dilation of 8–9 cm [$P = 0.002$; Table 2]. *Post hoc* analysis showed that at this time point, the mean score of LP intensity in the CT group was significantly less than both the HT ($P = 0.007$) and the control ($P = 0.005$) groups, while there was no significant difference between the HT and the control groups ($P = 0.991$). The results of the repeated measures analysis of variance also indicated the significant effects of time, so that the mean score of LP intensity significantly increased over time ($P < 0.001$) [Figure 3]. However, the effects of group on LP intensity were not statistically significant [$P = 0.127$; Table 2].

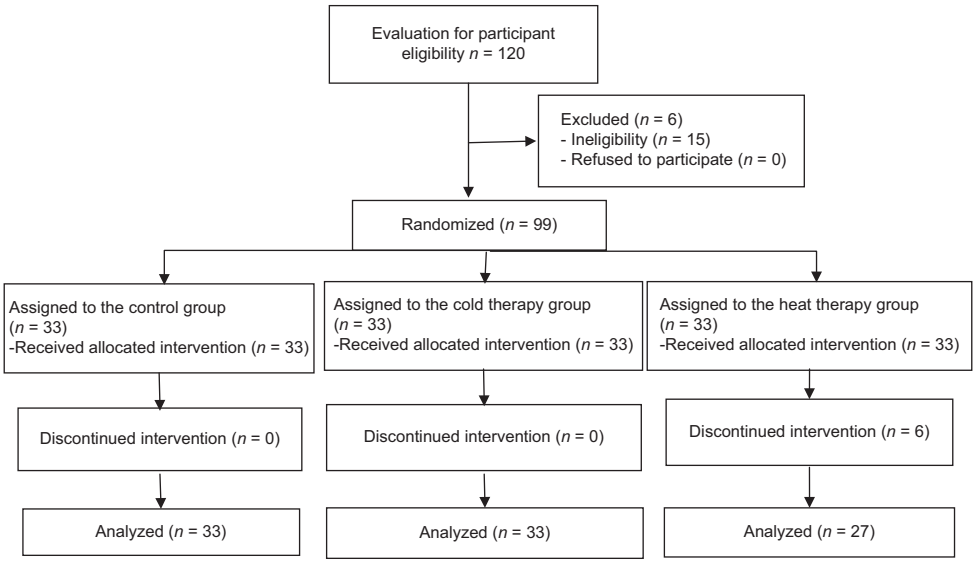

Figure 2: The flow diagram of the study

Table 1: Group comparisons respecting participants' demographic and clinical characteristics

Characteristics	Groups, *n* (%) or mean ± SD			*P*
	Control	Heat therapy	Cold therapy	
Age (years)				
<18	4 (23.52)	7 (41.17)	6 (35.29)	0.49[a]
18-35	29 (38.15)	20 (26.31)	27 (35.52)	
Level of education				
Below diploma	19 (57.58)	15 (55.56)	18 (54.55)	0.59[a]
Diploma	10 (30.30)	3 (11.11)	10 (30.30)	
Higher	4 (12.12)	9 (33.33)	5 (15.15)	
Neonatal gender				
Female	16 (35.6)	13 (28.9)	16 (35.6)	1[b]
Male	17 (35.4)	14 (29.2)	17 (35.5)	
Perineal injury				
Episiotomy	18 (32.7)	19 (34.5)	18 (32.7)	0.31[b]
First-degree laceration	5 (35.7)	5 (35.7)	4 (28.6)	
Second-degree laceration	10 (41.7)	3 (12.5)	11 (45.8)	
Age (years)	22.87 ± 5.23	22.29 ± 4.87	21.87 ± 4.14	0.69[c]
Gestational age (weeks)	39.60 ± 0.86	39.70 ± 0.72	39.84 ± 0.50	0.38[c]
Duration of the first stage (min)	180.75 ± 72.95	171.07 ± 71.40	179.09 ± 0.67	0.85[c]
Duration of the second stage (min)	42.27 ± 30.62	39.62 ± 20.18	39.75 ± 21.60	0.89[c]
Neonatal weight (g)	2989.09 ± 318.67	3027.77 ± 323.54	3018.18 ± 329.49	0.88[c]
1-min Apgar score	8.90 ± 0.29	8.96 ± 0.19	8.84 ± 0.44	0.41[c]
5-min Apgar score	9.93 ± 0.24	9.96 ± 0.19	9.87 ± 0.33	0.44[c]

[a]Chi-square test; [b]Exact test; [c]One-way ANOVA. SD: Standard deviation, ANOVA: Analysis of variance

Table 2: Among-group comparisons respecting the mean of labor pain intensity at the five measurement time points

Time	Groups (mean ± SD)			*P*[a]	Effect		
	Control	Cold therapy	Heat therapy		Time[b]	Group[b]	Time-group[b]
Dilation of 4 cm (before intervention onset)	5.15 ± 1.76	4.75 ± 1.52	4.96 ± 1.60	0.62	$F = 115.63$	$F = 2.11$	$F = 0.796$
Dilation of 4-5 cm	6.12 ± 4.56	5.21 ± 1.51	5.14 ± 1.81	0.36	$P < 0.001$	$P = 0.127$	$P = 0.574$
Dilation of 6-7 cm	7.15 ± 1.30	6.48 ± 1.22	6.81 ± 1.03	0.86			
Dilation of 8-9 cm	9 ± 0.93	8.15 ± 1.37	8.96 ± 0.70	0.002			
Second stage	9.57 ± 0.79	9.27 ± 1.03	9.18 ± 1.03	0.24			

[a]The results of the one-way ANOVA, [b]The results of the repeated measures ANOVA. ANOVA: Analysis of variance, SD: Standard deviation

Discussion

Study findings revealed a significant difference between the CT group and the HT and the control groups at the cervical dilation of 8–9 cm, denoting the significant positive effects of CT on LP. Several previous studies also reported the same finding.[6,24,27] For example, a study on 45 primiparous women indicated that CT applied to the lumbar and the perineal areas significantly reduced LP intensity and duration in the first and the second stages of labor.[24] CT can significantly reduce blood flow and slow down nerve conduction and pain transmission.[28] Moreover, the gate control theory of pain holds that CT closes the gates of pain signal transmission and thereby blocks pain transmission to the brain and reduces pain perception.[15] Moreover, CT stimulates thick alpha-beta nerve fibers which are mostly found in the surface of the body[16] and thereby blocks pain transmission to the brain. On the other hand, CT in the present study was applied to different areas, namely the lumbar, perineal, and suprapubic areas. The perineum is very sensitive to stimuli and its nerves are rapidly suppressed by CT. A study reported that CT applied to the perineal area significantly reduced postepisiotomy perineal pain.[18,29] Contrary to our findings, a study reported that HT was more effective than CT in reducing LP intensity in the first and the second stages of labor.[12] This contradiction is probably due to the fact that CT was applied at a temperature of 10°C–15°C in that study and at a temperature of 0°C–5°C in the present study.

Study findings showed that HT had no significant effects on LP intensity which is contrary to the findings of previous studies.[22,23] The duration of HT in the present study was 60 min, while a study showed that the acceptable duration of HT during labor is 80 min.[11] Moreover, a study reported that HT was more effective than CT in reducing LP in the first stage of labor. This contradiction is attributable to

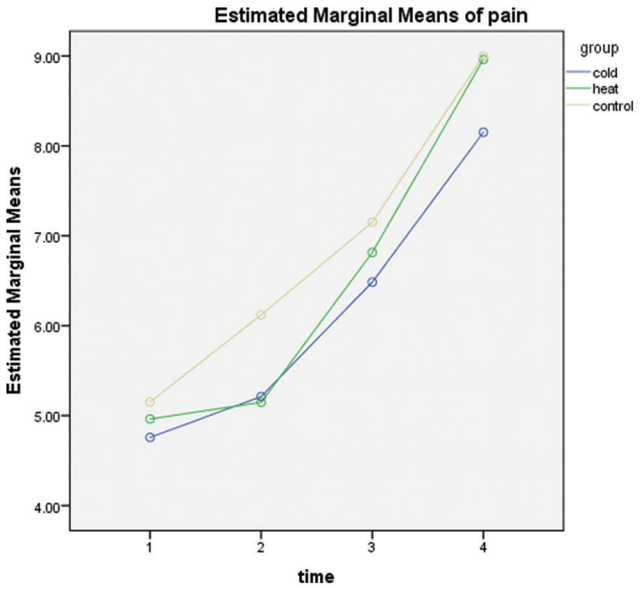

Figure 3: The variations of the mean score of labor pain intensity across different measurement time points

the difference in the LP measurement instrument which was the Visual Analog Scale in the present study and the Numerical Rating Scale in that study.[23]

Another finding of the present study was no significant difference among the groups with respect to labor duration. This is similar to the findings of a previous study[11] and contradictory to the findings of two other studies.[12,28]

Limitations

One of the limitations of the present study was our limited control over participants' personal differences respecting their pain perception and previous pain-related experiences. Moreover, environmental factors such as noises might have affected participants' pain perception. Blinding of participants to the study groups was also impossible due to the characteristics of the study interventions. Another limitation of the present study was the routine use of oxytocin for almost all women in the study setting. Future studies are recommended to control the potential confounding effects of environmental factors and oxytocin administration on the effects of HT and CT on LP intensity.

Conclusion

This study concludes that CT is an effective nonpharmacological technique for LP management. Given the easy applicability and the inexpensiveness of CT, midwives can use it to manage LP and improve women's labor experiences.

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Conflicts of interest

There are no conflicts of interest.

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