Original Article

The effect of intermittent local heat and cold on labor pain and child birth outcome

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Abstract

Background: Labor pain is one of the severest pains that cause many women request cesarean section for fear of pain. Thus, controlling labor pain is a major concern of maternity care. Nowadays, interest in non-pharmacological pain relief methods has been increased because of their lower side effects. The effects of discrete heat and cold on decreasing labor pain have been reported but there was no evaluation of the effects of simultaneous heat and cold. The aim of this study was to investigate the effect of intermittent heat and cold on pain severity and childbirth outcomes.

Materials and Methods: This study was a randomized controlled trial. Sixty-four nulliparous women with term, One fetus, and low-risk pregnancy were divided into the intervention (32 participants) and the control group (32 participants) by random allocation. Excluding criteria were: administration of pain relief drugs, skin disease in the field of intervention, fetal distress, bleeding, fever, and disagreement with participation in the study. Warm and cold packs were used intermittently on low back and lower abdomen during the first phase and on perineum during the second phase of labor. Pain intensity was assessed with Visual Analogue Scale. Descriptive statistic, chi square, and t-test were used for data analysis.

Results: There were no significant differences in demographic and midwifery characteristics and the baseline pain between two groups. The pain was significantly lower in intervention group during the first and second phases of labor. Duration of the first and third phases of labor was shorter in the case group. There were no significant differences in type of delivery, perineal laceration, oxytocin uptake, fetal heart rate, and APGAR between two groups.

Conclusion: Local warming with intermittent cold pack can reduce labor pain without adverse effects on maternal and fetal outcomes. It is an inexpensive and simple method. Intermittent local heat and cold therapy is a no pharmalogical, safe and effective method to relief labor pain.

Key words: Child birth, cold temperature, hot temperature, labor pain

Introduction

Labor pain as one of the severest pains that has always been a concern to pregnant women and therefore relieving labor pain is an important part of modern obstetrics. Yet, there is no ideal medication for relieving pain and anxiety during delivery. Women's perception of labor pain depends on various factors including preceding labor pain experiences, mother's compatibility with pain, environmental conditions, and psychological status.[1] Severe pain could result in exacerbation of mother's fear and anxiety during delivery and leads to stimulation of sympathetic nervous system, so increased catecholamine production such as epinephrine and norepinephrine, and consequently increased pain and prolonged delivery which may prevent mother's satisfaction of delivery.[2] Furthermore, the second phase of delivery is associated with development of a new feeling of fear and anxiety which might impair mother's cooperation to push child's head.[3] Studies have demonstrated that fear of pain encourages mothers to demand caesarian section (C/S) which has led to increased C/S rates.[4,5] In government hospitals in Iran, C/S rate reaches 40 to 50% and 60% of Iranian women are interested in C/S to suffer less pain.[6] Meanwhile, mortality rate of C/S is five times more than normal vaginal delivery,[7] yet suffering severe pain affects women's decision on method of next deliveries. Although women's information about delivery process is usually obtained from friends and relatives, their unpleasant experiences of delivery could be transmitted to other women and fear of labor pain spreads out among women through an abnormal cycle and interest in C/S will be increased.[8] Therefore, application of a safe and effective method for relieving labor pain is an essential topic in obstetrical studies.

Labor pain is different from other types of pain as there

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is no real trauma or tissue damage involved. Although eradication of the pain source is not achievable, other techniques should be utilized. Administration of drugs might not only cause side effects but also can disturb mother's active cooperation during delivery.[9] One of non-pharmacological methods of relieving labor pain is administration of heat and cold in various patterns. Cold could cause pain decrease through various mechanisms including reciprocal induction of numbness, impeding pain perception by stimulation of peripheral neural receptors, facilitating energy flow in points of acupuncture, declining muscle tension, alteration of neural transmission velocity, deceleration of transmission of pain signal to central nervous system, and also distraction from pain.[10,11] Concerning the effect of cold on decreasing anxiety,[12] it seems that cold can decline catecholamine level and therefore raise endorphin level and consequently decrease pain severity. Overall, it appears that based on gate control theory, cold can effectively block the neural transmission in sensory fibers and elevate pain threshold.[1,13-16] In addition to mentioned mechanisms about cold, heat may stimulate heat receptors in derma and deeper tissues and different impulses neutralize themselves at the level of spinal cord and lead to closure of the gate and subsequently impede neural impulses to reach the brain.[17]

To the best of our knowledge, no randomized clinical trial has been performed about the effects of simultaneous heat and cold. Some studies have investigated the effects of heat or cold discretely and although demonstrated some beneficial effects on relieving pain but regarding concomitant administration of other methods of relieving pain like acupressure or floating in water, accurate evaluation of the effects of heat or cold is not possible.[1,14,18-20] Since some studies evidenced that the effect of heat on pain relief is immediate and will be eliminated in a short time and the effect of cold appears later (after 10 to 30 minutes),[11,16,21] and on the other hand to change the stimulator may introduce more pain relief, so it seems applying intermittent heat and cold induces longer duration of pain relief. The aim of this study was to investigate the effect of intermittent heat and cold on pain severity and childbirth outcomes.

Materials and Methods

It was a randomized clinical trial to investigate the effect of intermittent local heat and cold on pain intensity and child birth outcomes in nulliparous women admitted in labor unit in Emam Ali and Shahid Rajai Hospitals (north of Iran, 2011). Sixty-four parturient women were recruited by purposive sampling and randomly allocated to intervention (32 participants) and control (32 participants) group. Participants in two groups were matched through blocking by body mass index(BMI) based on <19.8, 19.8-25, and >25 and status of membranes in the onset of active phase (rapture and intact). Inclusion criteria were nulliparous women, age between 18 to 35 years, gestational age between 37 to 41 weeks, single fetus, cephalic presentation, and beginning of the active phase of labor (dilatation of 3 to 4 cm). Women with psychological (psychosis, schizophrenia,…) or anatomic disorders (uterine abnormalities, contracted pelvis,…), chronic diseases (cardiopulmonary disease, hypertension. Diabetes,…), dermatologic disorders (any kinds of lesions, inflammation or eczema within the field of heat and cold therapy), gestational hypertension, polyhydramnios or oligohydramnios, decreased fetal movements, intrauterine growth retardation, fetal death, and history of infertility were not enrolled. Cases of applying sedative and narcotic drugs, abnormal patterns of fetal heart rate, occurrence of any obstetrics problems during the study (placenta abruption, abnormal child positions, prolapsed umbilical cord, etc.) and women who did not want to continue the study were excluded. Fitted parturient women were enrolled after taking informed consent.

Data-gathering instruments included the information form, observation checklist, and Visual Analogue Scale (VAS) for evaluation of pain severity. Heat has a short and immediate effect on pain relief and at least 20 minutes lying in warm water improves labor process.[16,22] On the other hand, the effect of cold is prolonger and increases pain threshold after 5 to 10 minutes.[16,21] Based on this information, the protocol for intervention group was set. During the first stage of delivery, participants of intervention group received warm water pack with a temperature of 38-40°C and covered with towel on their abdomen, lower abdomen, and low back for half an hour throughout contractions. Afterward, they received icepack covered with towel on the same parts of the body for 10 minutes. Then, heat was used once more after 30 minutes and this process was repeated. During the second stage of delivery, these times were decreased to half, so warm water pack covered with sterile towel was placed on patients' perineum for 15 minutes followed by icepack for 5 minutes. Control group received only routine care. Pain severity was evaluated in the beginning of active phase and then during the acceleration, maximum slop, and deceleration phases. Pain severity during second stage of delivery was also evaluated after delivery. Pain severity evaluation was performed with the same manner in the control group. Moreover, duration of first, second, and third stages of delivery in both groups were measured. Patients' satisfaction about labor experience was evaluated in the end of delivery by questioning from them by a five-point Likert item.

Descriptive tests (frequency, mean, and standard deviation), chi square, and t-test were utilized for data analysis.

Results

Totally, 64 women including 32 in the case and 32 in the control group were involved in the study. None of the patients were excluded till the end of the study. Demographic and obstetrics characteristics of participants between two groups were not significantly different [Table 1]. Results showed no significant difference in baseline pain severity (at the beginning of active phase of labor) between the heat and cold group and the control group (6.84 ± 1.93 and 7.0 ± 2.03, respectively; $P > 0.05$) but thereafter along with progression of labor and during four stages of pain evaluation, pain severity in the heat and cold group was significantly lower than the control group. The difference in pain severity was statistically significant between two groups at the end of the acceleration phase with $P = 0.002$ and during the maximum of slop, the deceleration phase and the second stage with $P = 0.000$ [Figure 1].

Comparison of labor outcomes between two groups demonstrated a significant difference in duration of the first and third phases of delivery as they were shorter in the heat and cold group, but maternal outcomes including type of delivery, oxytocin uptake, and condition of perineum, and also childbirth outcomes including heart rate and APGAR were not significantly different [Table 2].

Evaluation of mothers' satisfaction revealed that a great number of mothers in the heat and cold group had high satisfaction (43.8%) and 12.5% had very high satisfaction and none of them were dissatisfied. However, in the control group, 65.6% had low satisfaction and 18.8% were dissatisfied and none of them had very high satisfaction. The

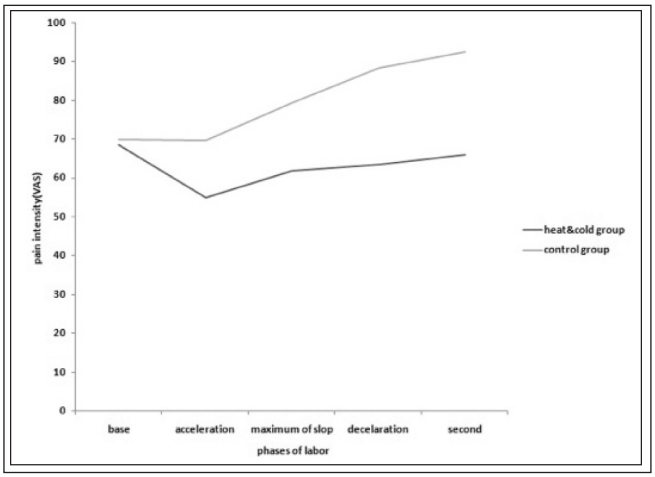

Figure 1: The comparison of pain severity between groups during labor

Table 1: The demographic and obstetrics characteristics in heat and cold therapy and control groups

Demographic and obstetrics factors	Heat and cold group	Control group	*P* value
Age (year) M±SD	28.81±5.52	28.56±5.41	NS
BMI (kg/m^2) M±SD	24.74±3.81	25.12±3.87	NS
Education			
illiterate	1 (50.0%)	1 (50.0%)	
Primary	7 (50.0%)	7 (50.0%)	NS
High school	15 (57.7%)	11 (42.3%)	
university	9 (40.9%)	13 (52.1%)	
Socioeconomical statues			
Low	2 (28.6%)	5 (71.4%)	NS
Moderate	14 (56/0%)	11 (44/0%)	
high	16 (50.0%)	16 (50.0%)	
Gestational age (week) M±SD	39.06±0.84	39.03±0.86	NS
Neonatal weight (gr) M±SD	3403±237.5	3390.6±237.4	NS
Duration of membrane rapture (minute) M±SD	195±50.71	207±49.21	NS
Membrane statues in onset of active phase			
Intact	20 (50%)	20 (50%)	NS
rupture	12 (50%)	12 (50%)	

NS: No significance (*P*>0.05)

Table 2: The comparison of child birth outcomes between heat and cold therapy and control groups

Child birth outcomes	Heat and cold group	Control group	*P* value
First stage duration (min) M±SD	201±64.86	273±108.13	0.002
Second stage duration (min) M±SD	39.5±12.28	41.15±11.96	NS
Third stage duration (min) M±SD	5.31±2.20	10.78±4.89	0.000
Duration of oxytocin application (min) M±SD	161±42.24	187.5±57.44	NS
Fetal heart rate M±SD	140.53±5.55	140.34±5.81	NS
APGAR (1st.minute) M±SD	8.81±0.47	8.71±0.58	
APGAR (5th.minute) M±SD	10	10	NS
Perineum			
Episiotomy	31 (52.5%)	28 (47.5%)	NS
tear	1 (33.3%)	2 (66.7%)	
both	0	2 (100%)	
Type of delivery			
Normal	31 (50.0%)	31 (50.0%)	NS
instrumental	1 (3.1%)	1 (3.1%)	
Oxytocin intake			
Yes	16 (48.5%)	17 (51.5%)	NS
No	16 (51.6%)	15 (48.4%)	

NS: No significance (*P*>0.05)

difference between two groups was statistically significant with $P = 0.000$.

Discussion

One of the methods for relieving labor pain is utilization of heat and cold. Results of this study showed that compared to routine treatments, administration of intermittent heat and cold in areas of pain including low back, abdomen, lower part of abdomen, and perineum could significantly reduce labor pain. This result was consistent with the preceding ones. Waters and Raisler investigated ice massage on Hugo point during contractions for pain reduction and reported reduction in labor pain at the beginning of labor.[1] In another pilot study, same procedure was utilized as mentioned above and showed a mean reduction in pain of 25.15 based on VAS criteria.[1] However, while that area is one of the acupuncture points, the effect could be related to stimulation of this point. Analysis of 210 labor departments in Britain demonstrated that midwives had used hot packs for reduction of labor pain during the second phase of labor in 33% of the parturient women and cold packs in 21% of them.[14,23] Regarding the effects of heat on labor pain relief, Cluett *et al.* reported that labor pain during three stages of labor in women who were put in warm water was less than women who received routine care.[24] Geissbuhler *et al*. evidenced that necessity of obstetrical anesthetics during delivery in warm water was less than routine delivery and warm water had decreased labor pain in 69% of the cases.[19] In Goodzke *et al.*'s study, delivery in warm water led to decreased labor pain in 76% of the cases.[20] However, in those three studies, they have used floating in warm water instead of local warm water which may cause a bias in concluding, but there are also reports of utilizing local warm water with beneficial effects. Behmanesh *et al.* demonstrated that administration of local warm water during the first ($P < 0.01$) and second phases ($P < 0.001$) of labor might decrease pain intensity.[25] Taavoni *et al.* used warm towel on sacral and perineum area and achieved beneficial effects in labor pain relief.[18] Dahlen *et al.* used warm pack on perineum of 360 women during the late of their second stage of labor and routine treatments in another 357 ones. Mothers and midwives found this method successful in pain relief as 79.7% of mothers and 80.4% of midwives believed warm pack to be efficient in pain relief and had positive impression for application of this method in next labors.[3] Mechanism of relieving pain by heat has been described based on gate control theory as well.[17] Besides, warm pack induce mother's comfort during the second stage and cause helpful psychological effects.[23,26]

This study also demonstrated that duration of first and third stages of labor in the intervention group was shorter than the controls. There are conflicting reports about the effect of heat and cold on duration of labor. Eckert *et al.* placed mothers in warm water but it could not cause any difference in duration of labor stages.[27] Inconsistently, Moneta *et al.* reported that placing mothers in warm water (37°C) for 20 minutes is associated with decline in mean duration of first phase of delivery.[22] Ohlsson and Cluett reported that duration of the first stage of labor in primigravid women was not significantly different between the women giving birth in warm water and women receiving routine treatments;[24,28] while Grodzka and Malarewice evidenced that warm water could shorten the labor stages.[20,29] Moneta *et al.* have also found that placing mothers in warm water might shorten the first stages of labor in multigravid women.[22] Behmanesh's reported duration of first stage of delivery was decreased by application of local heat.[25] Taavoni *et al.* also reported that administration of warm towel on sacral and perineal area did not make any difference in uterine contractions and duration of the active phase of labor.[18] Inconsistent results of these studies could be due to the differences in temperature of water, duration of positioning in water, and also lack of matching of confounding variables such as number of preceding labors, rupture of membranes, etc. On the other hand, since investigators in those studies have placed mothers in water, the results might not be comparable with the effects of local heat.

Although in this study the duration of second stage of labor was decreased but consistent with Behmanesh's study, it could not reach statistical significance.[25] It seems that since in both studies intervention during the second stages of labor was performed only on perineum, and abdominal and low back areas were not involved, the intervention was not influential enough to affect contractions. Taavoni *et al.* also did not used heat in these areas and could not detect any difference in duration of the labor stages.[18] Particularly, women experience the most intense pain during the second phase of labor and may require to increase the heat or decrease the cold.[23,30,31] It appears that the effect of heat on duration of labor is based on the effect of heat on contractions since heat can increase the local blood circulation and therefore increase the number, duration, and intensity of uterine muscle contractions.[25,31] Also, mother may experience a sense of control and strength that is effective in labor progression.[32] The beneficial effect of heat during the third phase of labor could be due to its effect on increasing mother's comfort and consequently increased endorphin and oxytocin which may lead to appropriate uterine contractions and earlier delivery of placenta. While administration of oxytocin was not significantly different between two groups, alteration of uterine contractions in the intervention group was not associated with oxytocin usage.

Moreover, heat and cold did not have adverse effects on maternal and child birth outcomes. Consistent with Khamisand Kalevi's results, we did not find any abnormal changes in fetal heart rate and along with Eckert and Ohlsson's studies, there was neither any significant difference in type of delivery nor in child's APGAR between two groups.[27,28,31,32] Kalevi and Risto also reported that heat does not alter child's APGAR.[32] Although in Behmanesh's and our study, there was no significant difference in perineal rupture and necessity of episiotomy between two groups, but some researchers reported that perineal warm compress during the second stage of delivery might be associated with increased second and third degree ruptures.[25,26,33] Reason for dissimilarity of results could be the difference of episiotomy rate which was 0.9% in Leah's study and 52.5% in ours. However, in our study, heat could not decrease ruptures, yet it did not increase it.

Mothers in the heat and cold group had higher satisfaction about labor experience, consistent with other studies that reported non-pharmacological pain relief methods to promote a high satisfaction because of perceived sense of control and empowerment.[34]

Conclusion

The findings showed local warming with intermittent cold pack is an effective method for reducing labor pain in various phases, addition to shortening first and third stages of labor. Besides, this method has no negative effects on delivery outcomes such as fetal health, instrumental delivery, perinea and uterine contractions. Therefore, it is expected that this method will increase mother's satisfaction, so encourage them to select natural delivery. Heat and cold therapy is an inexpensive, simple, safe, and effective non-pharmacological pain relief method that application of it does not require special proficiencies and is particularly available when pharmacological methods are not accessible.

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