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Uterine Cooling during Cesarean Section to Reduce Intraoperative Blood Loss: A randomized controlled trial

Namphung Nawasirodom, M.D.,*
Ussanee Sangkomkamhang, M.D.,*
Thananit Sangkomkamhang, M.D.,**.

** Department of Obstetrics and Gynecology, Khon Kaen Hospital, Thailand*
*** Department of Orthopedics, Khon Kaen Hospital, Thailand*

ABSTRACT

Objectives: The aim was to compare uterine cooling and routine cesarean section as a means of reducing intraoperative blood loss.

Materials and Methods: Pregnant women who underwent cesarean section at Khon Kaen Hospital between May and June, 2017 were randomly assigned to one of two groups: the uterine cooling (UC) group (n= 80) or the control group (n= 80). In the UC group, the uterus was wrapped using a sterile cooling swab while in the control group a routine cesarean section (CS) was performed.

Results: In UC group, there was a statistically significant reduction in intra-operative blood loss compared with routine CS (252.8 ± 133.8 vs 472.9 ± 201.8 ml), mean difference 220 ml (95%CI 166.6-273.5). Uterotonic drugs use was significantly less in the UC group (1.3% vs 10%, p = 0.02). Length of hospital stay was significantly less in the UC group (3.0 ± 0.5 vs 3.2 ± 0.7 day; p = 0.01). There was no significant difference between the two groups in postpartum hemorrhage. There was no intraoperative hypothermia found.

Conclusion: Uterine cooling was associated with a reduction in intraoperative blood loss among pregnant women undergoing cesarean section.

Keywords: uterine cooling, cesarean section, postpartum hemorrhage.

Correspondence to: *Namphung Nawasirodom, M.D., Department of Obstetrics and Gynecology, Khon Kaen Hospital, Khon Kaen 40000, Thailand, Phone: (043) 2373311, E-mail: honey_md34@hotmail.com*

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การศึกษาเปรียบเทียบการให้ความเย็นแก่มดลูกเพื่อลดการเสียเลือดระหว่างผ่าตัดคลอด

น้ำผึ้ง นวศิโรดม, อุษณีย์ สังคมกำแหง, ธนนิตย์ สังคมกำแหง

บทคัดย่อ

***วัตถุประสงค์**: เพื่อศึกษาเปรียบเทียบการให้ความเย็นแก่มดลูกเพื่อลดการเสียเลือดระหว่างผ่าตัดคลอดเปรียบเทียบกับการผ่าตัดคลอดแบบมาตรฐาน*

***วัสดุและวิธีการ**: สตรีตั้งครรภ์ที่เข้ารับการผ่าตัดคลอดที่โรงพยาบาลขอนแก่นระหว่างเดือนพฤษภาคมถึงเดือนมิถุนายน พ.ศ.2560 แบ่งอาสาสมัครออกเป็นสองกลุ่ม กลุ่มแรกจำนวน 80 ราย ห่อมดลูกด้วยผ้าชุบน้ำเกลือเย็นระหว่างการเย็บมดลูกเป็นเวลาอย่างน้อย 5 นาที กลุ่มที่สองจำนวน 80 ราย รับการผ่าตัดคลอดแบบมาตรฐาน*

***ผลการศึกษา**: การให้ความเย็นแก่มดลูกระหว่างผ่าตัดคลอดสามารถลดการเสียเลือดระหว่างผ่าตัดคลอดได้อย่างมีนัยสำคัญทางสถิติ เมื่อเทียบกับการผ่าตัดคลอดแบบมาตรฐาน ลดการเสียเลือดเฉลี่ย 220 มิลลิลิตร (252.8 ± 133.8 กับ 472.9 ± 201.8 มิลลิลิตร, $p < 0.001$) ลดการใช้ยากระตุ้นการหดตัวของมดลูกอย่างมีนัยสำคัญทางสถิติ (ร้อยละ 1.3 กับร้อยละ 10, $p = 0.02$) ลดระยะเวลาการนอนโรงพยาบาลได้อย่างมีนัยสำคัญทางสถิติ (3.0 ± 0.5 กับ 3.2 ± 0.7 วัน, $p = 0.01$) ส่วนอุบัติการณ์การตกเลือดหลังคลอดไม่มีความแตกต่างอย่างมีนัยสำคัญทางสถิติ และไม่พบว่าเกิดภาวะอุณหภูมิกายต่ำขณะผ่าตัด*

***สรุป**: การให้ความเย็นแก่มดลูกช่วยลดการเสียเลือดระหว่างผ่าตัดคลอด*

***คำสำคัญ**: การให้ความเย็นแก่มดลูก, การผ่าตัดคลอด, ภาวะตกเลือดหลังคลอด*

Introduction

Cesarean section (CS) rates have increased to as high as 25 to 30% in many parts of the world[1]. The most common complication during CS is postpartum hemorrhage, which leads to increased maternal mortality and morbidity[2]. The most frequent cause of hemorrhage is uterine atony, failure of the uterus (a) to contract sufficiently after delivery, and (b) to arrest bleeding from vessels at the placental implantation[3-6]. The uterus is a smooth muscle whose contraction is modulated most directly by intrinsic or extrinsic oxytocin. During pregnancy the spiral arteries within the uterus and beneath the placenta become enlarged in order to perfuse sufficient oxygen to the placenta. After separation of the placenta, the uterine smooth muscle cells contract in a pincer-like action to pinch the spiral arteries closed[7]. Many trials combined results from atony prophylaxis and treatment; for example, fundal massage, uterotonic drugs (i.e., oxytocin, methylergonovine, misoprostal, dinoprostone, tranexamic acid)[8-14], surgical method (i.e., uterine compression suture, internal iliac artery ligation, pelvic umbrella pack or peripartum hysterectomy)[15-17].

Nowadays, there is a new technique to reduce blood loss during hysterotomy repair; viz., uterine cooling immediately following delivery of the fetus and placenta so as to promote better uterine contraction and involution resulting in less blood loss[7]. Calcium ions play an important role in muscle contraction. Release of calcium ions from the sarcoplasmic reticulum stores is the immediate initiator of contraction, and calcium's diffusion from the muscle filaments and re-uptake by the sarcroplasmic reticulum results in relaxation of contraction. In some smooth muscles, cold enhances contraction, perhaps by slowing the reuptake of calcium[18-20]. When the usual pharmacologic agents fail to induce adequate contraction of the uterine smooth muscle, the investigators suspect that application of cold may be essential[7]. This study was conducted to assess the efficacy of uterine cooling in cesarean section for reducing intraoperative blood loss.

Materials and Methods

This randomized controlled trial was conducted at the Department of Obstetrics and Gynecology, Khon Kaen Hospital, Thailand between May and June, 2017. The study was approved by the Khon Kaen Hospital Institutional Review Board for Human Research. Before enrollment, the study design was explained to the participants who signed the informed consent form. We included pregnant women who underwent cesarean section for indications of previous uterine scaring, cephalopelvic disproportion, abnormal fetal presentation, and/or non-reassuring fetal heart rate pattern. We excluded pregnant women who refused to participate in the study, unable to understand the nature of the study due to mental illness or mental challenge, underlying blood dyscrasia with coagulopathy or on anticoagulant therapy, inability to exteriorize the uterus during cesarean section, placenta previa, abruptio placenta and chorioamnionitis.

Eligible participants were randomized by computer generated block of four into two groups; the uterine cooling group and the routine cesarean section group. The random numbers were put into sequentially sealed opaque envelopes.

The uterine cooling was done immediately following delivery of the fetus and placenta. The uterus was externalized and the body of the uterus cephalad to the hysterotomy incision wrapped in sterile surgical swabs saturated in sterile iced normal saline. These swabs were refrigerated between -2 and 2°C. The uterus wrapping was performed for at least 5 min until the hysterotomy was repaired. The uterus was then replaced into the pelvic cavity. The control group underwent a routine cesarean procedure. Ten to 20 units of oxytocin prophylaxis was administered in the intravenous fluid running at 100-120 ml/h in both groups. The participants of both groups received the same pre- and post-operative care. All surgical procedures were performed by staff or residents under supervision. The types of surgical incision and procedures were decided by the respective surgeon. Intraoperative blood loss was measured by summing the blood volume in the suction bottles and swabs.

Baseline characteristics were recorded, including:

age, gravidity, parity, body mass index (BMI), indication for surgery, type of incision, surgeon, and pre-, intra- and post-operative temperature. The pre-, intra- and post-operative body core temperature by oral route were routinely recorded at the ward and operating room by regular and anesthesia nurses. The intraoperative body core temperature was recorded during repair of the uterus.

The primary outcome was intraoperative measurement of blood loss. The secondary outcomes were use of additional uterotonic drugs (i.e., oxytocin, methylergometrine, misoprostal, and sulprostone), additional surgical interventions (i.e., uterine compression suture, uterine artery ligation, and internal iliac artery ligation), requirement of blood transfusion, total blood loss > 1,000 ml, and cesarean hysterectomy.

We used a formula to test the difference between the two independent means of measuring blood loss as set out by Mitchell et al.[7] ; uterine cooling group 536 ml and control group 756 ml. The sample size of each group was 80 cases.

Statistical analyses were performed using STATA 13 software. Analyses of the effect of uterine cooling were based on an intention to treat basis. Continuous variables were analyzed using the Student t-test or Mann-Whitney U-test. Categorical variables were analyzed using the Chi-square test. The 95% confidence interval (CI) was calculated. A p value < 0.05 was required to confirm statistical significance.

Results

One hundred and sixty pregnant women were assessed for eligibility. A total of 160 patients were included; 80 were randomly assigned to the uterine cooling group and 80 to the control group. There were no patient withdrawals from the study. A total of 80 patients from each group were analyzed (Fig. 1).

Baseline characteristics were similar between the uterine cooling and control groups (Table 1, 2). Cephalopelvic disproportion was the most common indication for cesarean section.

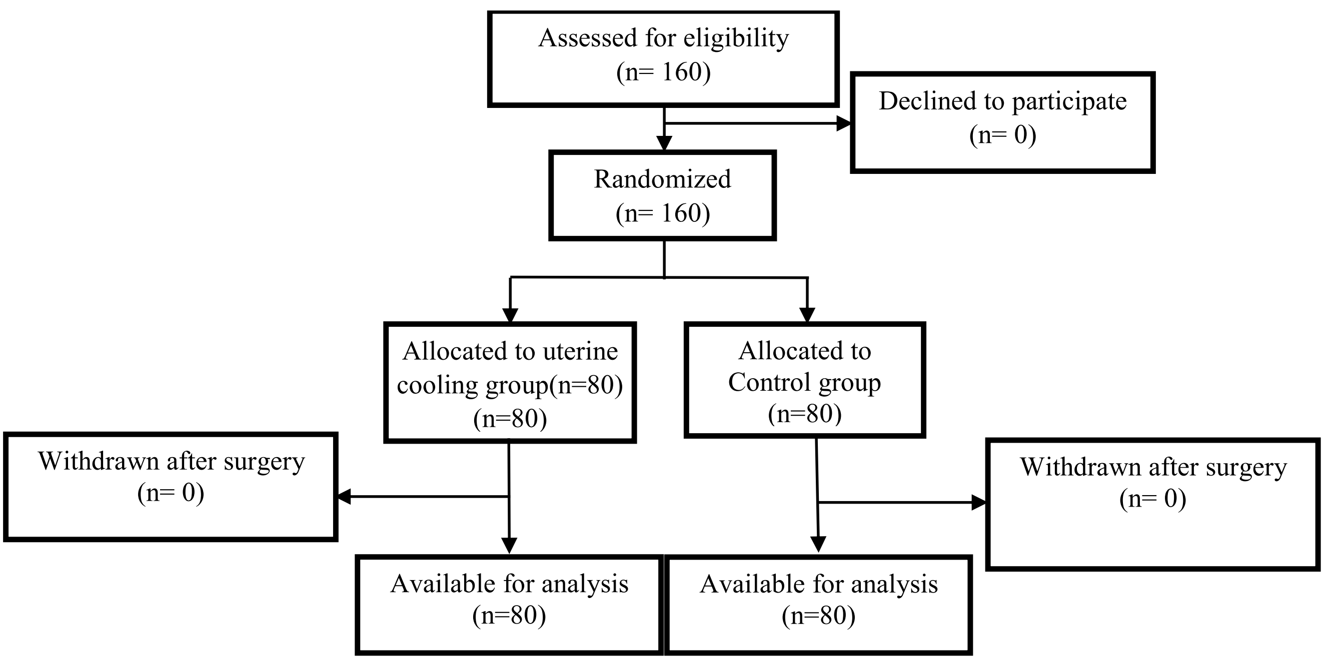

Fig. 1. Flow diagram.

Table 1. Demographic characteristics.

	Uterine cooling (n = 80) Mean ± SD or n (%)	Control (n = 80) Mean ± SD or n (%)	p value
Age (years)	28.5 ± 5.9	29.2 ± 6.1	0.45
BMI (kg/m^2)	29.1 ± 4.9	28.5 ± 4.3	0.43
Gravidity	1.9 ± 1.1	2 ± 0.9	0.57
Parity	0.7 ± 0.7	0.7 ± 0.6	0.90
History of postpartum hemorrhage	1 (1.3)	0	NA
Oxytocin used before cesarean section	5 (6.3)	4 (5.0)	0.73
Indication			0.83
Previous uterine scar	31 (38.8)	32 (40)	
Cephalopelvic disproportion	34 (42.6)	34 (42.5)	
Abnormal fetal presentation	5 (6.2)	7 (8.8)	
Non-reassuring fetal heart rate pattern	10 (12.5)	7 (8.8)	

SD: standard deviation.

Table 2. Surgical characteristics.

	Uterine cooling (n=80) Mean ± SD or n (%)	Control (n=80) Mean ± SD or n (%)	p value
Cesarean section			0.75
Emergency	46 (57.5)	28.5 ± 4.3	
Elective	34 (42.5)	2 ± 0.9	
Incision			0.61
Low midline	54 (67.5)	51 (63.8)	
Pfannenstiel	26 (32.5)	29 (36.2)	
Surgeon			0.61
Staff	25 (31.2)	28 (35.0)	
Residents	55 (68.7)	52 (65.0)	
Preoperative body temperature	37.0 ± 0.3	36.9 ± 0.3	0.34
Intraoperative body temperature	37.1 ± 0.2	37.0 ± 0.2	0.46
Postoperative body temperature	37.1 ± 0.3	37.1 ± 0.3	0.86

SD: standard deviation.

There was a statistically significant difference in intraoperative blood loss between the uterine cooling and routine cesarean section groups (252.8 ± 133.8 vs 472.9 ± 201.8 ml). The mean difference was 220 ml (95%CI 166.6-273.5). Uterotonic drugs use was significantly less in the uterine cooling group (1.3% vs 10%, p = 0.02). Length of hospital stay was significantly less in the uterine cooling group (3.0 ± 0.5 vs 3.2 ± 0.7 day, p = 0.01). The surgical time was slightly less in the uterine cooling group (35.8 ± 11.4 vs 40.8 ± 14.7 min, p = 0.02). There was no significant difference between groups in postpartum hemorrhage. There was no intraoperative hypothermia found (Table 3).

Table 3. Outcomes.

	Uterine cooling (n=80) Mean ± SD or n (%)	Control (n=80) Mean ± SD or n (%)	p value
Intraoperative measurement blood loss (ml)	252.8 ± 133.8	472.9 ± 201.8	< 0.001
Surgical time (min)	35.8 ± 11.4	40.8 ± 14.7	0.02
Length of hospital stay (days)	3.0 ± 0.5	3.2 ± 0.7	0.01
Use of uterotonic drug	1 (1.3)	8 (10)	0.02
Use of additional surgical intervention	0	1 (1.3)	0.15
Postpartum hemorrhage	1 (1.3)	4 (5)	0.17

SD: standard deviation.

Discussion

The current study demonstrated that uterine cooling could reduce intraoperative blood loss, use of additional uterotonic drugs, and length of hospital stay among pregnant women undergoing cesarean section. The mean difference in intraoperative blood loss in the uterine cooling group was 220 ml. This finding is higher than the 198 ml reported by Mitchell et al. in a similar study[7].

The in-room swab preparation technique used in our study seemed more convenient than the one used by Mitchell et al[7]. In the current study, the icy swabs were prepared using mixed icy sterile normal saline solution with sterile dry swabs in the operative room, while Mitchell et al. prepared the icy swabs using a sterile slush machine. The advantage of the technique used in this study was that the icy swabs would available for every operative room.

The results for the uterine cooling group in the current study differed from those of Mitchell et al[7]. We observed a significantly lower use of additional uterotonic drugs by the uterine cooling group (1.3% vs 10%, p = 0.02); possibly because of good uterine contraction. Length of hospital stay was also shorter (3.0 vs 3.2 days, p = 0.01) albeit not representing a significant clinical difference. The surgical time was shorter in the uterine cooling group (35.8 ± 11.4 vs 40.8 ± 14.7 min, p = 0.02); suggesting that cooling promoted uterine contraction, reducing bleeding and the need for repair procedures; making the operation faster.

There is inconclusive evidence regarding the most appropriate temperature for uterine cooling, thus further study is needed to determine this parameter.

The strengths of the current study were adequate sample size, measurement of blood loss, and use of locally available material. The limitation of our study was that we included only low risk pregnant women.

In summary, the current study demonstrated that uterine cooling effectively reduced intra-operative blood loss compared with routine cesarean section.

Conclusion

Ten percent lidocaine spray was an effective option for pain management during office-based EB.

Gynecologists should, therefore, consider using this spray in routine practice.

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Potential conflicts of interest

The authors declare no conflict of interest.

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