The Efficacy of Lower Uterine Segment Compression for Prevention of Early Postpartum Hemorrhage after Vaginal Delivery

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Objective: *To determine the efficacy and amount of blood loss of the maneuver utilizing lower uterine segment compression (LUSC) for the prevention of early postpartum hemorrhage.*

Material and Method: *The present study enrolled 686 mothers with singleton pregnancy, gestational ages between 28 and 42 weeks, at the Department of Obstetrics and Gynecology, Charoenkrung Pracharak Hospital, Bangkok between July 2009 and March 2010. All subjects had no past medical history and delivered by vaginal route. They were divided into two groups, the experimental group and the control group. Mothers in both experimental and control groups were treated with the same methods, oxytocin administration before and after delivery, clamping and cutting umbilical cords within three minutes after birth of the newborns, and placental delivery done by controlled cord traction together with uterine massage at the fundus through the abdominal wall immediately. In addition, in the experimental group, the subjects were assisted by LUSC for 10 minutes. The amount of blood loss was measured and recorded two hours after delivery of the placentas in both experimental and control groups.*

Results: *Among 686 cases, nine cases were excluded from the present study. They were composed of five cases in the control group, with retained placenta, and four cases in the experimental group because of retained placenta, retained placental fragments, severe perineum tear, and vaginal hematoma. Subjects in the experimental group who were additionally assisted by LUSC were found to have lesser incidence of PPH with statistical significance in comparison to those in the control group (2.9% vs. 6.8%; relative risk 0.43, 95% confidence interval 0.21-0.90, p = 0.02). The amount of blood loss reduced by 29.26 ml (289.70 $\pm$ 179.53 ml vs. 260.44 $\pm$ 116.30 ml), p = 0.012).*

Conclusion: *Lower uterine segment compression (LUSC) significantly reduced the rate of PPH and amount of blood loss after vaginal delivery. The efficacy of this technique was over the conventional method in labor room care. Besides, LUSC was easy and safe. Neither anesthesia nor extra-expense was needed. LUSC was considered the innovation for management of postpartum hemorrhage. The maneuver was able to reduce the risk of maternal morbidity and mortality after the delivery of newborns.*

Keywords: *Lower uterine segment compression, Postpartum hemorrhage, Active management of third stage of labor*

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Bleeding after childbirth or postpartum hemorrhage (PPH) is the common obstetric complication. World Health Organization (WHO) reported that approximately 14 million mothers worldwide have experienced PPH[1] and that the condition occurs immediately postpartum in nearly half of that population[2]. In developing countries, PPH is considered to be a major cause of maternal deaths in the postpartum period, accounting for 25% among patients in South America and the Caribbean, 25% in Asia and 33.9% in Africa[3].

PPH is defined as blood loss $\geq$ 500 ml after vaginal delivery or $\geq$ 1,000 ml after cesarean section[4]. Major etiologies of PPH include a failure of the uterus to contract (tone), accounting for 70%, tissue and vascular tearing (trauma), 20%, fetal or placental tissue retention (tissue), 10%, and coagulopathy (thrombin), 1%[5]. More than 70% of PPH are caused by uterine atony, which has multiple associated risks comprising a large-sized baby, induction of labor, magnesium sulfate administration in the mother, chorioamnionitis, and prior history of PPH[6]. The remaining causes include uterine rupture, retained placenta, and perineal

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tears. Two-thirds of patients with PPH occur in women with no demonstrable associated risks[7].

To prevent PPH, active management of third stage of labor (AMTSL) is recommended[8]. The management includes a combination of uterine massage immediately after placental delivery, uterotonic drug administrations, applying controlled cord traction, and early cord clamping. Oxytocin is the drug of choice that has been proven effective in reducing the incidence of PPH[9]. The injection of oxytocin immediately after delivery of the newborns can prevent PPH and reduce life-saving blood transfusion with a rate of 25% and 50%, respectively[6]. However, oxytocin injection requires skills and sterile technique for safe administration. Ergometrine, although more effective than oxytocin, increases the rate of manual placenta removal as well as adverse side effects such as nausea, vomiting and elevating blood pressure[10,11]. Hence, ergometrine is contraindicated in pregnant women with high blood pressure. Moreover, storage costs may be higher since it tends to lose the potency rapidly following light or room temperature exposure[12]. Misoprostrol may offer the bleeding control with a lower cost and ease of administration, but it appears to be less effective than oxytocin[13,14]. Controlled cord traction and early clamping, however, are considered the least beneficial because the management needs uterine contraction. In addition, delayed cord clamping for 2-4 minutes is able to increase the hemoglobin and hematocrit levels of the newborn[15]. Overall, AMTSL is able to decrease the rate of PPH and the duration of the third stage of labor[6,16-18]. However, the management requires skill attendances, availabilities of uterotonic drugs, including costs of supplies and long-term storage and quality of the health facilities. Hence, a new method of prevention and treatment of PPH may be needed.

A previous pilot study done by the authors showed the efficacy of the management by lower uterine segment compression (LUSC), a technique that has never been publicized as the treatment of PPH[19]. The result of the study showed reduction of the amount of blood loss by 105 ml (225 ± 401 ml vs. 120 ± 211 ml; $p = 0.026$) or 47% reduction when compared to conventional method in the treatment of PPH. How LUSC worked was explained as; after complete delivery of the placenta, the uterus initiates a process of contraction and thrombosis of maternal blood vessels that interface with the placental surface, like physiologic sutures or living ligatures[4]. The process of fibrin-platelet plug occluding placental bed vasculatures takes 8.5-15 minutes[20,21]. If the uterus fails to contract (atony), especially the placental bed at the lower segment of the uterus, the myometrium of which is thin and not very elastic, the process of homeostasis is disrupted, leading to massive hemorrhage with subsequent life-saving hysterectomy. In such cases, LUSC provides the benefit. The maneuver is able to facilitate fibrin-platelet plug, resulting in reduced blood loss that consequently decrease tissue hypoxia, the possible cause of uterine atony[22].

Therefore, the aim of the present research was to determine the benefit of the new technique in the prevention of PPH.

Material and Method

The present study included pregnant women with a gestational age between 28-42 weeks who delivered vaginally at the delivery room, Charoenkrung Pracharak Hospital, between July 2009 and March 2010. All women had a singleton pregnancy and no severe past medical histories such as cardiovascular disease, asthma, epilepsy, thyrotoxicosisn and thrombocytopenia. Complete blood count with a platelet level more than 150×10^9/L was checked in all cases. Also, cases with polyhydramnios or treated with magnesium sulfate were not included. Cases with complications comprising uterine inversion or rupture, hematoma or severe laceration of birth canal, retained placenta and bleeding diathesis such as disseminated intravascular coagulopathy (DIC) were excluded from the comparison of both groups. The present study was ceased and further appropriate management would be established when these women experienced blood loss exceeding 2,000 ml or unstable vital signs.

The subjects were divided into two groups by block randomization method. The randomized allocation was done in the second stage of labor. All subjects in both groups received conservative therapy by intravenous oxytocin 10 units in 1,000 ml solution in order to enhance uterine contraction. After birth of the newborn, the infusion rate of oxytocin was increased to 200 ml/hour. The umbilical cords were clamped and cut within three minutes after birth of the newborns and controlled cord traction was done afterwards. After delivery of the placentas, uterine massage at the uterine fundus through the abdomen was done for all subjects. In the experimental group, the authors added the maneuver of lower uterine segment compression (LUSC) for 10 minutes. If the uterine contraction was not as anticipated, the subjects in both groups were

treated with ergometrine 0.2 mg intravenously, plus oxytocin 10 units. If the mothers developed excess blood loss, they received Nalador or blood replacement. After the delivery of the placenta, episiotomy wound was repaired subsequently. The blood loss was observed until two hours after birth. The amount of blood loss was recorded. All soaking drapes and blood in a bucket were weighed, measuring as 1 g = 1 ml. The well-trained registered nurses were assigned to record the result in the Record Form.

All participants provided written consent after receiving a full explanation of the survey. The present study was approved by the Ethics Committee of the institution. All procedures were conducted in accordance with the ethical principles defined in the Declaration of Helsinki.

LUSC can be divided into two techniques, consisting of 1) using one hand (or both) to compress the lower uterine segment as hard as possible as long as the mother could tolerate it (Fig. 1) and 2) using one hand to compress the lower uterine segment and another hand compressing the uterine fundus, like bimanual uterine compression (Fig. 2). The first maneuver is appropriate for women whose abdominal walls are thick, such as obese women and primigravid pregnancies, whereas slimmer women and women with multiparity can gain the benefit of the second maneuver. In the present study, the first maneuver was used.

The sample size was calculated by the basis of 10% PPH rate[23]. To reduce these to 5%, 343 cases in each arm are required to achieve a power of 80% in detecting a statistically significant difference, at a 90% confidence level.

Data analysis was performed with statistical software. The variables were compared. Student's t test or Mann-Whitney U test was used for quantitative data and Chi-square or Fisher exact test was used for qualitative data. All statistical tests were 2-sided. A p-value < 0.05 was considered statistically significant.

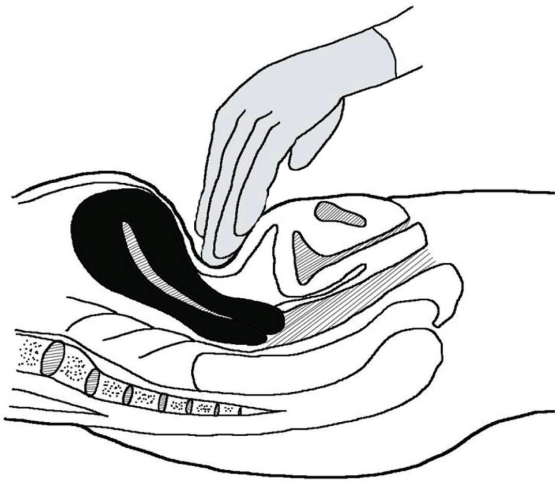

Fig. 1 Lower uterine segment compression method in treatment of acute postpartum hemorrhage by compressing at the lower uterine segment only

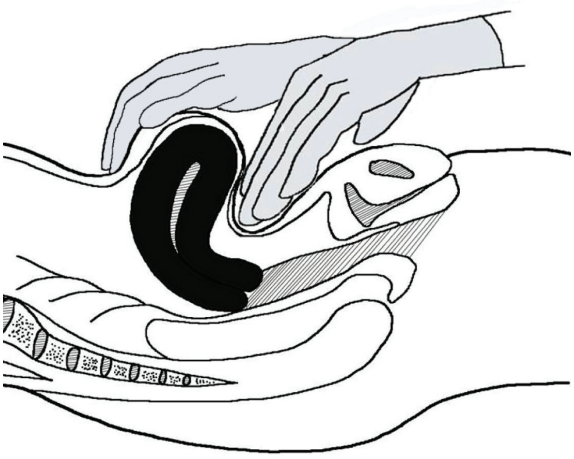

Fig. 2 Lower uterine segment compression method in treatment of acute postpartum hemorrhage by compressing at the lower uterine segment with counteracting pressure from fundus

Results

Chareonkrung Pracharak is a general hospital that has a capacity of 400 beds. There are approximately 5,000 births annually. There were 5% PPH in average. Six hundred eighty six cases of singleton pregnant women were enrolled in the present study. Nine subjects were excluded, consisting of five cases in the control group and four cases in the experimental group. All cases in the control group were detected with retained placenta whereas in the experimental group, each case was found to have retained placenta, retained placental fragments, deep perineum tear, and hematoma (Fig. 3).

For maternal baseline characteristics, no statistical differences were observed between the groups in terms of maternal age, gravidity, gestational age, body mass index (BMI), past history of PPH, the levels of hemoglobin and hematocrit, and platelet concentration (Table 1).

In antepartum or intrapartum period, no statistical differences were observed between the two

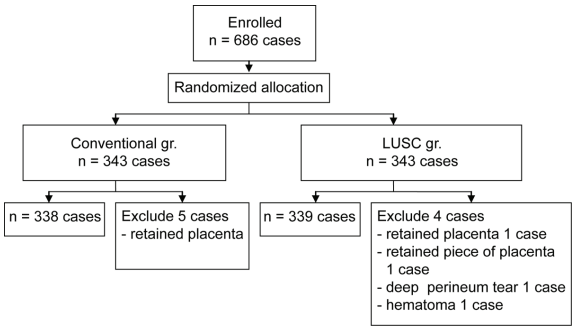

Fig. 3 Flow diagram of the study

groups about duration of oxytocin drip, duration of ruptured membrane, or body weight of the newborn (Table 2). During labor and postpartum period, the difference in the frequencies of oxytocin and Nalador usage were not statistically significant between the two groups. However, the experimental group was given ergometrine less frequently than those in the control group (n = 71; 20.9% and n = 91; 26.9%, respectively). Blood replacement was given in three cases, one case in the experimental group and two cases in the control group. The means of amount of blood loss in the third stage of labor were statistically different (p = 0.005), 187.94 ± 106.46 ml in the experimental group and 217.75 ± 160.37 ml in the control group. The means of amount of blood loss in the fourth stage of labor were not statistically different, 72.51 ± 45.80 ml in the experimental group and 71.95 ± 50.90 ml in the control group. Nevertheless, when considering the total amount of blood loss, the difference is statistically significant (p = 0.012). The total blood loss was less in the experimental group (260.44 ± 116.30ml) than that in the

Table 1. Baseline characteristics

Characteristics	Conventional (n = 338) mean ± SD	LUSC (n = 339) mean ± SD	p-value
Age (year)	25.37 ± 6.21	25.15 ± 5.74	0.629*
Gravidity	1.46 ± 0.64	1.48 ± 0.71	0.669*
Estimated gestational age (wk)	38.37 ± 1.85	38.49 ± 1.69	0.373*
Maternal weight (kg)	65.07 ± 10.83	63.85 ± 9.78	0.125*
Maternal height (cm)	157.80 ± 6.56	157.16 ± 6.29	0.360*
Body mass index (kg/m^2)	26.60 ± 4.08	26.19 ± 3.92	0.344*
Previous postpartum hemorrhage (No.)	1 (0.30%)	3 (0.9%)	0.624$^+$
Hemoglobin concentrate (gm/dl)	12.02 ± 1.20	12.10 ± 1.17	0.366*
Hematocrit concentrate (vol%)	37.30 ± 3.34	37.39 ± 3.35	0.726*
Platlet concentrate (x10^9/L)	242.51 ± 58.09	243.91 ± 56.95	0.751*

Values are mean ± standard deviation or number (percentage)
* Student t-test
$^+$ Fisher's exact test
LUSC = lower uterine segment compression

Table 2. Antepartum and intrapartum variables

Characteristics	Conventional (n = 338) mean ± SD	LUSC (n = 339) mean ± SD	p-value*
Time of oxytocin drip (min)	232.37 ± 171.75	225.63 ± 168.11	0.606
Time of ruptured membrane (min)	250.83 ± 221.00	238.00 ± 210.82	0.440
Time in stage (min)			
Stage 1	511.42 ± 274.60	524.57 ± 329.69	0.573
Stage 2	26.25 ± 23.42	28.07 ± 25.61	0.336
Stage 3	6.40 ± 4.08	6.42 ± 4.99	0.942
Birth weight (gram)	3,040.37 ± 433.67	3,057.83 ± 403.76	0.588

* Student's t test

control group (289.70 ± 179.53 ml) with a difference of 29.26 ml (Table 3).

The number of subjects who developed PPH in the third stage of labor between the two groups was significantly different (p = 0.006), four cases (1.2%) in the experimental group and 16 cases (4.7%) in the control group. However, when considering both the third and the fourth stages, the number of PPH increased by 6 in the experimental group and 7 in the control group. Therefore, after two hours postpartum, the total number of subjects with PPH in the control group (23 cases; 6.8%) became 1.4 times that of the experimental group (10 cases; 2.9%), which is statistically significant (p = 0.02).

Discussion

Maternal deaths due to PPH are commonly found during the first seven days after birth of the newborn[3]. The majority of these deaths, accounting for 88%, occur within 1-4 hours of delivery[24]. Thus, immediate management is necessary to prevent PPH. AMTSL has been proven to reduce the incidence of PPH. However, the management needs well-trained attendances and good facility of delivery suites. Therefore, in developing countries where resources and facilities are not readily available, the appropriate intervention of PPH may be delayed[12-14]. The report reveals a high number of maternal deaths of 500,000 per year, 35% of which were caused by PPH[25,26]. To achieve the Millennium Development Goals (MDG) within 2015 launched by WHO, vigorous management to decrease maternal mortality ratio (MMR) as 5.5% every year is attempted[27]. However, MMR decreases as low as less than 1% per year. In 1990, the average of MMR was 430/100,000 of live birth and in 2005, its average was 400/100,000 of live births[27].

Using uterotonic drugs and uterine massage through the abdomen have been proven to successfully reduce blood loss in the postpartum period[8]. A study done by Surbek et al[29] showed that giving misoprostol 600 mg orally, promptly after cord clamping could reduce the amount of blood loss (p = 0.031) but the rate of PPH was not statistically different (p = 0.43). However, the outcomes of the present study regarding amount of blood loss and incidence of PPH were somewhat similar to those managed by AMTSL. Over more, the management by oxygen inhalation in order to improve tissue hypoxia and enhance uterine contraction is able to decrease the rate of PPH (Table 4), but only a few studies have been established so far[22]. LUSC in this present study was able to reduce blood loss by 29.26 ml (289.70 ± 179.53 vs. 260.44 ± 116.30; p = 0.012) and prevent PPH with statistical significance (p = 0.02); from 23 cases (6.8%) to 10 cases (2.9%), accounting for 56.5% reduction. In the present research, the authors found the occurrence of new existing PPH observed 2 hours after birth in both groups (7 women in the control group and 6 women in the experimental group). Perhaps, the duration of management by LUSC may not be long enough. As an evidence to support this

Table 3. Labor and Delivery and post partum features

Characteristics	Control (n = 338)	Treatment (n = 339)	p-value
Oxytocin used (postpartum)			
Oxytocin 10 unit IV drip	325 (96.2)	333 (98.2)	0.102++
Oxytocin 20 unit IV drip	13 (3.8)	6 (1.7)	
Ergometrine used (No.)	91 (26.9)	71 (20.9)	0.068++
Nalador used (No.)	2 (0.6)	0 (0)	-
Blood transfusion (No.)	2 (0.6)	1 (0.3)	-
Estimate blood loss (ml)			
Stage 3	217.75 ± 160.37	187.94 ± 106.46	0.005*
Stage 4	71.95 ± 50.90	72.51 ± 45.80	0.882*
Total	289.70 ± 179.53	260.44 ± 116.30	0.012*
Number of postpartum hemorrhage			
Stage 3	16 (4.7)	4 (1.2)	0.006++
PPH until 2 hrs. postpartum	23 (6.8)	10 (2.9)	0.020++

Values are mean ± standard deviation or number (percentage)

* Student's t test

++ Chi-square test

Table 4. The results of various methods in the prevention of PPH

Method	Mean blood loss ± SD (ml)	% PPH	p-value	RR	95% CI
AMTSL[18]	268.48 ± 245.50	6.8	<0.0001	0.40	0.30-0.56
Uterine massage[28]	168.8 ± 90.5	5	-	0.52	0.16-1.67
Oral Misoprostol[29]	345 ± 19.5	7	0.43	-	-
Oxygen inhalation[22]	227.7 ± 5.8	-	<0.05	-	-
Lower uterine segment compression	260.44 ± 116.30	2.9	0.02	0.43	0.21-0.90

AMTSL = active management of third stage of labor

assumption, fibrin-platelet plug forms in 8.5 to 15 minutes[20,21]. LUSC may need 10 minutes or longer to be successfully performed. Thus, further studies are required.

Conclusion

Lower uterine segment compression (LUSC) has significantly reduced the rate of PPH and amount of blood loss after vaginal delivery. The efficacy of this technique was over the conventional method in labor room care. Besides, LUSC was easy and safe. Neither anesthesia nor extra-expense was needed. LUSC was considered to be the innovation for management of postpartum hemorrhage. The maneuver was able to reduce the risk of maternal morbidity and mortality after the delivery of the newborn.

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Potential conflicts of interest

None.

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ประสิทธิผลของการกดมดลูกส่วนล่างเพื่อป้องกันภาวะตกเลือดหลังคลอดระยะแรก

วันชัย จันทราพิทักษ์, กมล ศรีจันทึก, เรณู วัฒนเหลืองอรุณ

***วัตถุประสงค์**: เพื่อศึกษาประสิทธิผลของการกดมดลูกส่วนล่างในการป้องกันภาวะตกเลือดหลังคลอดระยะแรก*

***วัสดุและวิธีการ**: เป็นการศึกษาแบบทดลอง ณ กลุ่มงานสูติ-นรีเวชกรรม โรงพยาบาลเจริญกรุงประชารักษ์ สำนักการแพทย์ กรุงเทพมหานคร ระหว่าง กรกฎาคม พ.ศ. 2552 ถึง มีนาคม พ.ศ. 2553 ศึกษาในมารดาที่ตั้งครรภ์เดี่ยว อายุครรภ์ 28-42 สัปดาห์ ไม่มีโรคประจำตัว คลอดปกติทางช่องคลอดจำนวน 686 ราย แบ่งเป็น 2 กลุ่ม โดยการสุ่มเลือกเป็นกลุ่มควบคุม 343 ราย และกลุ่มทดลอง 343 ราย ทั้งกลุ่มควบคุม และกลุ่มทดลองได้รับการดูแลการคลอดแบบปกติ คือ ได้รับ oxytocin ก่อนคลอดและหลังคลอดหนีบ และตัดสายสะดือภายใน 3 นาทีหลังทารกคลอด ทำคลอดรกแบบ controlled cord traction พร้อมทั้งคลึงมดลูกทันทีหลังรกคลอด ส่วนกลุ่มทดลองเพิ่มการกดมดลูกส่วนล่างทางหน้าท้องนาน 10 นาที วัดและบันทึกปริมาณเลือดที่สูญเสียหลังคลอด 2 ชั่วโมง ทั้งสองกลุ่มตัวอย่างเพื่อศึกษาประเมินผล*

***ผลการศึกษา**: มารดาหลังคลอดปกติ 686 ราย ถูกคัดออกเหลือ 675 ราย โดยกลุ่มควบคุมถูกคัดออก 5 ราย จากสาเหตุรกค้าง ส่วนกลุ่มทดลองถูกคัดออก 4 ราย เนื่องจากรกค้าง 2 ราย ผีเย็บฉีกขาดเป็นบริเวณกว้าง 1 ราย และเกิดก้อนเลือดคั่งในช่องทางคลอด 1 ราย ในกลุ่มทดลองมีการตกเลือดหลังคลอดน้อยกว่ากลุ่มควบคุม ซึ่งได้รับการกดมดลูกส่วนล่างอย่างมีนัยสำคัญทางสถิติ (2.9% vs. 6.8%; relative risk 0.43, 95% confidence interval 0.21-0.90, p = 0.02) กลุ่มทดลองสามารถลดการเสียเลือดลงได้ 29.3 มิลลิลิตร (289.70 $\pm$ 179.53 มิลลิลิตร vs. 260.44 $\pm$ 116.30 มิลลิลิตร, p = 0.012)*

***สรุป**: การกดมดลูกส่วนล่างสามารถป้องกันการตกเลือดหลังคลอด และลดจำนวนเลือดที่สูญเสียหลังคลอดลงได้อย่างมีนัยสำคัญทางสถิติ เป็นวิธีที่กระทำได้ง่าย ปลอดภัย ไม่ต้องใช้ยาสลบ และไม่มีค่าใช้จ่าย นับเป็นนวัตกรรมด้านการป้องกันภาวะตกเลือดหลังคลอด สามารถลดความเสี่ยง ลดอันตรายที่อาจก่อให้เกิดภาวะทุพพลภาพ และการสูญเสียชีวิตลงได้*