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Efficacy of Lower Uterine Segment Compression in Women with 3rd Stage of Labor Blood Loss More Than 300 ml for the Prevention of Early Postpartum Hemorrhage: A Multi-Center Open-Labeled Randomized Controlled Trial

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ABSTRACT

OBJECTIVE: To compare the efficacy of 20-minute lower uterine segment compression (LUSC) and conventional treatment for postpartum hemorrhage (PPH) prevention in women with blood loss > 300 ml in the 3rd stage of labor.

METHODS: Patients were recruited from four hospitals under the Bangkok Metropolitan Administration. In total, 1082 postpartum patients who experienced the 3rd stage of labor bleeding exceeding 300 ml were enrolled in this study, and were randomly equally split into a control group, in which patients received conventional treatment for PPH prevention, and the LUSC group, in which patients received 20-minute LUSC and conventional PPH prevention measures. LUSC was administered by compressing the suprapubic area covering the lower uterine segment using four digits (index to little finger) of one hand until bleeding had ceased. The primary and secondary outcome of this study were to assess amount of blood loss in the 4th stage of labor and the rate of PPH of LUSC group compare to control group.

RESULTS: A total of 1,128 patients with the 3rd stage bleeding exceeding 300 ml were identified, 34 patients declined participation, and 12 patients were excluded due to twin pregnancies (6 cases), hydramnios (2 cases), and hysterectomy (4 cases). 541 patients in control group had mean age 28.70 ± 6.48 year while 541 patients in LUSC group had mean age 27.41 ± 6.22 year (p = 0.001). There were statistically significant differences in parity, the duration of rupture of the membrane, duration of the 2nd and 3rd stages of labor, birth attendant, and the degree of perineal tear between the two groups. The mean volumes of blood loss in the 4th stage of labor of the control group were 90 (50,150) ml versus 50 (40,70) ml in the LUSC group (p < 0.001). PPH occurred in 45.5% of the control group compared to only 26.1% in the LUSC group (p < 0.001).

CONCLUSION: 20-minute LUSC is effective for reducing blood loss and preventing PPH in patients who experience more than 300 ml blood loss in the 3rd stage of labor.

KEYWORDS: lower uterine segment compression, postpartum hemorrhage, PPH prevention

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INTRODUCTION

A systematic analysis of the global causes of maternal deaths reported that the worldwide maternal mortality rate during 2003-2009 was approximately 27.1% (uncertainty interval (UI): 19.9-36.2%), with more than two-thirds of maternal deaths attributed to postpartum hemorrhage (PPH)[1]. It was also reported that roughly 62-92% of intensive care unit (ICU) admissions related to pregnancy occur in the postpartum period, with hemorrhage being a leading cause within this group[2]. The overall incidence of PPH varies from 1-10% of all deliveries[3].

By definition, PPH is characterized by bleeding exceeding 500 ml following vaginal delivery and more than 1,000 ml following cesarean delivery, occurring within 24 hours postpartum[3]. Although a hemorrhage of 500 ml would not yet induce hemodynamic changes, reducing the incidence of PPH is considered crucial for improving maternal health, and would also contribute to the achievement United Nations Millennium Development Goal 5[4,5].

Various guidelines exist to help prevent PPH, such as the 2022 guidelines from the International Federation of Gynecology and Obstetrics that recommend the use of oxytocin for both vaginal delivery and cesarean section. Other choices include ergotamine, misoprostol, carbetocin, and controlled cord traction for placental removal, with the selection dependent on the specific conditions in each geographical area[6]. There are also several mechanical modalities to treat PPH, including arterial embolization, balloon tamponade[7-9], uterine compression sutures[10,11], and iliac artery ligation[12]; all of which are invasive methods.

As an alternative to the above invasive methods, lower uterine segment compression (LUSC) was proposed by Chantrapitak in 2009 as a non-invasive method. This involves applying pressure with one hand to the lower uterine segment on the anterior abdominal wall until bleeding ceases. It was reported that patients experienced no pain for 10 minutes after LUSC, and also that LUSC reduced blood loss by 47% in PPH patients[13]. Another study in 2011 by the same authors reported that a 10-minute application of LUSC could prevent early PPH in a low-risk group of patients for vaginal deliveries[14]. Similarly, Anansakunwat et al. reported in 2018 that a 20-minute application of LUSC could prevent early PPH in low-risk normal deliveries[15].

While LUSC has been proven to be effective in preventing PPH in low-risk vaginal deliveries, it still requires the attention of one personnel to perform the compression, and therefore it may not be suitable in places where staff availability is limited. The Royal Thai College of Obstetricians and Gynaecologists (RTCOG) recommends the use of a measuring bag to evaluate the amount of bleeding that make an assessment of the amount of blood loss more accurate and can aid assessing PPH risk. This study focused on patients with blood loss ≥ 300 ml in the 3rd stage of labor to investigate whether LUSC can prevent progression to PPH. A 20-minute duration for LUSC was chosen as it aligns with the normal clotting time range of 8.5 to 15 minutes, or up to 20 minutes in some cases[16,17].

The aim of the current research was to investigate the effectiveness of 20-minute LUSC in preventing PPH in women delivering vaginally who experience blood loss of at least 300 ml. The primary outcome of the current research was to assess amount of blood loss in the 4th stage of labor of LUSC group compare to control group. The secondary outcome of this study was the rate of PPH in both groups.

METHODS

The present study was approved by the Ethics Committee of the Bangkok Metropolitan Administration (S001h/60) and registered in the Thai Clinical Trials Registry (TCTR20180320006), with written informed consent forms signed by all subjects. This study was conducted across four hospitals under the Bangkok Metropolitan Administration, namely Charoenkrung Pracharak Hospital, Ratchapiphat Hospital, Sirindhorn Hospital,

and Taksin Hospital. The study recruited women who delivered between April 1, 2018, and December 10, 2021, and who experienced blood loss of at least 300 ml in the 3rd stage of labor. The inclusion criteria were: age 18-50 years old, vaginal delivery at gestational age 28-42 weeks, and a blood loss of at least 300 ml during the 3rd stage of labor (after delivery of the baby). The exclusion criteria were: cases of multifetal gestation, myoma uteri, or hydramnios (amniotic fluid index > 20 cm) within four weeks before delivery, administration of magnesium sulfate, abnormal bleeding (e.g., platelet count < 150,000/mm^3 or development of disseminated intravascular coagulation), serious medical condition, such as heart disease, uncontrolled diabetes mellitus, asthma, epilepsy, thyrotoxicosis, and lack of antenatal care.

Before the study started, nurse representatives at each hospital had been trained for LUSC and act as mentors to other nurses in their hospitals. Women who intended to undergo vaginal delivery at the four participating hospitals received project instructions and were provided with an informed consent form. Following delivery of the newborn and the removal of residual amniotic fluid, each woman had a measuring bag inserted to assess blood loss before placental delivery. Women with blood loss collected in the measuring bag of at least 300 ml, who had also signed informed consent, were then randomized into two groups. The nurse on duty in the delivery room classified those women into the control group and the study group by picking up a sealed envelope with that had been randomly assigned to the groups in a block design (block of four). The control group received conventional treatment for PPH prevention while the study group received 20 minutes of LUSC performed by one nurse on duty in the labor room in addition to other conventional PPH prevention measures at the time of perineal repair.

After complete the perineal repair and 20 minutes of LUSC ended, birth attendant measured blood in bag to represented the 3rd stage of labor blood loss. All women were required to wear sanitary pad to record blood loss in the 4th stage of labor. The 4th stage of labor blood loss was obtained by measuring blood in the pad at 2 hours after delivery by the nurse in delivery room. Lower abdominal pain and pain of uterine contraction was asked by the nurse in delivery room and using visual analogue scale at 2 hours after delivery.

Conventional PPH prevention consisted of a uterotonic agent (oxytocin 10-40 units in 1,000 ml intravenous solution plus 10 units oxytocin as an intramuscular injection), placental delivery by the controlled cord traction method, and uterine massage[4,18-20].

LUSC was administered by compressing the suprapubic area covering the lower uterine segment using four digits (index to little finger) of one hand until bleeding had ceased for 20 minutes as shown in Figure 1. In some pregnant women who had a relaxed abdominal wall, nurses added counteracting pressure at the fundus to LUSC to increase the intrauterine pressure as shown in Figure 2[13]. Blood loss collected in the measuring bag represented the blood loss in the 3rd stage of labor, while blood was also measured in the 4th stage of labor by quantifying the blood lost in the two hours following delivery. If the sum of blood loss in the 3rd and 4th stages of labor exceeded 500 ml, it was defined as PPH.

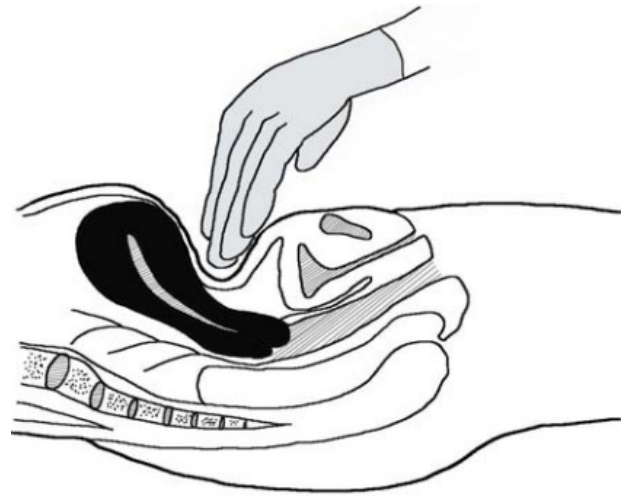

Figure 1 Lower Uterine Segment Compression (LUSC) method[13]

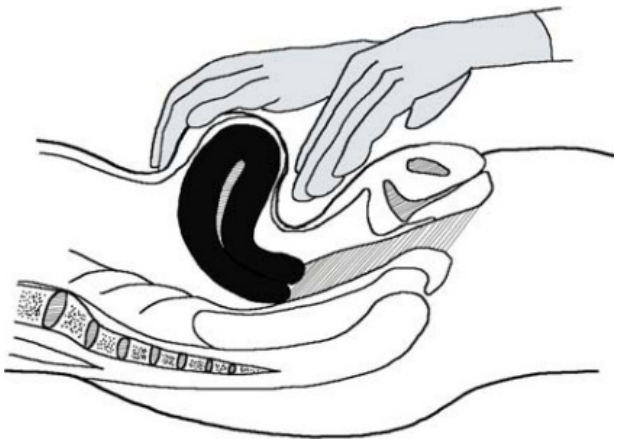

Figure 2 Lower Uterine Segment Compression (LUSC) method in women who had relaxed abdominal wall[13]

If PPH occurred in any patient in either group, they received treatment according to the guidelines of the hospital they delivered. PPH treatment consisted of intravenous crystalloid and/or blood component, empty bladder with urinary catheterization, uterine massage, oxytocin supplementation (if needed), and uterotonic agents, such as oxytocin, methylergometrine, and misoprostol. In some severe PPH cases, other methods could be applied, such as bimanual uterine compression, uterine packing or intrauterine balloon tamponade, laparotomy to apply a B-lynch compression suture, or hysterectomy[4,18,20].

The data were analyzed using parametric and nonparametric statistical methods in SPSS version 26 (IBM Corp., Armonk, NY, USA). Demographic data were presented as the mean ± SD. Continuous data were assessed for normal distribution using the Kolmogorov-Smirnov test before employing parametric statistics. Differences between continuous data were evaluated using the Student's t-test for normally distributed data and the Mann-Whitney U test for data that did not follow a normal distribution. Chi-square or Fisher's exact test was applied to compare categorical data. A p-value less than 0.05 was considered statistically significant.

The required sample size was calculated using the formula for a randomized controlled trial and referenced from the percentage of PPH cases at Chareonkrung Pracharak Hospital (9%), and estimated as a 50% reduction rate of PPH after using LUSC (4.5%). This study considered a = 0.05 as the statistical significance threshold, with b = 0.20 used for the power calculation. The total required sample number was determined to be 487 participants. Considering a possible 10% loss to follow-up, the final number sample size required per arm was thus 541 patients.

RESULTS

During the study period, a total of 1,128 patients with the 3rd stage bleeding exceeding 300 ml were identified. However, 34 patients declined participation, and 12 patients were excluded due to twin pregnancies (6 cases), hydramnios (2 cases), and hysterectomy (4 cases). The 4 cases of hysterectomy were excluded because of massive bleeding after delivery of baby (> 1,000 ml), 1 case from placenta accreta and 3 cases from uterine atony that unresponsive to medical treatment and uterine massage. All 4 cases could not record the amount of blood loss in the 4th stage of labor. Subsequently, 1,082 patients were enrolled in the study, and were split in to two groups, with 541 patients receiving conventional treatment for PPH prevention (control group) and 541 patients undergoing 20 minutes of LUSC in addition to other conventional PPH prevention measures (LUSC group) as shown in Figure 3.

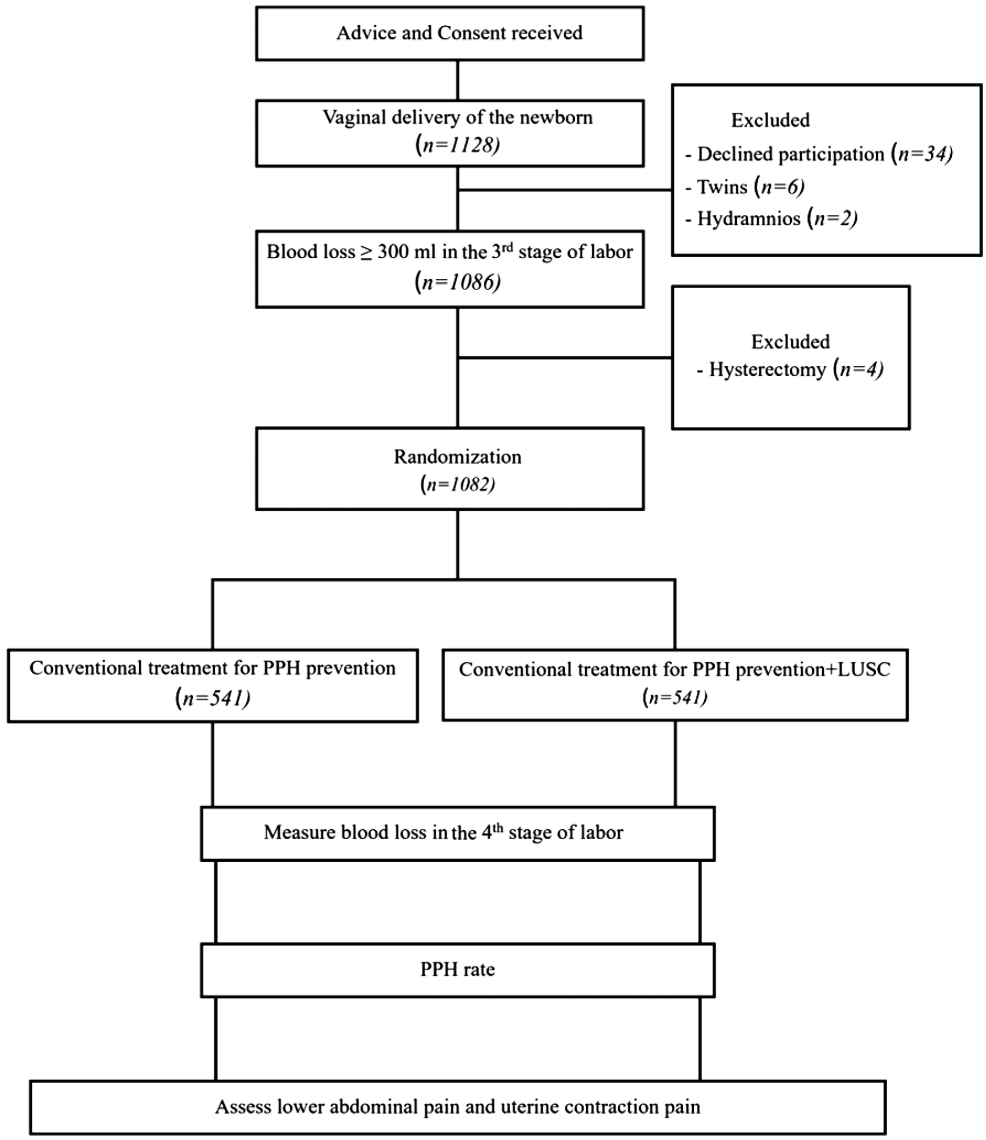

Figure 3 Consort flow diagram in this study

Table 1 presents the maternal demographic data for both the control group and the LUSC group. There were statistically significant differences in age and parity between the two groups. No significant differences were observed between the two groups in terms of gestational age, BMI, hematocrit level, platelet count, or history of PPH.

Table 2 presents data on the variable factors during the antepartum and intrapartum periods. No significant differences were observed in terms of the induction of labor, duration of oxytocin use, duration of the 1st stage of labor, neonatal birth weight, and episiotomy between the two groups. However, there were statistically significant differences in the duration of rupture of the membrane, duration of the 2nd and 3rd stages of labor, birth attendant, and the degree of perineal tear between the two groups.

Table 1 Maternal demographic data

Characteristics	Control group (n = 541)	LUSC group (n = 541)	P-value
Age (year); mean ± SD	28.70 ± 6.48	27.41 ± 6.22	0.001[t*]
Parity; n (%)			
0	255 (47.1)	314 (58.0)	0.006[c*]
1	198 (36.6)	166 (30.7)	
2	63 (11.6)	48 (8.9)	
3	22 (4.1)	9 (1.7)	
4	2 (0.4)	1 (0.2)	
5	1 (0.2)	2 (0.3)	
6	-	1 (0.2)	
Gestational age (week); mean ± SD	38.96 ± 1.34	38.89 ± 1.31	0.359[t]
Gestational age group; n (%)			
< 37 week	20 (3.7)	28 (5.2)	0.238[c]
≥ 37 week	521 (96.3)	513 (94.8)	
BMI (kg/m^2); mean ± SD	27.95 ± 4.59	27.70 ± 4.30	0.365[t]
BMI (kg/m^2); n(%)			
< 18.5	2 (0.4)	1 (0.2)	0.925[c]
18.5–22.9	69 (12.7)	66 (12.2)	
23–24.9	84 (15.5)	93 (17.2)	
25–29.9	233 (43.1)	229 (42.3)	
≥ 30	153 (28.3)	152 (28.1)	
Hematocrit; mean ± SD	36.21 ± 3.33	36.33 ± 3.13	0.539[t]
Platelet; mean ± SD	243,108.87 ± 78,469.80	241,213.49 ± 59,280.18	0.654[t]
Previous PPH; n(%)			
Yes	17 (3.1)	13 (2.4)	0.459[c]
No	524 (96.9)	528 (97.6)	

Abbreviations: BMI, body mass index; kg/m^2, kilogram per square meter; LUSC, lower uterine segment compression; n, number; PPH, postpartum hemorrhage; SD, standard deviation
Data are presented as number (%).
P-value corresponds to [t] Independent t-test, [c] Pearson chi-square
* Significant at p-value < 0.05

Table 2 Data on the variables in the antepartum and intrapartum periods

Characteristics	Control group (n = 541)	LUSC group (n = 541)	P-value	P-value Adjusted
Induction of labor; n (%)	389 (71.9)	385 (71.2)	0.788[c]	0.466
Duration membrane rupture (minute); mean ± SD	207.86 ± 205.39	257.15 ± 251.67	< 0.001[t*]	0.003*
Duration oxytocin use (minute); mean ± SD	168.18 ± 178.11	181.11 ± 195.05	0.255[t]	0.893
Duration the 1st stage of labor (minute); mean ± SD	477.92 ± 326.37	490.33 ± 343.85	0.543[t]	0.850
Duration the 2nd stage of labor (minute); mean ± SD	24.58 ± 23.47	28.17 ± 28.48	0.024[t*]	0.402
Duration the 3rd stage of labor (minute); mean ± SD	8.54 ± 10.72	7.07 ± 7.70	0.010 [t*]	0.041*
Birth attendant; n(%)				
Nurse	361 (66.7)	376 (69.5)	0.013[c*]	0.031*
Nurse student	47 (8.7)	55 (10.2)		
Medical student	43 (7.9)	30 (5.6)		
Resident	22 (4.1)	37 (6.8)		
Staff	68 (12.6)	43 (7.9)		

Table 2 Data on the variables in the antepartum and intrapartum periods (continued)

Characteristics	Control group (n = 541)	LUSC group (n = 541)	P-value	P-value Adjusted
Neonatal birth weight (g); mean ± SD	3,230.96 ± 402.67	3,209.75 ± 374.39	0.370[t]	0.497
Episiotomy[#]; n (%)				
No	53 (9.8)	42 (7.8)	0.287[c]	0.615
Median	76 (14.0)	66 (12.2)		
Mediolateral	414 (76.2)	432 (80.0)		
Degree of perineal tear[##]; n (%)				
No	452 (83.5)	431 (79.7)	0.014[c*]	0.011*
The 1st degree	23 (4.3)	17 (3.1)		
The 2nd degree	45 (8.3)	46 (8.5)		
The 3rd degree	18 (3.3)	34 (6.3)		
The 4th degree	3 (0.6)	13 (2.4)		
Mean volume of blood loss in the 3rd stage of labor; mean ± SD	469.74 ± 234.79	428.06 ± 180.25	0.001[t*]	0.002*

Abbreviations: g, gram; LUSC, lower uterine segment compression; n, number; SD, standard deviation
Data are presented as number (%).
P-value corresponds to [t] Independent t-test, [c] Pearson chi-square
* Significant at p-value < 0.05
[#] episiotomy = a surgical enlargement of the vaginal orifice by an incision to the perineum during the last part of the 2nd stage of labor to facilitate passage of the fetal head[21,22];
[##] perineal tear = damage of female genitalia during labor after spontaneous tear or episiotomy, classified as the 1st to the 4th degree depending on the severity of the tear[22,23].
P-value adjusted; P-value from adjusted by duration membrane rupture, duration the 2nd stage of labor, duration the 3rd stage of labor, birth attendant, degree of perineal tear and mean volume of blood loss in the 3rd stage of labor used multivariable logistic regression.

Table 3 presents the results related to bleeding after management in the 4th stage of labor was 90(50,150) ml in the control group and 50(40,70) ml in the LUSC group (p < 0.001). PPH occurred in 45.5% of cases in the control group, but only in 26.1% of cases in the LUSC group (p < 0.001). Lower abdominal pain and pain of uterine contraction of both groups were assessed by using the visual analogue score on a scale of 0-10, showed a significant difference between the groups (p = 0.006).

Table 3 Results after treatment

Variables	Control group (n = 541)	LUSC group (n = 541)	P-value
Mean volume of blood loss in the 4th stage of labor; median (Q1, Q3)	90 (50, 150)	50 (40, 70)	< 0.001[U*]
Mean volume of blood loss in the 3rd+4th stages of labor; mean ± SD	614.89 ± 341.34	482.54 ± 184.31	< 0.001[t*]
Postpartum hemorrhage; n (%)			
≥ 500	246 (45.5)	141 (26.1)	< 0.001[c*]
< 500	295 (54.5)	400 (73.9)	
Pain score; mean ± SD	3.83 ± 2.4	3.46 ± 1.96	0.006[t*]

Abbreviation: LUSC, lower uterine segment compression; n, number; SD, standard deviation
Data are presented as number (%).
P-value corresponds to [U] Mann–Whitney U test, [t] Independent t-test, [c] Pearson chi-square
* Significant at p-value < 0.05

DISCUSSION

The present study demonstrated that a 20-min application of LUSC could significantly reduce blood loss in the group experiencing post-delivery bleeding of more than 300 ml, which is at risk for PPH. In the non-LUSC group, the results indicated a blood loss in the 4th stage of labor more than blood loss in the LUSC group ($p < 0.001$). Furthermore, the rate of PPH in the LUSC group was significantly lower than in the non-LUSC group ($p < 0.001$).

All of variable in antepartum and intrapartum period that had statistically significant differences composed of the duration of rupture of the membrane, duration of the 2nd and 3rd stages of labor, birth attendant, and the degree of perineal tear between the two groups might be the confounding factors. When adjusted for confounding factors, the results were still the same. About the factor of birth attendant, in control group had more medical student than in LUSC group, it might be another reason for the higher blood loss due to lack of experience. The pain score of lower abdomen and uterine contraction in control group was higher than LUSC group, it shown that LUSC does not cause more pain than other conventional methods.

The comparison of all previous study was summarized in Table 4. In 2009, Chantrapitak et al. reported that in cases of PPH, a 10-minute application of LUSC could reduce blood loss by 105 ml compared to conventional treatment for PPH, representing a 47% reduction in blood loss[13]. Subsequently, in 2011, Chantrapitak et al. utilized a 10-minute LUSC intervention to prevent PPH. The blood loss in the LUSC group in their later study was 260.44 ml, whereas the non-LUSC group experienced a blood loss of 289.70 ml. Their findings demonstrated that LUSC reduced blood loss by 29.26 ml (10.1% reduction) and decreased the incidence of PPH from 6.8% to 2.9% in low-risk deliveries ($p = 0.02$)[14].

Consistent with these findings, Anansakunwat et al. reported in 2018 that a 20-minute application of LUSC could prevent PPH in low-risk deliveries, with a PPH rate of 2.0% in the LUSC group compared to 10.5% in the non-LUSC group ($p = 0.002$). Furthermore, the blood loss in the LUSC and non-LUSC groups was 263.2 ml and 304.3 ml, respectively, indicating a 13.5% reduction in blood loss in the LUSC group ($p = 0.046$)[15].

Table 4 Comparison of the results from the present study with those of previous studies

Source	Year	Treatment / Prevention	Number of patients (LUSC : non LUSC)	Results / Outcomes
Chantrapitak, et al.[13]	2009	Treatment by 10-minute LUSC	32 : 32	LUSC reduced blood loss by 47%
Chantrapitak, et al.[14]	2011	Prevention in low-risk delivery by 10-minute LUSC	339 : 338	LUSC reduced blood loss by 10% and PPH incidence from 6.8% to 2.9%
Anansakunwat, et al.[15]	2018	Prevention in low-risk delivery by 20- minute LUSC	153 : 152	LUSC reduced blood loss by 13.5% and PPH incidence from 10.5% to 2.0%
Chantrapitak, et al.[24]	2018	20 years retrospective		10 years earlier (1994–2003) PPH rate of LUSC doctor = 2.0% PPH rate of non-LUSC doctors = 3.9% PPH rate of non-LUSC nurses = 4.6% 10 years earlier (1994–2003) : 10 years later (2004–2013) PPH rate of non-LUSC nurses = 4.6% PPH rate of LUSC nurses = 2.2%
Present study		Prevention in high-risk delivery by 20- minute LUSC	541 : 541	LUSC reduced blood loss by 63.1% and PPH incidence from 45.5% to 26.1%

Abbreviations: LUSC, lower uterine segment compression; PPH, postpartum hemorrhage

In another study in 2018, Chantrapitak et al. reported on their 20 years of experience in this area. They compared the first 10 years' experience at their hospital, during which only one doctor used LUSC (42,450 deliveries) and the PPH rate was 2.03 ± 0.72%, and the rate with other doctors who did not use LUSC, with an average PPH rate of 3.90 ± 1.60% (p = 0.005). During that time, the PPH rate for cases delivered by nurses who did not use LUSC was 4.65 ± 0.60% (p < 0.001). Additionally, they compared the rates of PPH over two 10-year periods, from 1994 to 2003 and from 2004 to 2013. For the former period, the PPH rate for cases delivered by nurses who did not use LUSC was 4.65 ± 0.60%, whereas in the latter period, after the integration of LUSC into the delivery process, the PPH rate was reduced to 2.16 ± 0.74% (p < 0.001)[24].

In this study PPH rate was higher than PPH rate in general population because of this study selected the case of blood loss more than 300 ml in the 3rd stage of labor which was a group with the risk to turn to PPH (closer 500 ml than in the general population).

The strength of our study compose of LUSC do not need any special instrument, cost-effective and can be employed in any geographical area. This method can adapt to diverse healthcare settings and resource constraints. This multicenter study demonstrates that a variety of healthcare providers can performed this procedure. There was study limitation that this study was not control the use of uterotonic drugs that use in conventional treatment to prevent PPH, such as oxytocin, ergotamine, this may result in unequal amount of blood loss.

CONCLUSION

The findings of this study indicate that a 20-minute application of LUSC is effective for reducing blood loss and preventing PPH in high-risk patients who experience bleeding of more than 300 ml in the 3rd stage of labor. Notably, this method can be implemented in any delivery setting without incurring additional costs or requiring extra instruments. Given these advantages, LUSC has emerged as a viable and accessible option for preventing PPH in diverse healthcare settings. Its simplicity and efficacy make it a compelling choice for inclusion in PPH prevention strategies across various regions.

CONFLICT OF INTEREST

The authors confirm they have no conflicts of interest to declare.

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DATA AVAILABILITY STATEMENT

All data generated or analyzed during this study are included in this article. Further enquiries can be directed to the corresponding author.

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