Original Article

Postpartum Hemorrhage Outcome in Lower Uterine Segment Compression Maneuver: A 20-Year Experience in Charoenkrung Pracharak Hospital

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Objective: Primary objectives were: 1) To compare the incidence of postpartum hemorrhage [PPH] between the patients who received lower uterine segment compression [LUSC] in conjunction to their standard delivery care and those who received only standard delivery care and 2) to compare the incidence of PPH after the labor room staff were trained to perform LUSC in addition to standard delivery care. Secondary objective was to compare blood loss, disseminated intravascular coagulopathy [DIC], and hysterectomy between patient in LUSC and non-LUSC groups.

Materials and Methods: The retrospective study was conducted in Charoenkrung Pracharak Hospital. The data had been collected between 1994 and 2013 where normal labors from any gestational ages were considered eligible for the study. The study consisted of two phases; from 1994 to 2003, and 2004 to 2013. Data collected consisted of the incidences of PPH, the volume of blood loss, and complications arisen from PPH such as DIC and the need to perform hysterectomy. The subjects were divided into two groups: one receiving only standard delivery procedure, and another receiving LUSC.

Results: During 20 years of the study, there were 77,081 cases of normal labor, 2,740 of which had PPH. The study was divided into two phases. Phase 1 (1994 to 2003), the incidence of PPH in patients who received LUSC was significantly lower than the patients who delivered with only standard delivery care (2.03±0.72 versus 4.46±0.66, $p<0.001$). Phase 2 (2004 to 2013), the labor room staff were trained to perform LUSC. The incidence of PPH in the first 10 years (1994 to 2003) when nurses performed standard delivery procedure was significantly higher than 10 years later (2004 to 2013) when nurses had integrated LUSC into their delivery care (4.65±0.60 versus 2.16±0.74, $p<0.001$). No maternal death occurred throughout the study. There were 12 cases that needed hysterectomy as a complication from PPH, all of which were from non-LUSC group.

Conclusion: From 20 years of experience using LUSC, it is observed that the incidence of PPH has both noticeably and statistically decreased as compared to patients who received only standard care. As such, the effectiveness and safety of LUSC was thoroughly demonstrated.

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

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Postpartum hemorrhage [PPH] is defined as the condition where blood loss after delivery exceeds 500 ml in normal labor or 1,000 ml in caesarian section[1-3]. PPH is one of the three major causes of maternal mortality, totaling up to 289,000 deaths worldwide[4,5], the majority of which is attributed to uterine atony[6]. PPH has little association with risk factors[7] such as fetal macrosomia, induction of labor, chorioamnionitis, and previous history of hemorrhage. Hence, every pregnant woman is at risk of developing PPH[8,9].

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World Health Organization [WHO] has set a goal through Millennium Development Goals-5 [MDG5] aiming to reduce maternal mortality ratio [MMR] by 75% before 2015. According to the 1990 database, the goal fell short and MMR only declined by 43%[10,11]. In 2015, the average MMR worldwide is at 216 per 100,000 live births[11]. However, in less developed areas, such as some African countries, there is still a very high MMR at 1,000 per 100,000 live births[11]. Subsequently, in succession to the MDG5, WHO has set a new goal through Sustainable Development Goal [SDG] aiming to reduce worldwide average MMR to 70 per 100,000 live births and each country not exceeding 140 per 100,000 live births by 2030. This is equivalent

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to decreasing MMR by 7.5% annually[12] compared to 5.5% set by the MDG5 and only 3.1% achieved by the scheme. Therefore, it is a challenging task but the capability to reach the goal is greatly improved by the new technology and modern innovations.

There are several methods to prevent PPH that are currently in clinical use such as the Active Management of Third Stage of Labor [AMTSL], which consists of the use of uterotonics in conjunction with control cord traction [CCT], and cord clamping within three minutes of delivery[2,3]. Literature reviews revealed that the effectiveness of AMTSL in preventing PPH is solely attributed to uterotonics[2,13]. Any other non-drug intervention such as uterine massage, CCT, or timing of cord clamping has little contribution to PPH prevention[13]. As of now, nothing new is being used to help prevent PPH effectively, not even non-drug intervention. Nevertheless, a study conducted by Chantrapitak et al[14,15] that utilized innovative maneuver called "Lower Uterine Segment Compression" for prevention and treatment of PPH had shown a good result, being able to prevent PPH in 56.5% of the cases. Moreover, lower uterine segment compression [LUSC] is a simple maneuver, possible to perform at any time and places, and does not require any equipment. In addition, there is neither cost nor special skills required. The present study would henceforth look into the result of the 20 years of LUSC after it was introduced into the hospital and assess its effectiveness in reducing PPH.

Materials and Methods

Charoenkrung Pracharak Hospital, the Medical Service Department of Bangkok Metropolitan Administration holds up to 400 beds. In the past, the average rate of PPH was at approximately 4% to 5%, but now Charoenkrung Pracharak Hospital boasted the lowest rate at 1% to 2%.

A 20-year retrospective study collected the data between 1994 and 2013 from the medical record archive of Charoenkrung Pracharuk Hospital. The data in scrutiny were all in good condition both as hard copies and digital files. Only normal labor cases were eligible in the study. The data collected included incidences of PPH, volume of blood loss, complications such as disseminated intravascular coagulopathy [DIC] and emergency hysterectomy, and the care givers. During the first 10 years of the study, the author was the sole user of LUSC maneuver. In the latter 10 years, labor room nurses were trained and were capable of performing LUSC in conjunction to standard delivery.

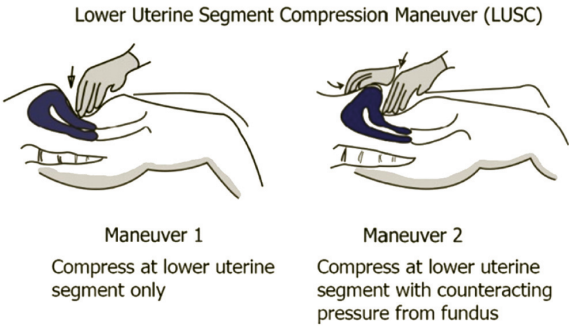

Figure 1. How to perform lower uterine segment compression.

The technique (Figure 1) of applying compression is essential. The main principles are:

1. The compression should be precisely on lower uterine segment, as soon as large amount of blood is observed. In some cases, the uterus can be very flexible and sits way above pubic symphysis, so another hand has to be used to push the uterus down, preventing it from shifting away. The pressing hand then has to palpate the underside of the body of uterus. Some patients may possess wide abdomens, making the uterus to possibly be shifted either to the right or to the left. In those cases, two hands are then again used, one positioning the uterus in the medial plane and another compressing it.

2. Apply as much force as possible but the patient should not be showing any sign of pain. The pressure applied to the uterus should be similar to that applied to stop bleeding in other parts of the body.

3. Keep the compression consistent. This is to allow enough time for the blood at the end of the blood vessel to clot. Hence, it is important to maintain a strong and consistent compression. The result should be observed after 10 minutes of compression (as minimum). If the bleeding has not stopped, the compression should be continued. The time used to check if the bleeding has stopped should be as short as possible.

4. Be swift. When large amount of blood is observed postpartum, immediate compression will result in decreased blood loss. The sooner, the better.

5. If the uterus still feels soft during the compression, the non-compressing hand should massage the fundus simultaneously. This will allow quick identification of the location of the uterus and its lower segment if uterus contracts.

6. Stretchy abdomen might require the non-

compressing hand to help push the fundus towards the lower segment. Whereas, tight or thick abdomen can use one hand for the compression.

Data analysis were performed with statistical software, Student's t-test was used for quantitative data, a *p*-value smaller than 0.05 was considered statistically significant.

Results

During the first 10 years of study (1994 to 2003), there were 42,450 cases of normal labor, 40,295 (94.92%) of which were done with standard procedure and 2,155 (5.07%) were done with LUSC. The study was divided into two categories:

1. The incidence of PPH in patients who received LUSC from a doctor was significantly lower than the patients who went through standard delivery procedure performed by other doctors (2.03±0.72 versus 3.90±1.60, $p = 0.005$), as shown in Figure 2.

2. The incidence of PPH in patients who received LUSC from a doctor was significantly lower than the patients who went through standard delivery procedure performed by nurses (2.03±0.72 versus 4.65±0.60, $p<0.001$), as shown in Figure 3.

In the latter 10 years (2004 to 2013), there were 34,631 cases of normal labor, 30,169 (87.16%) of which were done by labor room nurses who received LUSC training.

The incidence of PPH in the first 10 years (1994 to 2003) when nurses only perform standard delivery procedure was significantly higher than 10 years later (2004 to 2013) when nurses had integrated LUSC into their delivery care (4.65±0.60 versus 2.16±0.74, $p<0.001$), as shown in Figure 4.

Figure 5 compared the rate of PPH incidence between LUSC group and non-LUSC group. The rate of PPH was significantly lower than the non-LUSC group.

Figure 6 compare PPH between First Era (1994 to 2003) and Second Era (2004 to 2013) PPH rate was lower in late 10 years (2004 to 2013) than the early 10 years (1994 to 2003).

There were five cases of hysterectomy as the complication of PPH from uterine atony during the first 10 years, and seven during the latter, totaling 12 cases in 20 years. All the hysterectomy cases were from non-LUSC group. The average volume of blood loss did not have statistically significant differences among groups (LUSC 698.80±141 ml, non-LUSC doctors 699.50±53 ml, and nurse non-LUSC 555.20±166 ml), as shown in Table 1.

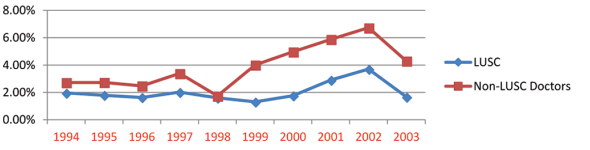

Figure 2. Compare PPH among LUSC, non-LUSC doctors (10 year, 1994 to 2003).

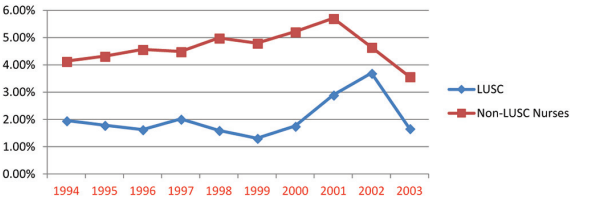

Figure 3. Compare PPH among LUSC, non-LUSC nurses (10 year, 1994 to 2003).

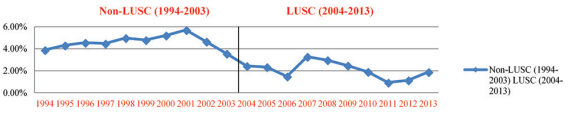

Figure 4. Compare PPH between 1st Era (1994 to 2003) and 2nd Era (2004 to 2013) by nurses.

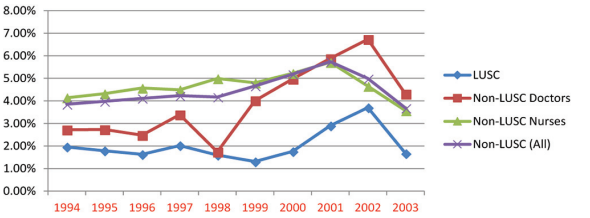

Figure 5. Compare PPH among LUSC, non-LUSC doctors, non-LUSC nurses (10 year, 1994 to 2003).

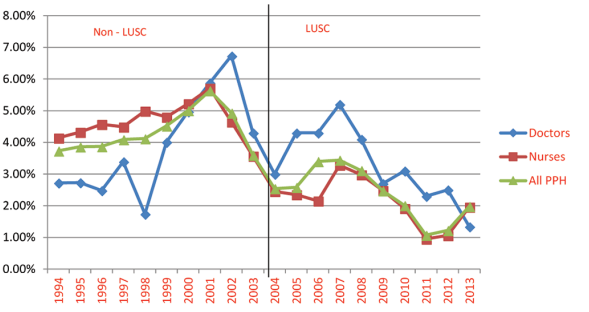

Figure 6. Compare PPH between 1st Era (1994 to 2003) and 2nd Era (2004 to 2013).

Discussion

The Obstetric-Gynecology Department of Charoenkrung Pracharak Hospital, has been developing

Table 1. Blood loss and complication (10 year, 1994 to 2003)

	LUSC doctor	Non-LUSC doctor	Non-LUSC nurse	p-value
Blood loss (ml)	698.8±141.7	699.5±5.31	-	0.996
	698.8±141.7	-	555.2±166.0	0.052
DIC	0	0		
Hysterectomy	0	5		

DIC = disseminated intravascular coagulopathy

innovative methods to prevent and treat PPH for more than 20 years. The author as an obstetric-gynecologist since 1988 realized the effectiveness of LUSC maneuver[14-16] after trials and practices and thus passed on the knowledge and know-how to the labor room nurses. The incidence of PPH was then noticeably lower after the practice of LUSC had been integrated into the routine procedure.

From the aforementioned studies, in terms of treatment property against PPH, LUSC was found to decrease the volume of blood loss by 105 ml or 47% (225±401 ml versus 120±211 ml, $p = 0.026$)[14]. In terms of preventive property against PPH, LUSC was found to reduce the rate of PPH by 56.5% (2.9% versus 6.8%, RR 0.43, 95% confidence interval 0.21 to 0.90, $p = 0.02$), and volume of blood loss reduction by 29.26 ml (289.70±179.53 ml versus 260.44±116.30 ml, $p = 0.012$)[15].

The procedure of LUSC is similar to that of bimanual uterine compression, which is used to treat PPH. However, literature reviews revealed almost no data or reports on the said surgical procedure[17]. Both bimanual uterine compression and LUSC reduce bleeding via compression of lower uterine segment until clotting mechanism is activated. The difference lies in that bimanual uterine compression requires both hands for compression, one in the vaginal canal and the other compressing through the abdomen, and a need for anesthesia. Whereas LUSC only requires one or two hands compressing through the abdomen. This means LUSC would be more easily performed and it can be done as both treatment and prevention for PPH.

The 20 years duration is considerably long, yet LUSC has shown consistent efficacy throughout. During the first 10 years, the author had been the sole user of LUSC maneuver. The comparison between LUSC and non-LUSC cases, both done by nurses and doctors alike, showed that PPH incidences significantly differed (2.03±0.72 versus 4.46±0.66, $p<0.001$). Furthermore, during the latter 10 years, after the nurses were trained to perform LUSC, the incidences of PPH also decreased significantly (4.65±0.60 versus 2.16±0.74, $p<0.001$). In 2008, the standard protocol was changed and AMTSL was introduced. The scheme emphasized that oxytocin was to be given to every patient, but cord clamping and CCT were still not mentioned. Later in 2011, LUSC was implemented and the maneuver was to be deployed if blood loss reached or exceeded 300 ml. As a result, the incidence of PPH was further reduced to approximately 1%.

During the study, the labor rooms of Charoenkrung Pracharak Hospital employed the use of uterotonics such as oxytocin, ergometrine, and prostaglandins. When oxytocin was indicated, the main intention of use was to augment labor to prevent and alleviate PPH. Every patient was treated equally in accordance to the protocol and with intention-to-treat basis. There was also a limitation in the study design. During the study, the volume of blood loss was estimated visually, so the perceived blood loss may be more or less than actual volume. From literature reviews, it was found that volume of blood loss is often underestimated by up to 50%[18-20], which implied that the comparison of blood loss among groups would be ambiguous.

From the present study, it was found that LUSC for 10 minutes can reduce the incidence of PPH by 56.50%[15]. Practically, patients with abnormally profuse bleeding, noticed to be associated with low implanted placenta inclined towards lower segment of uterus where contraction can be inadequate[21,22], were performed LUSC. This can also partially explain why PPH was not much related to various risk factors. Ten minutes of LUSC proved to be effective in preventing PPH, but to alleviate the symptoms of PPH, adequate LUSC may take 10 to 30 minutes. The limitation of this method surfaced when labor room was fully occupied, and the queue was packed, hence the application of LUSC might be suboptimal in some cases, explaining the still existing PPH cases. From further study, longer LUSC lead to decrease in incidence of PPH, and earlier compression showed better results, which had a supporting rationale behind it. When uterus experiences hypoxia, uterine muscles will relax with high intensity and velocity[23]. In addition, it was found that oxygen supplement after childbirth can decrease PPH[23,24]. As a result, if the bleeding was allowed to continue, uterus would be hypoperfused, leading to hypoxia, which led to uterine atony and ultimately PPH. Thus, uterine atony itself can be either the cause or the effect of PPH. Any method that ceases bleeding before excessive/massive blood loss can help prevent PPH. This vicious cycle of bleeding shows that uterine atony causes PPH and vice versa. If this process keeps

on going, serious sequelae will occur. This includes profound shock, DIC, need for hysterectomy, or in worst case maternal death. All in all, if uterine atony occurred, it would already be too late, so we can aim to stop at the upstream event, preventing uterine hypoxia, which is achievable by LUSC.

The role of LUSC is to block excessive bleeding at the earliest process. LUSC for 10 to 20 minutes would allow the coagulation mechanism enough time to cease bleeding.

The limitation of LUSC lies in the long duration of compression, rendering this maneuver not suitable for patients in critical condition. In addition, it may not work in patients with coagulopathy. Nevertheless, there is no know downside of the maneuver.

Conclusion

From the author 20-year experience using LUSC to combat PPH, it was found that LUSC can indeed significantly reduce the incidence of PPH compared to non-LUSC groups. Moreover, in LUSC group, there were no severe complications such as DIC or emergency hysterectomy as a result of uterine atony. LUSC had passed the test of time and triumphed over PPH.

What is already known on this topic?

One of the major problems in obstetric is maternal deaths related to birth and delivery. The incidence remains high, and 25% of which is attributed to PPH. During the past 25 years (1990 to 2015), maternal deaths caused by PPH were 289,000 cases per year (800 cases daily) or MMR was 216 per 100,000 live births. WHO had set its goal to reduce the incidence of PPH in MDG5, and only 43% of which was achieved.

AMSTL has been proven useful while non-drug interventions had proven otherwise. The positive results observed are mainly credited to uterotonics such as oxytocin and ergometrine. However, the problem lies in uterotonics' storage requirement and thorough pharmacological administration. Hence, they are deemed inappropriate in rural areas where both refrigerators and medical personnel are scarce. Misoprostol, despite no need to be refrigerated, had only marginal benefits or even no benefits against PPH according to some papers. As of now, only LUSC can reduce PPH by over 50%. The present study had analyzed and proven the efficacy and consistency of LUSC. It also emphasized that prevention of uterine hypoxia right after delivery was more practical and effective than treating the subsequent uterine atony. In conclusion, LUSC served as a groundbreaking guidance into humankind's future combat against PPH.

What this study adds?

The study showed that LUSC can effectively reduce the incidence of PPH by more than 50%, which subsequently decrease maternal deaths caused by PPH. From 20 years of experienced, 12 cases from the group that received standard delivery care had hysterectomy while none from the LUSC group did. Therefore, the keystone of this article is to emphasize the significance of making LUSC maneuver known worldwide, especially in developing regions where technology and drugs are hard to come by, which will result in a drastic decrease in the number of maternal deaths caused by PPH.

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Potential conflicts of interest

The authors declare no conflict of interest.

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