*Original Article*

# Uterine Compression Suture Versus Cesarean Hysterectomy in Management of Intractable Postpartum Hemorrhage

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***Background***: Postpartum hemorrhage (PPH) is the third leading cause of maternal death. Uterine atony is the most common cause, and surgical management is the last method for PPH.

***Objective***: To assess operative outcomes after uterine compression suture (B-Lynch suture technique) versus cesarean hysterectomy.

***Materials and Methods***: The comparison retrospective research evaluated the operative outcomes of the pregnant women managed by the B-Lynch suture technique (group 1) versus cesarean hysterectomy (group 2). Unique data form, designed to collect all patients involved in the present study, were reviewed and analyzed. The population study was pregnant women divided into two groups. Thirty-five patients were assigned to group 1 and thirty-five patients were assigned to group 2. The independent t-test was used to compare means of categorical variables between the two groups, with $p<0.05$ indicating statistical significance.

***Results***: Twenty-three thousand two hundred fifty-eight pregnant women delivered during the study period, which was 18 years 6 months. PPH occurred in 563 patients (2.42%), in both vaginal and cesarean deliveries. Intractable PPH occurred in 177 patients (0.76%) during cesarean section. Clinical data risk factors were age, complications while receiving blood transfusion, injury to the urinary bladder, and death. Several outcomes in group 1 were better than in group 2, such as the interval of operation, blood loss, fever after surgery, and saving of life. However, three patients in the trial of B-Lynch suture were changed to hysterectomy due to curative management.

***Conclusion***: The uterine compression suture (the B-Lynch technique) should be used promptly to manage acute PPH due to uterine atony. Additionally, a cesarean hysterectomy might be used for surgical management in the latter method, depending on the severity of the patient, the etiology of PPH, and the obstetrician's skills and experience.

***Keywords***: Postpartum hemorrhage, Uterine compression suture, Cesarean hysterectomy

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Postpartum hemorrhage (PPH) is one of the three leading causes of maternal death[1-4]. PPH means that more than 500 mL of blood was lost after a vaginal birth, or more than 1,000 mL after a cesarean section[2-4]. It has many potential causes, and the most common is uterine atony due to the uterus's failure to contract and retract after delivery of the fetus. This condition can be managed immediately with medical treatment using uterotonic drugs. Unfortunately, medicinal treatment may be unsuccessful in the intractable PPH patients, and these patients require further surgical intervention. Hysterectomy is a standard surgical procedure for such a situation, but it is not suitable for patients who desire to maintain their fertility and sexual health status. Conservative surgical management such as balloon tamponade, uterine compression suture, uterine artery, and internal iliac artery ligation preserves the reproductive function[3-5]. During a cesarean section, intractable PPH is a severe, rapidly occurring obstetrical crisis

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that is life-threatening. In a study, Eltabbakh et al[6] concluded that emergency postpartum hysterectomy was associated with significant blood loss, need for transfusion, postoperative complications, and more extended hospitalization partly because of its indications. Christopher B-Lynch[7] reported an attempt to the uterine stitching surgery using dissolved silk to keep the uterus in the mothers with PPH treated unsuccessfully with uterotonic drugs. Following this report of the B-Lynch suture, many obstetricians agreed with the B-Lynch procedure. They studied the B-Lynch techniques, which are more comfortable and productive[8-12]. In the present research, the authors were interested in reviewing the outcome of the intractable PPH management. This research purposed to assess the operative outcomes after uterine compression suture (B-Lynch suture technique) versus cesarean hysterectomy.

## Materials and Methods

The Ethics Committee of Sukhothai Provincial Health Officer approved the present study (IRB 35/2020). The comparison retrospective research evaluated the operative outcomes of the pregnant women managed by the B-Lynch suture technique, in group 1, versus the pregnant women managed by cesarean hysterectomy, in group 2. The population study was pregnant women who received a cesarean section and had intractable PPH. Traditionally, intractable PPH was defined as a life-threatening hemorrhage that was unresponsive to conservative treatment, such as uterine massage and uterotonic drugs[2-5]. Seventy patients in the intractable PPH management required surgical intervention during the cesarean section in Srisangwornsukhothai Hospital between January 2002 and July 2020. They were divided into two groups. Thirty-five patients were in group 1, using the uterine compression suture (B-Lynch technique), and thirty-five patients were in group 2, and received cesarean hysterectomy including total and subtotal peripartum hysterectomy.

A review of the medical record was conducted to recruit the cases. Clinical data were extracted on 1) risk factors such as age, underlying diseases, gravid, body mass index (BMI), gestational age, fetal weight, 2) indication for cesarean section, 3) outcomes of treatment such as blood loss, operation time, history of blood component transfusion, postoperative fever, and the length of the hospital stay, and 4) complication of operation.

Group 1 received uterine compression sutures with the B-Lynch suture technique[7].

Group 2 received cesarean hysterectomy[3] both total and subtotal (supracervical) hysterectomy using standard operative techniques by steps.

The inclusion criteria of each sample group were 1) pregnant women with a history of pregnancy hospitalized at Srisangwornsukhothai Hospital and receiving a cesarean section, 2) diagnosed with the intractable PPH from a weak uterine contraction during cesarean section, and 3) being able to communicate with the Thai language.

The exclusion criteria were 1) antenatal bleeding, 2) abnormal blood clotting before surgery, and 3) incomplete medical records during the cesarean section and in-patient medical records.

The sample size was calculated using a free online sample size calculator available at https://clincalc.com/stats/samplesize.aspx[13]. The statistical analysis was considered the Independent t-test, a significant level of 5% and a power of 80%, therefore, 35 pregnant women were required for each group. The data were analyzed and discussed from a clinical manifestation.

### Statistical analysis

Descriptive results of continuous variables were demonstrated as mean, range, and standard deviation (SD) and categorical variables, shown as numbers and percentages. Statistical analysis was performed using independent t-test, and a p-value of less than 0.05 was considered statistically significant. The data were use SPSS Statistics for Windows, version 16 (SPSS Inc., Chicago, IL, USA) with Windows 10.

## Results

During the study period, there was 23,258 deliveries and PPH occurred in 563 patients (2.42%) of both vaginal and cesarean deliveries. The cesarean delivery was performed in 7,559 patients (32.5%). The uterine atony with massive PPH during the cesarean section was 177 patients (0.76%). Thirty-five patients were managed with uterine compression suture (B-Lynch suture, group 1), and 35 patients were managed with cesarean hysterectomy (group 2).

Table 1 demonstrates the demographic characteristics in both groups of pregnant women. Clinical data were risk factors, the average age in group 1 (29.03±7.01 years) was less than in group 2 (33.14±5.94 years), with statistical significance (p=0.012). Almost all of both groups had no underlying diseases (97.1%). The BMI of group 1 (29.60±4.58 kg/m$^2$) was more than group 2 (29.26±3.91 kg/m$^2$), but this was not statistically significant (p=0.336). Most

**Table 1.** Demographic characteristics in both group of pregnant women

| Variable demographic data | Group 1: B-Lynch (n=35) | | Group 2: TAH (n=35) | | Total (n=70) | | p-value |
|---|---|---|---|---|---|---|---|
| | n (%) | Mean±SD | n (%) | Mean±SD | n (%) | Mean±SD | |
| Age (years) | | 29.03±7.01 | | 33.14±5.94 | | 31.09±6.78 | 0.012* |
| <35 | 25 (71.4) | | 16 (45.7) | | 41 (58.6) | | |
| ≥35 | 10 (28.6) | | 19 (54.3) | | 29 (41.4) | | |
| BMI (kg/m$^2$) | | 29.60±4.58 | | 29.26±3.91 | | 29.43±4.23 | 0.336 |
| 23 to 24.90 | 4 (11.4) | | 7 (20.0) | | 11 (15.7) | | |
| 25 to 29.90 | 15 (42.9) | | 12 (34.3) | | 27(38.6) | | |
| ≥30 | 16 (45.7) | | 16 (45.7) | | 32(45.7) | | |
| Underlying disease | | | | | | | 1.000 |
| Yes | 1 (2.9) | | 1 (2.9) | | 2 (2.9) | | |
| No | 34 (97.1) | | 34 (97.1) | | 68 (97.1) | | |
| Gravidity | | | | | | | 0.142 |
| 1 | 16 (45.7) | | 5 (14.3) | | 21 (30.0) | | |
| 2 | 11 (31.4) | | 17 (48.6) | | 28 (40.0) | | |
| ≥3 | 8 (22.9) | | 13 (37.1) | | 21 (30.0) | | |
| Parity | | | | | | | 0.138 |
| 0 | 18 (51.4) | | 5 (14.3) | | 23 (32.9) | | |
| 1 | 9 (25.7) | | 18 (51.4) | | 27 (38.6) | | |
| 2 | 6 (17.1) | | 10 (28.6) | | 16 (22.9) | | |
| ≥3 | 2 (5.7) | | 2 (5.7) | | 4 (5.7) | | |
| Gestational age (weeks) | | | | | | | 0.366 |
| ≤35 | 1 (2.9) | | 2 (5.7) | | 3 (4.3) | | |
| 36 to 37 | 7 (20.0) | | 7 (20.0) | | 14 (20.0) | | |
| ≥38 | 27 (77.1) | | 26 (74.3) | | 53 (75.7) | | |
| Fetal sex | | | | | | | 0.884 |
| Male | 20 (57.1) | | 19 (54.3) | | 39 (55.7) | | |
| Female | 15 (42.9) | | 16 (45.7) | | 31 (44.3) | | |
| Fetal weight | | 3,290.00±344.04 | | 3,153±382.23 | | 3,221.57±367.51 | 0.646 |
| Type of anesthesia | | | | | | | |
| Spinal | 24 (68.6) | | 12 (34.3) | | 28 (40.0) | | |
| GA | 11 (31.4) | | 18 (51.4) | | 37 (52.9) | | |
| Combine | 0 (0.0) | | 5 (14.3) | | 5 (7.1) | | |

TAH=total abdominal hysterectomy; SD=standard deviation; BMI=body mass index; GA=general anesthesia

* p<0.05 is statistic significant

of the gravidity was one in group 1 (45.7%), and two in group 2 (48.6%), while most of the gestational age were term pregnancies (75.7%). Fetal weight in group 1 (3,290.00±344.04 kilograms) was higher than in group 2 (3,153±382.23 kilograms), but the difference was not statistically significant (p=0.646).

Table 2 describes the complication of both groups, which were that group 1 (11.4%) received less blood transfusion than group 2 (57.1%). Additionally, there was one case of accidental injury of the urinary bladder in group 2. Unfortunately, two patients in group 2 died due to consumptive coagulopathy during the operation. This retrospective study has a weak point, which is to verify complex data, but it was necessary for learning to decrease the maternal mortality rate. However, three patients in group 1 were changed to the hysterectomy due to curative intervention. The first case was found in the placenta

**Table 2.** Complication of operations

| Complications | Group 1: B-Lynch (n=35) n (%) | Group 2: TAH (n=35) n (%) | Total (n=70) n (%) | p-value |
|---|---|---|---|---|
| Blood transfusion (PRC+FFP) | | | | <0.001* |
| No | 31 (88.6) | 15 (42.9) | 46 (65.7) | |
| Yes | 4 (11.4) | 20 (57.1) | 24 (34.3) | |
| • 1 | 1 (2.9) | 5 (14.3) | 6 (8.6) | |
| • 2 | 1 (2.9) | 6 (17.1) | 7 (11.0) | |
| • ≥3 | 2 (5.7) | 9 (25.7) | 11 (15.7) | |
| Tear vesicular bladder | 0 (0.0) | 1 (2.8) | 1 (1.4) | |
| Death | 0 (0.0) | 2 (5.7) | 2 (2.8) | |
| Changing group B-Lynch to hysterectomy | | | | |
| No | - | - | 0 | |
| Yes | - | 3 | 3 | |

TAH=total abdominal hysterectomy; PRC=packed red cell; FFP=fresh frozen plasma

* p<0.05 is statistic significant

**Table 3.** Indication of operations

| Indication for cesarean section | Group 1: B-Lynch (n=35) n (%) | Group 2: TAH (n=35) n (%) | Total (n=70) n (%) | p-value |
|---|---|---|---|---|
| Cephalopelvic disproportion | 19 (54.3) | 13 (37.1) | 32 (45.7) | 0.893 |
| Previous cesarean section | 8 (22.9) | 12 (34.3) | 20 (28.6) | |
| Pregnancy induce hypertension | 3 (8.6) | 3 (8.6) | 6 (8.6) | |
| Placenta previa | 2 (5.7) | 3 (8.6) | 5 (7.1) | |
| Preterm PROM, oligohydramnios | 0 (0.0) | 2 (5.7) | 2 (2.8) | |
| Myoma uteri | 0 (0.0) | 1 (2.9) | 1 (1.4) | |
| Fetal distress | 2 (5.7) | 1 (2.9) | 3 (4.3) | |
| Breech | 1 (2.9) | 0 (0.0) | 1 (1.4) | |

TAH=total abdominal hysterectomy; PROM=premature rupture of membranes

previa totalis. The second case was complicated multiple myoma uteri during pregnancy and might have loosened the tie of the suture. The third case of failure to this suture was abnormal placental implantation (placenta increta) due to an atonic uterus. Although B-Lynch suture was simplified to use preventable PPH due to uterine atony, the cesarean hysterectomy was used for surgical management in the latter method for PPH.

Table 3 demonstrates the most often in the cesarean section's indication due to cephalopelvic disproportion and previous cesarean section similar in both groups. Only two (group 1) and three patients (group 2) were placenta previa.

Table 4 assess the operative outcomes after uterine compression suture (B-Lynch suture technique) versus cesarean hysterectomy in managing the intractable PPH.

The operation time for group 1 (64.86±32.68 minutes) was shorter than in group 2 (116.29±54.71 minutes), with statistical significance (p=0.003). The preoperative hemoglobin (Hb) was higher in group 1 (12.01±0.95) than in group 2 (11.40±3.05), which was statistically significant (p=0.025). It was considered that there was a significant difference in demographic characteristics in both groups of pregnant women. Then the measurement of Hb drop in group 1 (0.93±0.82) was less than in group 2 (2.04±1.70), with statistical significance (p=0.004). Estimated blood loss for the group 1 (872.29±225.37) was less than for group 2 (1,298.57±690.49), with statistical significance (p<0.001). After the operation, the fever

**Table 4.** Statistic analysis for several outcome measurement

| Outcome measurement | Group 1: B-Lynch (n=35) Mean±SD | Group 2: hysterectomy (n=35) Mean±SD | 95% CI | p-value |
|---|---|---|---|---|
| Interval of operation (minutes) | 64.86±32.68 | 116.29±54.71 | 29.93 to 72.92 | 0.003* |
| Preoperative Hb (g/dL) | 12.01±0.95 | 11.40±3.05 | 0.46 to 1.69 | 0.025* |
| Hb drop (g/dL) | 0.93±0.82 | 2.04±1.70 | 0.47 to 1.74 | 0.004* |
| Estimated blood loss (mL) | 872.29±225.37 | 1,298.57±690.49 | 181.29 to 671.28 | <0.001* |
| Fever after operation | 1.46±0.50 | 1.74±0.44 | 0.05 to 0.51 | 0.003* |
| n (%) | 16 (45.7) | 26 (74.3) | | |
| Length of stay (days) | 4.26±0.70 | 4.54±1.46 | 0.26 to 0.83 | 0.001* |
| Death; n (%) | 0 (0.0) | 2 (5.7) | | |

SD=standard deviation; CI=confidence interval; Hb=hemoglobin

* Independent t-test, p<0.05 is statistic significant

in group 1 was less than in group 2, with statistical significance (group 1, 1.46±0.50, group 2, 1.74±0.44, p=0.003). The length of hospital stay in group 1 (4.26±0.70) was less than in group 2 (4.54±1.46), with statistical significance (p=0.001).

## Discussion

PPH is the leading cause of maternal death after birth[1-4]. According to the World Health Organization (WHO) statistics[2], approximately 2% of PPHs were found in childbirth, but one in four maternal deaths worldwide was more common in undeveloped countries due to a shortage of care resources. In Thailand, the Maternal and Child Health Group, Department of Health[1] reported maternal mortality starting from 2019. The 2019 maternal mortality analysis showed the ratio of maternal mortality was 20.3 per 100,000 live births. Between October 2018 and September 2019, the cause of maternal death revealed the mothers died from a direct cause in 56%, indirect causes in 36%, and unknown cause in 8%. The leading direct cause of death was hemorrhage (obstetric hemorrhage), hypertensive disorder in pregnancy, suicide, amniotic fluid embolism, while the indirect cause was infection, influenza, heart disease, and stroke. According to maternal mortality, the above reflected the size and severity of the problem in each area. Proactive situation data and performance reports were returned to the authorities to determine the direction of surveillance and prevention of recurrence and formulate policies and measures and plan for integration with the relevant authorities. Maternal mortality prevention and reduction were required to review maternal causes of mortality to plan the development of pregnant women and postpartum care systems to be more effective in the area's context. The cause of maternal death was found to be obstetric hemorrhages, which had always been the number one cause of death, especially uterine atony. The focus was on proper management, especially the obstetric risk screening system. The company also provided surveillance results to the Department of Health executives every month to recognize, acknowledge, manage, and contribute to learning and development, which led to follow-up and empowerment. It was an exchange of experience, joint analysis, problem analysis, and feedback. The solution was appropriated for each area's context and it provided support according to the Department of Health's mission. The obstetrician's skills and experience would be looked at when there was a failure of the initial treatment. It is necessary to study the surgery to analyze the cause, which could be uterine atony, placental abnormality, uterine trauma, control of specific bleeding, including uterine-sparing and reproductive preservation. Therefore, surgery played a role in treating PPH, and it was essential to reduce the severity of blood loss, adverse complications, and maternal mortality after birth. However, assessing the amount of blood loss using sight might not be accurate and was often lower than reality, so clinical skills were required to evaluate the severity.

In the present study, low resource general hospitals might receive severely complicated pregnant women from several community hospitals. Prompt active management of labor should be performed, including active management of the third stage of labor[14]. During this uterine compression suture procedure, such as the B-Lynch procedure, attempt to treat the patients with intractable PPH to preserve the

uterus with future fertility should be made. However, cesarean hysterectomy is often performed by the obstetricians in those situations. The comparative study was designed to assess the advantages of these operative outcomes. The researchers studied the efficacy of these two procedures in the emergency events to improve the maternal outcomes. Many types of researches supported uterine preservation. Kaoiean[11] concluded that the B-Lynch suture was an effective and safe surgical option for intractable hemorrhage treatment with no apparent adverse outcomes. Tadakawa et al[15] studied the B-Lynch sutures for PPH and found that it did not jeopardize fecundity. Ghezzi et al[16] presented the uterine compression sutures to treat hemorrhage (PPH). The Hayman suture offered the potential advantage that could be applied faster and more comfortably, avoiding the performance of a lower segment hysterotomy when PPH follows a vaginal delivery.

Price and B-Lynch[17] suggested that the B-Lynch suturing technique was particularly useful because of its simplicity of application, life-saving potential, relative safety, and capacity for preserving the uterus and subsequent fertility. The adequacy of hemostasis could be assessed both before and immediately after applying the suture. Only when the suture failed that other, more radical surgical methods are recommended. Abdrabbo[18] presented the stepwise uterine devascularization as an effective and safe alternative to hysterectomy for the management of uncontrollable hemorrhage. Furthermore, Senturk et al[19] concluded that the peripartum hysterectomy caused postpartum depression. However, some studies reported complications from the treatment of uterine compression sutures, and the adverse operative outcomes of B-Lynch suture compared with cesarean hysterectomy. Dohbit et al[20] concluded that the hysterectomy was safer than uterine preserving surgery's management of intractable PPH in their settings. Uterine preserving surgery choice as first-line surgical management of PPH in resource-limited settings should entail keen anticipation of these adverse maternal outcomes to reduce PPH's perioperative burden. They concluded that the hysterectomy was safer than uterine preserving surgery in the management of intractable PPH in their settings. Uterine preserving surgery choice as first-line surgical management of PPH in resource-limited settings should entail keen anticipation of these adverse maternal outcomes to reduce PPH's perioperative burden. Kayem et al[21] concluded that the prolonged delay of two to six hours between delivery and uterine compression suture was independently associated with a fourfold increase in hysterectomy odds. Treloar et al[22] presented the case report of uterine necrosis following B-Lynch suture for primary PPH.

In Srisangwornsukhothai Hospital, the one case report described the successful use of the uterine compression suture in treating acute PPH during cesarean delivery, occurring twice in the same woman. The uterine atony was the potential etiology due to the failure of the uterine contraction (In 2011, polyhydramnios in the first, and in 2015, transverse fetal lie in the second pregnancy). B-Lynch procedure was done in the first pregnancy and used the suture technique. B-Lynch and Hayman procedure was used in the second pregnancy. In those two emergency events for repeated uterine atony with preservation uterus, the patient had a good impression of PPH management's plan. However, the holistic approach in all B-Lynch suture and cesarean hysterectomy patients should be investigated and physical examination should be studied over the long term. Because of this research result, the efficacy of the B-Lynch suture's perioperative outcomes was better than cesarean hysterectomy in decreasing the interval of operation, blood loss, fever after the operation, the length of hospital stay, and no significant adverse complication. Prophylaxis management of the uterine atony and the intractable PPH should be performed promptly, quickly, safely, and correctly by B-Lynch suture for preservation of the uterus. The obstetrician should decide quickly to resolve the intractable PPH and clinical manifestation of the patient during the emergency, both critical factor for beneficial or adverse outcomes, including choosing both B-Lynch suture and cesarean hysterectomy. Therefore, uterine compression suture (B-Lynch suture) choice as first-line surgical management of PPH in low resource hospitals should be performed to prophylactic adverse maternal outcomes to reduce the perioperative burden of PPH. The present study reported that most of the patients who chose the B-Lynch procedure had nulliparous (40.7%) and were younger than 35 (74.1%) because of the mindset to be aware of future fertility sexual health status of her family. It was an exciting finding to redesign the prospective comparison study and essential causes of confounding factors due to adverse maternal outcomes, which had been questioned for the randomized controlled trial in the future PPH. The limitation of the present research was a retrospective study. The selection of either group might be clinically biased due to the authorities'

decision to choose types of resolving surgery for the intractable PPH in the different situations and missing the essential data of medical records, especially in complicated patients of both groups.

Finally, it was essential to reduce the severity of blood loss to prevent PPH. The obstetrician should diagnose quickly and treat appropriately to reduce complications and maternal mortality after birth. The authors described an innovative method that was simple and effective, tried and tested with a successful outcome for controlling life-threatening PPH, as an alternative to more complicated surgery, including hysterectomy.

## Conclusion

The uterine compression suture (the B-Lynch technique) should be used promptly to manage acute PPH due to uterine atony. In case the cesarean hysterectomy might be used for surgical management in the latter method, it depends on the severity of the patient, etiology of PPH, together with the obstetrician's skills and experience.

## What is already known on this topic?

PPH was diagnosed in some cases of total vaginal and cesarean deliveries, and mainly caused by the uterine atony. However, when uterine atony persists after administering uterotonic drugs, the uterine compression sutures should be chosen promptly. If this conservative approach failed to control the bleeding, the curative option of hysterectomy should be performed. During this uterine compression suture procedure, the B-Lynch procedure should be attempted to treat the patients with intractable PPH to preserve the uterus with future fertility.

## What this study adds?

This study shows the need to screen obstetric risk and the importance of training to achieve the skillfulness for helping the intractable PPH patients in an emergency event at low resource general hospitals.


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## Conflicts of interest

The authors declare no conflict of interest.

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