Successful Use of the B-Lynch Uterine Compression Suture in Treating Intractable Postpartum Hemorrhage after Cesarean Delivery in Rajavithi Hospital

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Objective: To evaluate the effectiveness of the uterine compression suture (B-Lynch and modified B-Lynch suture) in avoiding hysterectomy in cases of postpartum hemorrhage and in eliminating the need for surgical intervention to arrest bleeding.

Material and Method: This was a retrospective study using data all from women giving birth in Rajavithi Hospital between July 2010 and June 2012. Data were gathered exclusively from the medical records of patients who underwent the B-Lynch suture procedure, and details were recorded of risk factors, managements, and outcomes.

Results: There were 17,692 deliveries during this period with postpartum hemorrhage (PPH) occurring in 4.2% of total vaginal and cesarean deliveries. Of these, the B-Lynch suture procedure was performed in treating postpartum hemorrhage in 24 cases. Hysterectomy could not be avoided in one woman who had excessively prolonged massive bleeding resulting in disseminated intravascular coagulopathy (DIC). The success rate in this study was 95.8% with 95% confidence interval 79.8-99.3.

Conclusion: The present study showed that the B-Lynch suture is an effective and safe surgical option for treatment of intractable postpartum hemorrhage with no apparent adverse outcomes. The procedure should be taught to any physician who deals with parturition and should be applied as standard protocol for the management of PPH in the operating room.

Keywords: B-Lynch suture, Postpartum hemorrhage, Cesarean section

Postpartum hemorrhage (PPH) is a major factor in maternal morbidity and mortality. It accounts for 25-30% of maternal deaths in both the developing and developed countries; it is responsible for the deaths of 125,000 to 140,000 women each year or one maternal death every four minutes[1,2]. In addition, 64.7% of severe maternal morbidity is the result of obstetric hemorrhage[3]. Available methods to control PPH vary according to its cause, but in general delaying diagnosis and treatment may lead to a life threatening situation especially in case of massive hemorrhage (>1,500 ml) and failed standard medical therapy. When intractable hemorrhage is encountered by most obstetricians and midwives, then surgical intervention is usually inevitable. For many decades, ligation of major vessels and hysterectomy were the standard, conventional approach, resulting in many maternal deaths that were still prominently reported especially in developing countries. In 1997, Christopher B-Lynch reported a new approach for surgical management: a so-called B-Lynch uterine compression suture[4]. This report described a technique, which used a continuous suture to apply vertical compression to an atonic uterus in an attempt to avoid hysterectomy. This suturing technique, when applied correctly, has been highly successful without any problems or apparent complications[5]. Various modifications of the B-Lynch suture have come into practice and there have been numerous reports of its success in controlling PPH. Nowadays, the B-Lynch procedure is used worldwide to treat various causes of PPH, especially in developing countries as in Africa and Asia where the incidence of PPH has been high. Because the procedure is faster and simpler than hysterectomy and internal iliac artery ligation, and it produces excellent outcomes, most obstetricians are very keen to learn and practice this innovative suture technique in order to improve their maternity care skills. Currently there are numerous reviews in publications around the world extolling the merits of this technique and declaring its successful
outcomes\textsuperscript{(4-8)}. In Thailand and some other countries in Southeast Asia, there are few reports of this uterine compression suture even though they may have been numerous case series in each country.

**Material and Method**

The ethics committee of Rajavithi Hospital approved the present study. It was a retrospective study of consecutive patients diagnosed with intractable PPH who were subsequently treated with the B-Lynch compression suture between July 2010 and June 2012 in Rajavithi Hospital, a teaching and referral tertiary center of the Ministry of Public Health of Thailand. The aim of the present study was to examine the clinical outcomes of cases in which the B-Lynch suture was used as a hemostatic measure in intractable PPH. The cases were identified by review of medical records and data were gathered on risk factors, managements, and outcomes. The data were then analyzed and discussed from a clinical point of view. The procedure was considered successful, if the bleeding stopped and the uterus was preserved after the B-Lynch suture was completely inserted. Whether the compression suture was combined with vessel ligation or ended with hysterectomy depended on the severity of the bleeding or hemodynamic status.

**Statistical analysis**

Descriptive results of continuous variables were expressed as mean, range, and standard deviation (SD) and categorical variables were expressed as numbers and percentages. Statistical analysis was performed using Chi-square or Student’s t-test as appropriate and a p-value <0.05 was considered statistical significant. Analysis was done with the software program SPSS for Window version 17.0.

**Results**

There were 17,692 deliveries during this period with PPH occurring in 742 cases (4.2%) of total vaginal and cesarean deliveries. Forty-seven cases of intractable hemorrhage were identified and needed surgical intervention. Of these, four cases achieved successful hemostasis by bilateral internal iliac (hypogastric) artery ligation (BUAL) as a first choice procedure, 24 cases were managed by uterine compression suture (the B-Lynch suture and its modifications), and 20 cases, nine of which had failed prior BHAL, ended up being treated by hysterectomy.

In the present study, out of the 24 cases (Table 1) in which the B-Lynch suture was attempted by skilled operators: 15 cases (62.5%) were emergency C/S and nine (37.5%) were elective C/S. No incidence of B-Lynch suture performed on PPH and caused by vaginal delivery between the study periods. Hysterectomy was unavoidable in one case (patient No. 14) even in the first parity because of the severity of bleeding from the atonic uterus resulting from an elective cesarean section in an elderly twin pregnancy. There was a lot of bleeding and numerous units of blood component were transfused resulting in disseminated intravascular coagulopathy (DIC). In a re-explorative laparotomy, BHAL was attempted before insertion of the B-Lynch suture, but both procedures failed to control the bleeding and were ultimately followed by a hysterectomy in order to save the life of the patient. Thus, the success rate of the present study was 95.8% (95% CI 93.9-97.3). The estimated blood loss ranged from 600 to 6,600 mL (median 1,750) and patients received a median of 1.67 units of packed red cells intra-operatively and postoperatively (range, 0-10). The causes of intractable PPH were mostly uterine atony (83%) and bleeding from the placental bed caused by placenta previa (17%). Out of a total of 24 cases, the B-Lynch suture was the only intervention in 16 cases (66.7%); a combination of B-Lynch suture with bilateral uterine artery ligation (BUAL) was used in six cases (25%); the Hayman surgical technique (a modified B-Lynch suture) alone was used in one case (4.2%); and in the other case (4.2%) hysterectomy was required after failure of BHAL and B-Lynch suture. Twenty-three cases required all three kinds of uterotonic agents before application of the compression suture. One patient was given both oxytocin and ergometrine (case No. 9) in which the B-Lynch suture was applied for prophylaxis of placenta previa.

The ages of the present study population ranged from 18 to 42 years (mean 30.6±6.5 years); gestational age ranged from 32 to 41 weeks (mean 37.6±2.5); and parity varied from 0 to 4 with 46% of participants nulliparous and 54% multiparous. Pregnancies were at term in 21 cases (88%) while three patients were operated at weeks 32, 33, and 34 of gestation. All three cases were due to twin pregnancy with pre-term labor. Mean postoperative hemoglobin concentration was significantly higher than pre-operatively (10.4±0.5 mg/dl vs. 7.8±0.8 mg/dl; \( p<0.001 \) by the \( \chi^2 \) test) (Table 2).

DIC occurred in case No. 14 (the only intra-operative complication that occurred in the present study) due to massive hemorrhage; however, all
<table>
<thead>
<tr>
<th>Patient No.</th>
<th>Age</th>
<th>Parity</th>
<th>GA</th>
<th>Mode of delivery</th>
<th>Cause of PPH</th>
<th>Procedure to arrest bleeding</th>
<th>Other adjunctive treatment</th>
<th>EBL (ml)</th>
<th>Transfusion</th>
<th>Intrapartum and postpartum complication</th>
<th>Hospital stay (day)</th>
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<tr>
<td>1</td>
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<td>40</td>
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<td>Atony</td>
<td>B-Lynch</td>
<td>Oxytocin, ergometrine, PGs</td>
<td>1,400</td>
<td>PRC 1 unit</td>
<td>None</td>
<td>4</td>
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<td>2</td>
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<td>G2P0A1</td>
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<td>Atony</td>
<td>B-Lynch</td>
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<td>1,800</td>
<td>None</td>
<td>None</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
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<td>None</td>
<td>3</td>
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<td>7</td>
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<td>41</td>
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<td>Atony</td>
<td>B-Lynch</td>
<td>Oxytocin, ergometrine, PGs</td>
<td>2,000</td>
<td>PRC 2 units</td>
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<td>4</td>
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<tr>
<td>8</td>
<td>35</td>
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<td>Atony</td>
<td>B-Lynch</td>
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<td>6</td>
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<td>9</td>
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<td>Oxytocin, ergometrine</td>
<td>600</td>
<td>None</td>
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<td>3</td>
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<td>4</td>
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<td>37</td>
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<td>Atony</td>
<td>BHAL</td>
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<td>6,600</td>
<td>PRC 10 units, FFP 8 units, Cryo 20 units</td>
<td>DIC</td>
<td>8</td>
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<td>B-Lynch</td>
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<td>18</td>
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<td>B-Lynch</td>
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<td>17</td>
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<td>G2P1</td>
<td>39</td>
<td>Emergency C/S</td>
<td>Atony</td>
<td>B-Lynch</td>
<td>Oxytocin, ergometrine, PGs, BUAL</td>
<td>3,500</td>
<td>PRC 6 units, FFP 4 units</td>
<td>None</td>
<td>5</td>
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<tr>
<td>18</td>
<td>31</td>
<td>G2P1</td>
<td>37</td>
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<td>Atony</td>
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<td>Oxytocin, ergometrine, PGs</td>
<td>2,400</td>
<td>PRC 2 units</td>
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<td>3,400</td>
<td>PRC 4 units, FFP 4 units</td>
<td>None</td>
<td>5</td>
</tr>
</tbody>
</table>

PPH = postpartum hemorrhage; GA = gestational age; EBL = estimated blood loss; PGs = prostaglandins; C/S = cesarean section; BUAL = bilateral uterine artery ligation; BHAL = bilateral hypogastric artery ligation; PRC = pack red cell; FFP = fresh frozen plasma; DIC = disseminated intravascular coagulopathy
patients had a good postoperative recovery. The length of hospital stay ranged from three to eight days with a median of four days. Postoperative complications that occurred during a hospital stay were puerperal fever in two patients (case No. 17 and 19) with good recovery before hospital discharge. No case required intensive care unit treatment postoperatively.

Discussion

Since implementation of the active management of the third stage of labor in Rajavithi Hospital in 2006, the PPH rate of vaginal birth has dropped from more than 5% to less than 2%, but PPH during cesarean delivery has remained high and is tending to increase, especially massive PPH which occurs about 8 to 10 fold more than in vaginal delivery. A review by Doumouchtsis et al evaluated the various interventions of conservative treatment of intractable PPH. There was no significant difference in success rates in arresting PPH using balloon tamponade, arterial embolization, uterine devascularization and uterine compression procedure and its modified forms in Rajavithi Hospital since 2007, and it still plays an important role today in decreasing maternal mortality.

A review by Doumouchtsis et al evaluated the various interventions of conservative treatment of intractable PPH. There was no significant difference in success rates in arresting PPH using balloon tamponade, arterial embolization, uterine devascularization and uterine compression procedure and its modified forms in Rajavithi Hospital since 2007, and it still plays an important role today in decreasing maternal mortality.
uterine compression: several variations of this technique have been described and no technique has been proven significantly more effective than another. The specific placement of compression sutures is determined by the operator at the time of laparotomy. If uterine atony persists after administration of uterotonics drugs, compression sutures should be inserted promptly, as delaying placement by more than an hour increases the likelihood that a hysterectomy will be needed. Gilles et al studied risk factors associated with failure of uterine compression suture in the treatment of 211 women with severe PPH in the UK. Gilles concluded that a prolonged delay of two to six hours between delivery and insertion of uterine compression suture was associated with a fourfold increase in the chances of hysterectomy being required. In the present study, only one of 24 cases of treatment by B-Lynch suture failed when used in re-exploring laparotomy in an elderly twin pregnancy. The cause of this failure was that uterine atony was initiated after prior elective cesarean section with a time interval of 9.30 hours to perform a B-Lynch suture. In this case, BHAL was tried before insertion of B-Lynch suture. A lot of blood components and fluids were transfused to keep normal circulation and coagulopathy, but finally DIC occurred, and then inevitably hysterectomy. Thus, the success rate in this study was 95.8% (Table 3) which is similar to results reported in many publications. It is important to note that these suturing techniques may not always achieve adequate control of bleeding, particularly when there is coagulopathy and diffuse bleeding from an atomic uterus. Delay in performing surgery may further compromise the patient’s condition. Thus, it is crucial to evaluate blood carefully for loss after delivery to avoid any prolonged delay in recognizing hemorrhage. According to Price and Lynch, other possible causes of B-Lynch suture failure are a lack of tightness or improper suture application.

Surprisingly, there was no case of B-Lynch suture application on intractable PPH after vaginal delivery in the study period and all 24 cases involved in the use of the B-Lynch technique during caesarean section. This may result from high efficiency in the hemostatic strategy of the labor room resulting in a much lower incidence of non-responsive medical PPH in vaginal delivery. In the case of intractable hemorrhage after vaginal delivery, however, where surgical intervention is required, the procedure usually takes much longer and is more severe than an intraperitoneal hemorrhage; and there are no other possible treatment modalities available.

Another reason could be the increase in the rate of cesarean sections in cases where the risk factors are associated with a tendency to increase the chance of hemorrhage such as multiple pregnancy, elderly pregnancy, prolonged labor, induction of labor, macrosomia, placenta previa, and operative delivery, especially in emergency cesarean section.

In the present study, there were four cases of placenta previa as a cause of bleeding, three of which were combined with BUAL. Atonic uterus has been satisfactorily treated with B-Lynch compression suture as described originally by Christopher B-Lynch in 1997. In placenta previa, bleeding usually originated from vessels at the placental bed in lower uterine segment that cannot be accessed enough by the compression effect, thus B-Lynch suture will be more effective in stopping bleeding when combined with BUAL. BUAL is preferable to BHAL because the uterine arteries are more readily accessible, the procedure is technically easier, and there is less risk of damage to major adjacent vessels and the ureter.

Although BUAL alone will not control bleeding from uterine atony or placenta accreta, it may decrease blood loss while other interventions are being attempted. The other case of hemorrhage with placenta previa (case No. 9) had the least blood loss of 600 ml, and the B-Lynch suture was applied early as a prophylaxis of further bleeding.

In 23 (95.8%) cases, the classical B-Lynch suture was applied, and in the remaining (4.2%) case (case No. 20), the Hayman suture, a modified B-Lynch technique, was inserted to an atomic uterus with failed medical treatment after the uterine incision was closed and bleeding continued. The lithotomy position was used to assess the effectiveness of the suture, and the procedure was successful in stopping bleeding. The advantage of the Hayman suture technique is that it is easier and faster than the B-Lynch technique, as it takes probably only two or three minutes to complete the suture after gaining some familiarity.

### Table 3. Final outcomes: success and failure rate of the B-Lynch compression suture

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>Number of cases</th>
<th>% (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Success</td>
<td>23</td>
<td>95.8 (79.8-99.3)</td>
</tr>
<tr>
<td>Failure (hysterectomy after B-Lynch suture)</td>
<td>1</td>
<td>4.2 (0.7-20.25)</td>
</tr>
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</table>
to put the B-Lynch suture in place, as delaying could severely compromise the patient’s condition. Obstetricians should promote the implementation of B-Lynch suture more often as a prophylaxis in cases of high risk of PPH, and it should be one of their duties to train unskilled physicians responsible for parturition. Nowadays, most oncogynecologic staff in this study center, who are likely to treat intractable PPH with BHAL and sometimes hysterectomy, are familiar with the B-Lynch procedure, and currently a rising number of B-Lynch suture cases are being performed by these gynecologists with a high success rates.

**Conclusion**

The data of the present study showed a high success rate of 95.8% with the B-Lynch procedure in treating PPH and no apparent adverse clinical outcomes. The advantages of the procedure are that it is technically simple, rapid, effective, and relatively safe, with satisfactory hemostasis immediately after insertion. Furthermore, it has the capacity to preserve the uterus and thus, fertility. The uterine compression suture should be applied within 1 to 2 hours in order to avoid the need for hysterectomy. There are many situations in which the B-Lynch procedure can be a treatment option, in particular in uterine atony, placenta previa, placenta accrete/increta and as a prophylaxis in cases where there is a high risk of hemorrhage. In treating bleeding from abnormal placentation, the B-Lynch suture combined with BUAL is suggested to increase effectiveness in reducing the pulse pressure of the lower uterine segment. A modified B-Lynch suture, especially the Hayman technique, can be effectively applied in cases of atomic bleeding after closure of uterine incision or intractable PPH after vaginal birth; this procedure has the advantage of being easier and faster than the original B-Lynch suture. Finally, the uterine compression suture should be a standard protocol for management of PPH in any operating room where it is available, even in settings with low technical resources, and certainly in training centers throughout the world.

**Potential conflicts of interest**

None.

**References**

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ผลลัพธ์ของการเย็บมดลูกด้วยวิธี B-Lynch suture ในการห้ามเลือดโดยการผ่าตัดในมารดาตกเลือดหลังคลอดในโรงพยาบาลราชวิถี

สรุป

วัตถุประสงค์: เพื่อประเมินประสิทธิภาพของการเย็บมดลูกแบบ B-Lynch suture เพื่อหลีกเลี่ยงการตัดมดลูกในผู้ป่วยคลอดหลังคลอด

วัสดุและวิธีการ: เป็นการศึกษาโดยเก็บรวบรวมข้อมูลย้อนหลัง (retrospective study) จากหญิงคลอดบุตรในโรงพยาบาลราชวิถีที่ได้รับการทำการ B-Lynch suture ระหว่างเดือนกรกฎาคม พ.ศ. 2553 ถึงเดือนมิถุนายน พ.ศ. 2555 วิเคราะห์ข้อมูลด้านปัจจัยเสี่ยง วิธีการรักษา และผลการรักษา

ผลการศึกษา: มีหญิงคลอดบุตรทั้งสิ้น 17,692 ราย ในระหว่างระยะเวลาดังกล่าว พบมีการตกเลือดหลังคลอดทั้งในกรณีคลอดทางช่องคลอด และการผ่าตัดคลอด โดยประมาณ 4.2 ในจำนวนนี้ผู้ป่วยที่ได้รับการทำการ B-Lynch suture มีผู้ป่วย 1 ราย ที่เสียเลือดมากและเกิดภาวะ DIC และต้องตัดมดลูกในที่สุด ในการศึกษาพบอัตราความสำเร็จของการเย็บมดลูกด้วยวิธี B-Lynch suture ในการห้ามเลือด ร้อยละ 95.8 และค่าความเชื่อมั่นที่ 95% เท่ากับ 79.8-99.3

สรุป: การเย็บมดลูกด้วยวิธี B-Lynch suture เพื่อเรียกเก็บกระแสเลือดหลังคลอด เป็นวิธีที่มีประสิทธิภาพและปลอดภัย ดังนั้นควรมีการฝึกสอนวิธีการเย็บมดลูกด้วยวิธี B-Lynch suture แก่แพทย์ที่ต้องดูแลการคลอด โดยเฉพาะอย่างยิ่งควรมีการนำไปใช้เป็นแบบมาตรฐานในการรักษาการตกเลือดหลังคลอด ในการรักษาภาวะตกเลือดที่ต้องตัดมดลูก