B-Lynch suture application due to hemorrhage during Cesarean section

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Original article

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Summary

Introduction. According to WHO, postpartum hemorrhage is observed in 10.5% of labors worldwide and is one of the most significant causes of mortality among young women, estimated at 25%. It is responsible for approximately 150,000 deaths annually.

Aim. The paper presents authors’ own experience based on the material consisting of 56 women who had a Cesarean section performed in the Clinic of Perinatology of the First Department of Gynecology and Obstetrics of the Medical University in Łódź, Poland. All women developed PPH and had the compression B-Lynch suture applied.

Results. The efficacy of B-Lynch suturing due to uterine atony was 92.86%. Because of persisting uterine bleeding, peripartum hysterectomy was conducted in 4 cases (7.14%) of 56 patients who had previously had the B-Lynch suture placed on the uterus. The occurrence of PPH was usually associated with the first delivery (64.29%, n=36).

Conclusion. The hemostatic B-Lynch suture has introduced significant changes to the treatment of acute PPH. The period of 13 years of observation has shown that benefits, such as a significant reduction of the frequency of conducting radical procedures in the form of hysterectomy, considerably outweigh remote complications that can be potentially associated with the B-Lynch procedure.

Key words: postpartum hemorrhage, B-Lynch suture, Cesarean section

INTRODUCTION

Postpartum hemorrhage (PPH) is one of the main global causes of peripartum mortality, both in developed and developing countries [1]. According to WHO, postpartum hemorrhage is observed in 10.5% of cases worldwide [2] and is one of the most significant causes of death among young women, estimated at approximately 25%. It is responsible for about 150,000 deaths annually [3]. Most deaths (88%) are observed within 4 hours after labor, which suggests that they are consequences of stage 3 of labor [4].

Physiological blood loss after labor ranges from 200–300 ml [5]. The traditional definition of primary postpartum hemorrhage says that blood loss estimated visually is 500 ml within the first 24 hours after labor. Secondary postpartum hemorrhage is defined as excessive vaginal bleeding occurring 24 hours after labor and continuing up to the 6th week afterwards [6]. Primary postpartum hemorrhage concerns 4–6% of pregnancies and is caused by uterine atony in 80% of cases [7]. Risk factors of postpartum hemorrhage can be identified before labor in only 40% of patients, which makes it difficult, or sometimes even impossible to predict [8].

Compression sutures, including the B-Lynch suture, were a breakthrough in the management of postpartum uterine atony. The B-Lynch suture was used for the first time in 1997 and until 2006 was performed in 1,800 patients according to data collected from research centers. Moreover, it is technically easier to perform than surgical ligation of arteries and...
does not require the usage of additional X-ray equipment [9]. The technique of applying the B-Lynch suture is demonstrated on the following website: https://www.youtube.com/watch?v=MkMhB24LukA. It is not, however, free from complications. For instance, there have been concerns about possible uterus perforation during suture application, uterine infection at the sutured site and spread of inflammatory infiltration, delay in cleaning the uterus of lochia and endometritis, which can spread to the pelvic peritoneum, with accompanying paralytic ileus [1]. Long-term observations are necessary to assess the procedure, its efficacy and possible remote consequences. The time period in which complications after hemostatic suture application can develop ranges from directly after the procedure [20] to even several years later [12]. The complications mentioned include: metritis with pyometra that can potentially lead to sepsis [18], ischemic uterine wall necrosis [13], uterine wall erosion following suture application [11] and intrauterine adhesions that cause hematometra and the lack of menstrual flow [12]. To date, no instances of death directly caused by the B-Lynch suture or its modification have been reported (Fig. 1). Although there are relatively few complications of this method as reported so far, their number can increase as the method is becoming more popular.

**AIM**

The aim of the paper was to verify the hypothesis that there are potential factors that increase the risk of PPH.

**MATERIAL AND METHODS**

The study was conducted on a group of 56 women who had a Cesarean section performed in 2009–2014 in the Clinic of Perinatology of the First Department of Gynecology and Obstetrics of the Medical University in Łódź, Poland. The retrospective analysis included women in whom intraoperative uterine examination was the basis for the application of the B-Lynch compression suture in order to treat postpartum uterine atony that did not react to pharmacological therapy. The total number of labors in 2009–2014 was 14,025, 7,175 of which were Cesarean sections (51.16%).

The documentation of patients eligible for the study was analyzed in terms of indications for and type of a Cesarean section as well as potential risk factors of postpartum hemorrhage (based on interview, current pregnancy and labor). Moreover, the documentation provided information about the type of anesthesia applied during the procedure of a Cesarean section and uterotonic agents used. Also, the following blood count parameters were included: WBC, RBC, HGB, HCT and PLT as well as the volume of lost blood and a possible necessity of a transfusion. The data obtained were analyzed statistically using the Statistica 2014 system. Correlations between the selected variables were tested using chi-squared log likelihood test, Pearson’s chi-squared test and U-Mann-Whitney test. The level of statistical significance was p<0.05 for all analyses.

**RESULTS**

The authors analyzed the data of 56 women who had a Cesarean section performed in the Clinic of Perinatology of the First Department of Gynecology and Obstetrics of the Medical University in Łódź, Poland.

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**Fig. 1. B-Lynch suture**
Obstetrics of the Medical University in Łódź, Poland. All women developed PPH and, because of a failure of alternative management, the compression B-Lynch suture was applied.

Because of persisting uterine bleeding, peripartum hysterectomy was conducted in 4 cases (7.14%). In 2 cases, peripartum hysterectomy was associated with early PPH and was conducted during the procedure of a Cesarean section. The remaining two patients developed late postpartum hemorrhage which required relaparotomy on the second day after the Cesarean delivery. In both patients, the first procedures conducted were: uterine curettage under general anesthesia, uterine massage, administration of uterotonic agents and Emmet’s suture application. However, due to the inefficacy of these procedures and continued bleeding, relaparotomy was conducted. In one patient who had hysterectomy performed on day 2 after the Cesarean delivery, a repeated relaparotomy was conducted on the next day because of persisting bleeding to the abdominal cavity. During abdominal revision, hemostatic sutures were applied to the vaginal stump, peritoneum of the pouch of Douglas and rectal serosa in the region of the rectouterine fold.

Based on the analysis of the material collected, it was concluded that the occurrence of PPH was usually associated with the first delivery (64.29%, n=36). The most common indication for a Cesarean section in the investigated group was the risk of fetal hypoxia (35.71%, n=20). Table 1 presents indications for a Cesarean section. The percentage of multiple pregnancies was 7.14% (n=4). The remaining pregnancies were single. There were two incidents of intrauterine fetal death. The mean birth weight was 3,146.7 g, the mean pre-pregnancy BMI of patients was 23.05 kg/m², and the mean body mass gain during pregnancy was 13.22 kg. Table 2 presents detailed characteristics of the investigated group.

They type of a Cesarean section was also analyzed. Emergency or urgent procedures were conducted in 69.23% (n=36) of patients who had the B-Lynch suture applied without subsequent hysterectomy compared with 3 of 4 cases in whom hemorrhage was an indication for hysterectomy. There were no statistically significant differences concerning the time of delivery. In both groups, it was approximately 37th week of gestation.

Eleven women (19.64%) had previously delivered via a Cesarean section. In all these cases, B-Lynch suture application was sufficient therapeutic management.

Other factors that increase the risk of PPH are surgical procedures involving the uterus, which concerned 7.14% (n=4) of women. The same percentage of patients had in the past had a laparoscopic procedure due to endometriosis. Previous PPH occurred in 10.0% (n=2) of 20 patients with the history of at least one labor.

Of pregnancy-related risk factors of PPH, the most common was arterial hypertension amounting to 25.0% of patients (n=14) which was a statistically significant value compared with other PPH risk factors (p < 0.005 for chi squared log likelihood test).

<table>
<thead>
<tr>
<th>Indications for Cesarean section</th>
<th>Patients with B-Lynch suture only (n=52)</th>
<th>Patients with B-Lynch suture and radical procedure (n=4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk of fetal hypoxia</td>
<td>32.69% (n=17)</td>
<td>75.0% (n=3)</td>
</tr>
<tr>
<td>Medical indications</td>
<td>26.92% (n=14)</td>
<td>25.0% (n=1)</td>
</tr>
<tr>
<td>History of Cesarean section</td>
<td>21.15% (n=11)</td>
<td>(n=0)</td>
</tr>
<tr>
<td>Premature rupture of fetal membranes</td>
<td>19.23% (n=10)</td>
<td>25.0% (n=1)</td>
</tr>
<tr>
<td>Placenta previa</td>
<td>15.38% (n=8)</td>
<td>(n=0)</td>
</tr>
<tr>
<td>Incorrect fetal position</td>
<td>13.46% (n=7)</td>
<td>25.0% (n=1)</td>
</tr>
<tr>
<td>Fetal hypotrophy</td>
<td>15.38% (n=8)</td>
<td>(n=0)</td>
</tr>
<tr>
<td>Uterine myomas</td>
<td>13.46% (n=7)</td>
<td>(n=0)</td>
</tr>
<tr>
<td>Large fetus</td>
<td>11.54% (n=6)</td>
<td>25.0% (n=1)</td>
</tr>
<tr>
<td>Ongoing labor</td>
<td>9.61% (n=5)</td>
<td>25.0% (n=1)</td>
</tr>
<tr>
<td>Intrauterine infection</td>
<td>9.61% (n=5)</td>
<td>(n=0)</td>
</tr>
<tr>
<td>Oligohydramnios</td>
<td>9.61% (n=5)</td>
<td>(n=0)</td>
</tr>
<tr>
<td>Disproportion</td>
<td>5.77% (n=3)</td>
<td>(n=0)</td>
</tr>
</tbody>
</table>
Inducing labor, which is considered a potential PPH risk factor, was used in 19.64% of women (n=11). In 8 cases, labor induction consisted in intravenous oxytocin administration, and amniotomy was performed in the remaining 3 cases. Labor induction was not needed in any of the 4 women who ultimately underwent hysterectomy. Pre-induction was conducted in three cases: with a Foley catheter in 2 cases and with intracervical PGE gel application in 1 case. The most common PPH risk factors observed in the study population are presented in Tab. 3.

In 14.29% of women (n=8), a decision to conclude pregnancy with a Cesarean section was made after an attempt of a natural labor (stage 1 of labor). In the remaining 48 patients (87.27%), the time from the start of the operation to B-Lynch suture application was analyzed. The mean time from the beginning of the procedure to suture application was 65.2 minutes. The time range, in which the suture was usually applied, was 45–60 minutes. The results of the analysis are presented in Fig 2.

Furthermore, laboratory parameters underwent assessment as well. Lower Hct and PLT values were noted in patients who required radical surgery (hysterectomy). By contrast, patients in whom the B-Lynch suture was sufficient were characterized by higher values (26.78% and 143.67/l vs 29.99% and 203.98/l, respectively). The differences were statistically significant (p<0.005). Similar correlations were found concerning blood loss. Average values amounted to 1,857.2 ml for women after hysterectomy vs 739.8 ml for the B-Lynch suture group (the difference was statistically significant).

For 19.64% (n=11) of patients, postpartum hemorrhage was an indication for packed red blood cell transfusion in the proportional amount to the lost blood: 3.55 units of packed RBCs in patients without hysterectomy and 10.6 units of packed RBCs following hysterectomy. The initial hypothesis was that patients undergoing hysterectomy require transfusions of greater amounts of blood because of considerable blood loss (p<0.005). Apart from packed RBCs, 9 women received fresh frozen plasma. In the group of patients that required radical surgery, 8.6 units of FFP were used whereas the group with the B-Lynch suture as a sufficient solution required 5.74 units of FFP. In 2 patients after hysterectomy, PPH was so severe that, apart from packed RBCs and FFP, a therapy with recombinant factor VIIa (Novoseven) was initiated.

Intra-operative assessment of patients with a suture applied revealed placenta increta in 3.57% of women

<table>
<thead>
<tr>
<th>Variables tested</th>
<th>Percentage / Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
</tr>
<tr>
<td>- &lt; 35 years of age</td>
<td>69.64% (n=39)</td>
</tr>
<tr>
<td>- ≥ 35 years of age</td>
<td>30.36% (n=17)</td>
</tr>
<tr>
<td>Primiparas</td>
<td>64.28% (n=28)</td>
</tr>
<tr>
<td>History of Cesarean section</td>
<td>19.46% (n=11)</td>
</tr>
<tr>
<td>History of 1 or more miscarriages</td>
<td>16.07% (n=9)</td>
</tr>
<tr>
<td>Patient after IVF</td>
<td>5.36% (n=3)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PPH risk factors</th>
<th>Patients with B-Lynch suture only (n=52)</th>
<th>Patients with B-Lynch suture and radical procedure (n=4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arterial hypertension in the current pregnancy</td>
<td>21.15% (n=11)</td>
<td>75.0% (n=3)</td>
</tr>
<tr>
<td>History of previous Cesarean section</td>
<td>21.15% (n=11)</td>
<td>(n=0)</td>
</tr>
<tr>
<td>Labor induction</td>
<td>21.15% (n=11)</td>
<td>(n=0)</td>
</tr>
<tr>
<td>Premature placental abruption</td>
<td>13.46% (n=7)</td>
<td>25.0% (n=1)</td>
</tr>
<tr>
<td>Large uterine myomas</td>
<td>13.46% (n=7)</td>
<td>(n=0)</td>
</tr>
<tr>
<td>Antepartum bleeding</td>
<td>11.54% (n=6)</td>
<td>25.0% (n=1)</td>
</tr>
<tr>
<td>Fetal weight &gt;4,500 g</td>
<td>11.54% (n=6)</td>
<td>(n=0)</td>
</tr>
<tr>
<td>Chorioamnionitis</td>
<td>9.61% (n=5)</td>
<td>(n=0)</td>
</tr>
<tr>
<td>History of uterine surgery</td>
<td>3.85% (n=2)</td>
<td>50.0% (n=2)</td>
</tr>
<tr>
<td>History of postpartum hemorrhage</td>
<td>1.92% (n=1)</td>
<td>(n=0)</td>
</tr>
<tr>
<td>History of thrombocytopenia</td>
<td>1.92% (n=1)</td>
<td>(n=0)</td>
</tr>
</tbody>
</table>
B-Lynch suture application due to hemorrhage during Cesarean section

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(n=2). In both cases, uterine curettage was performed and the compressive B-Lynch suture was applied. A radical procedure in the form of hysterectomy was not necessary.

As for the antibiotic therapy conducted in investigated patients, 19.64% (n=11, including 2 patients who underwent hysterectomy) of women received postoperatively third-generation cephalosporin (Cefuroksym) in addition to the standard peri-operative antibiotic therapy.

The duration of hospitalization in the investigated group was 3 days in 73.21% of patients (n=41), including four women discharged on request. The percentage of complications in the postoperative period was 12.5% (n=7).

DISCUSSION
The management in uterine atony depends on several factors, e.g. hemodynamic condition, and plans about having children in the future. Despite the fact that hysterectomy is an effective treatment option, it is selected as the last resort in young patients. Current recommendations of WHO and gynecologic societies suggest that the management compliant with the devascularization algorithm should be followed and that hysterectomy should be conducted in justified cases only.

Most cases of uterine atony that is resistant to conservative treatment, e.g. oxytocin administration, do not require a more extensive surgical intervention; compression B-Lynch suturing is sufficient. The introduction of compression / hemostatic sutures applied to the uterus has become a cost-effective and simple procedure which has become established in the algorithm of severe postpartum hemorrhage treatment. It has contributed to a decrease in the frequency of conducting peripartum hysterectomy. The number of peripartum hysterectomies conducted in the Clinic of Perinatology of the Medical University of Łódź in Poland was 1.2/1,000 deliveries in 2009–2014. This value was lower than the one recorded in 1991–2001 (2.5/1,000 deliveries). The efficacy of the application of a compression suture due to uterine atony in the material investigated amounted to 92.86%. A radical procedure in the form of hysterectomy due to persisting uterine atony was conducted in 4 cases (7.14%) of 56 patients who had previously had the B-Lynch compression suture applied.


Zheng et al. have reported 9 cases of B-Lynch suture application (in one case, it was placed 5 h after a physiological labor, and in 8 patients – after a Cesarean section). In all cases, hysterectomy was avoided. The 18-month follow-up did not show any significant complications [1].

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Fig. 2. Time from the beginning of labor to B-Lynch suture application
Cho et al. [16] present a method that consists in the postpartum involution of the uterine muscle (B-Lynch). Sequence, they may impair the physiological process of result in obstruction and blood retention. In consequence, the authors report that in the remaining 11 women, in whom hemorrhage was effectively controlled, hysteroscopy conducted later did not show any abnormalities, there have been no menstrual disorders or any clinical signs of menopause [10].

The risk of potential complications seems higher when delayed absorbable or unabsorbable sutures are used. This can cause intrauterine adhesions preventing menstrual flow or uterine wall erosion due to ischemia [11–13]. There have been no reports on serious urinary bladder or rectal injury due to the application of a compression suture modification. In the population investigated in this study, 8.1% of women (n=3) reported recurring urinary tract infections, which had not been experienced prior to the application of the B-Lynch suture. Moreover, one patient reported urinary incontinence. New gastrointestinal disorders appeared in 18.92% of patients (n=7). In all cases, these were: intensified flatulence and the feeling of bloating in the abdominal cavity.

In accordance with B-Lynch’s recommendations of 2005, monofilament sutures with total absorption within 90–120 days should be used. B-Lynch has found that the main mechanism of compression sutures on the uterus is not the direct pressure on bleeding sites of the detached placenta, but the reduction of blood flow to the uterus. To sum up, the main aim of the suture is the compression on the uterine muscle, which does not stop the blood flow to the uterus completely, but merely decreases it until its involution [14].

In our clinical practice, B-Lynch sutures are applied with the use of absorbable, multifilament sutures made of poly(glycolide-co-L-lactide) that absorb completely within 60–70 days.

Hayman [15] and Cho [16] emphasize potential risks associated with certain suture modifications that can result in obstruction and blood retention. In consequence, they may impair the physiological process of postpartum involution of the uterine muscle (B-Lynch). Cho et al. [16] present a method that consists in the maximum approximation of the anterior and posterior uterine walls so that there is no free space in the uterine cavity. Another Hayman’s modification recommends the application of an additional hemostatic-compression suture placed on the cervix. Both these modifications can predispose to impaired drainage of clots from the uterus. Our own experience dictates that the application of an additional transverse suture holding two sutures in safer that applying the B-Lynch compression suture without such a support. We have also observed that a short time for decision-making whether or not to place a compression suture, without unnecessary delay, brought about good outcomes in the form of high efficacy of this method.

Another issue that should be considered is the fact that the application of B-Lynch-like sutures on the uterus in combination with iliac vessel ligation carries a higher risk of complications, such as: endometriosis, pyometra, or chronic inflammation due to additional reduction of blood flow to the uterus. A lot of authors are of the opinion that long-term follow up, including diagnostic hysteroscopy, is essential if combination techniques for PPH prevention are used [10,17–20].

Wohlmuth et al. have presented their 8-year experience in using the B-Lynch suture for PPH treatment. The procedure was performed in 22 women, including 10 cases with additional internal iliac artery ligation. It was possible to avoid hysterectomy in 77% of cases. When atony was the main cause of PPH, this percentage was higher and amounted to 85%. There have been no serious complications, such as metritis or necrosis due to ischemia [21].

In the case presentation of Mechsner et al., postoperative sepsis and grade I mitral and aortic regurgitation developed in a patient with B-Lynch and Pereira sutures with bilateral uterine artery embolization [20]. The publication of Abdel - Aziz El Refaeey of 2014, concerning 19 patients with atony in whom PPH developed during a Cesarean section, discusses a modification of the B-Lynch procedure; so-called VV suture was effective in 94.7% of cases. No serious complications were observed, and four women became pregnant again naturally. This suture was effective in 5 of 6 cases of placenta previa, which, according to the authors, is associated with the fact that their manner of suture application helps control bleeding to a considerably greater degree [22].

CONCLUSION

The B-Lynch hemostatic suture has introduced significant changes to the treatment of severe PPH. The period of 13 years of observation has shown that benefits, such as a significant reduction of the frequency of conducting radical procedures in the form of hysterectomy, considerably outweigh remote complications that can be potentially associated with the B-Lynch suture.
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