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# Outcome of B-Lynch Application in Patients with Post-Partum Hemorrhage Following Cesarean Section at Tertiary Care Hospital Larkana

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## ABSTRACT

**Background:** Postpartum hemorrhage (PPH) remains a leading cause of maternal morbidity and mortality worldwide, particularly in low- and middle-income countries. **Objective:** This study aimed to evaluate the outcomes of B-Lynch suture application in patients with PPH following cesarean section. **Methods:** This prospective observational study was conducted at Shaikh Zayed Women's Hospital, Larkana, Sindh, from 10th Oct 2024 to 10th April 2025. A total of 124 patients who developed PPH unresponsive to medical management during cesarean section were included. The B-Lynch compression suture was applied, and intraoperative, postoperative, and follow-up outcomes were recorded. **Results:** The mean age of patients was 29.8 ± 5.4 years, with 70.1% being multigravida. The most common risk factors were uterine overdistension (31.4%) and placenta previa/accreta (21%). The B-Lynch suture successfully controlled hemorrhage in 108 patients (87.1%), while 16 patients (12.9%) required additional interventions, including stepwise devascularization (n = 9) and hysterectomy (n = 7). The mean blood loss was 1520 ± 410 mL, and 79% required blood transfusion with an average of 2.6 units. Postoperative morbidity occurred in 16.9% of patients, with febrile morbidity being the most common. **Conclusion:** It is concluded that the B-Lynch compression suture is a highly effective and safe procedure for controlling PPH during cesarean section. It significantly reduces the need for hysterectomy, preserves fertility, and is associated with minimal complications, making it particularly valuable in resource-limited settings.

## INTRODUCTION

The increasing development of assisted reproductive technology promotes the incidence of twin pregnancy, in which the uterine fibres will be overstretched, resulting in difficulty in uterine fibre contraction and retraction after delivery, that is, uterine atony [1]. As a result, the risk of postpartum haemorrhage in women with twin pregnancy is significantly increased and is reported to be 2. 26 to 4 times higher than that of women with singleton pregnancy according to some studies [2]; additionally, the risk of severe postpartum haemorrhage is reported to be 2.11 times higher [3]. Postpartum hemorrhage (PPH) is one of the most dreaded obstetric emergencies and continues to be a major contributor to maternal mortality and severe maternal morbidity worldwide. It is defined as excessive blood loss of more than 1000 milliliters following a cesarean section or more than 500 milliliters following a vaginal delivery [4]. However, in real-world settings, the diagnosis is typically clinical and is based on hemodynamic instability rather than a precise measurement of blood loss. PPH accounts for approximately 25% of maternal deaths globally, with the burden disproportionately higher in low- and middle-income countries where limited resources, delays in recognition, and inadequate access to transfusion and surgical interventions amplify its consequences [5]. In South Asia and Sub-Saharan Africa, the condition remains a leading direct cause of preventable maternal deaths, highlighting the urgent need for effective, low-cost, and fertility-preserving interventions [6]. The etiology of PPH is often remembered by the "Four T's": Tone (uterine atony), Tissue (retained products of conception), Trauma (genital tract lacerations or uterine rupture), and Thrombin (coagulopathies). Among these, uterine atony is by far the most common, accounting for up to 70–80% of cases [7]. In women undergoing cesarean section, the risk of PPH is higher compared to vaginal delivery due to factors such as uterine overdistension, prolonged labor, placenta previa, and operative complications. If uncontrolled, rapid and massive hemorrhage can result in hypovolemic shock,

multi-organ failure, disseminated intravascular coagulation, and death [8]. According to the World Health Organization (WHO), maternal mortality (MM) is a serious global problem that affects about 300,000 women every year. Alarmingly, 94% of these deaths occur in low-income or developing countries and could have been avoided with timely interventions. Although global maternal mortality rates have decreased over the past few decades, wide disparities persist between countries and regions [9]. Research and international health initiatives have emphasized that the determinants of maternal mortality are not purely medical but also socio-economic in nature. Maternal survival is largely determined by factors such as access to skilled birth attendants, income inequality, and education level. This underscores the need for targeted strategies that not only strengthen healthcare systems but also address broader social determinants of health to ensure equitable outcomes [10].

The management of PPH requires a stepwise approach. Initial strategies focus on non-surgical measures such as bimanual uterine massage and administration of uterotonic drugs, including oxytocin, prostaglandins (carboprost, misoprostol), and ergometrine. Antifibrinolytic therapy, particularly tranexamic acid, has been shown to reduce mortality when administered early. Surgical procedures are required when these medical procedures fail to achieve hemostasis. Traditionally, invasive procedures such as uterine artery ligation, internal iliac artery ligation, or hysterectomy have been employed [11]. Even though they are effective, these methods necessitate advanced surgical expertise, are technically challenging, and, in the case of a hysterectomy, eliminate future fertility. This is especially devastating for young women who want to have more children [12]. In this context, conservative surgical techniques such as uterine compression sutures have emerged as a crucial advancement in the management of atonic PPH. Christopher B-Lynch introduced the B-Lynch suture in the United Kingdom in 1997 [13]. It was the first technique for uterine compression sutures that was widely accepted. It involves placing a brace-like suture that exerts continuous vertical compression on the uterus, thereby reducing blood flow to the uterine sinusoids and controlling haemorrhage [14]. Its relative simplicity, ability to preserve the uterus, rapid application during cesarean sections, and minimal equipment requirements are its primary draws [15]. Since its introduction, multiple modifications and alternative compression sutures have been described, but the B-Lynch technique remains the most extensively studied and widely practiced. In several studies, the B-Lynch suture's reported success rates in controlling PPH range from 75% to 90%, with many women avoiding hysterectomy [16].

### Objective

This study aimed to evaluate the outcomes of B-Lynch suture application in patients with PPH following cesarean section.

## METHODOLOGY

This was a prospective observational study conducted at Shaikh Zayed Women's Hospital, Larkana, Sindh, from 10th Oct 2024 to 10th April 2025. A total of 124 patients were enrolled in the study. The sample size was determined using non-probability consecutive sampling, and all patients who met the inclusion criteria during the study period were recruited.

### Inclusion and Exclusion Criteria

Women who underwent cesarean section and developed postpartum hemorrhage that was unresponsive to standard medical management, including uterotonic drugs, uterine massage, and tranexamic acid, were included in the study. Patients with known coagulation disorders, uterine rupture requiring repair, placenta accreta spectrum requiring hysterectomy, or those unwilling to provide consent were excluded.

### Data Collection

Data were collected using a structured proforma. Demographic characteristics, obstetric history, parity, risk factors for PPH, and intraoperative details were documented. The amount of blood loss was estimated based on intraoperative suction measurements and soaked swab counts. The number of blood transfusion units, duration of surgery, length of hospital stay, and postoperative complications were also recorded. In all included patients, once medical measures failed to control bleeding, a B-Lynch compression suture was applied. The procedure was performed as originally described by Christopher B-Lynch in 1997, using an absorbable suture material to place a brace-like stitch that exerted vertical compression across the uterus. The adequacy of hemostasis was assessed intraoperatively by visual control of bleeding and improvement in uterine tone. In cases where bleeding persisted despite the application of B-Lynch sutures, further interventions such as stepwise devascularization or hysterectomy were performed, and these were recorded. The primary outcome measure was successful control of postpartum hemorrhage using the B-Lynch suture, defined as cessation of hemorrhage without the need for additional surgical interventions. Secondary outcome measures included maternal survival, need for blood transfusion, intra- and postoperative complications (such as pyometra, wound infection, febrile morbidity, or hematometra), and the resumption of normal menstruation at follow-up. Follow-up assessments were conducted at six weeks and three months postoperatively to evaluate menstrual function and any long-term complications.

### Statistical Analysis

Data were entered and analyzed using the Statistical Package for Social Sciences (SPSS) version 25. Quantitative variables such as age, blood loss, and hospital stay were expressed as mean ± standard deviation (SD). Categorical variables such as parity, etiology of PPH, success rate of B-Lynch suture, requirement of additional surgical procedures, and occurrence of complications were presented as frequencies and percentages. Associations between categorical variables were assessed using the chi-square test. A p-value ≤0.05 was considered statistically significant.

## RESULTS

Data were collected from 124 patients, with mean age 29.8

± 5.4 years. Most were multigravida (87, 70.1%), with nearly one-third primigravida (37, 29.9%). The leading risk factor for PPH was uterine overdistension (39, 31.4%), followed by placenta previa/accreta (26, 21.0%) and prolonged labor (19, 15.3%); about one-third had other/no identifiable risk (40, 32.3%). Overall, the case-mix reflects a typical cesarean PPH population with a predominance of atony-related risk (overdistension) and a meaningful burden of abnormal placentation.

**Table 1**

*Baseline Demographic and Clinical Characteristics of Patients (N = 124)*

| Variable | Total (n = 124) |
|---|---|
| Age, years (Mean ± SD) | 29.8 ± 5.4 |
| Parity | |
| – Primigravida | 37 (29.9%) |
| – Multigravida | 87 (70.1%) |
| Risk Factors | |
| – Uterine overdistension | 39 (31.4%) |
| – Placenta previa/accreta | 26 (21.0%) |
| – Prolonged labor | 19 (15.3%) |
| – Others/none | 40 (32.3%) |

B-Lynch controlled hemorrhage in 108 patients (87.1%), while 16 (12.9%) required escalation stepwise devascularization in 9 (7.3%) and hysterectomy in 7 (5.6%). Average blood loss was substantial (1520 ± 410 mL), and most patients needed transfusion (98, 79.0%; mean 2.6 ± 1.2 units). Postoperative morbidity was modest overall (21, 16.9%), mainly febrile morbidity (12, 9.6%) and wound infection (6, 4.8%), with a small number of pyometra cases (3, 2.4%).

**Table 2**

*Intraoperative Outcomes*

| Outcome | n (%) |
|---|---|
| Successful control of hemorrhage with B-Lynch | 108 (87.1%) |
| Failed B-Lynch requiring further intervention | 16 (12.9%) |
| – Stepwise devascularization | 9 (7.3%) |
| – Emergency hysterectomy | 7 (5.6%) |
| Mean blood loss (mL ± SD) | 1520 ± 410 |
| Blood transfusion required | 98 (79.0%) |
| Mean units transfused | 2.6 ± 1.2 |
| Complications | |
| Febrile morbidity | 12 (9.6%) |
| Wound infection | 6 (4.8%) |
| Pyometra | 3 (2.4%) |
| Other complications | 0 (0.0%) |
| Total morbidity | 21 (16.9%) |

**Figure 1**

*Risk Factors in PPH Patients*

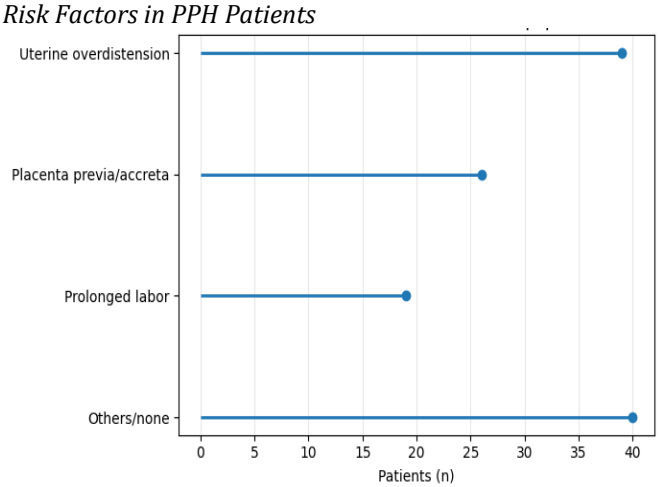
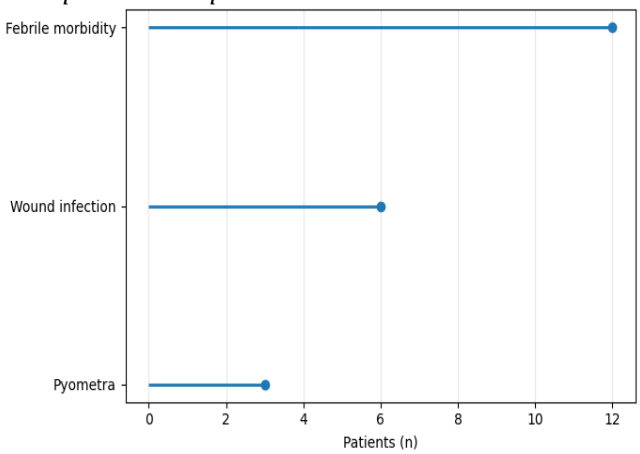



**Figure 2**

*Post-Operative Complications*




Recovery markers were favorable. By 6 weeks, most patients had resumed normal menses (111, 89.5%) with limited irregularities (13, 10.5%). By 3 months, normalization increased to 118 (95.2%), and persistent irregularities fell to 6 (4.8%).

**Table 3**

*Follow-up Outcomes*

| Follow-up Outcome | n (%) |
|---|---|
| Normal menstruation at 6 weeks | 111 (89.5%) |
| Menstrual irregularities at 6 weeks | 13 (10.5%) |
| Normal menstruation at 3 months | 118 (95.2%) |
| Persistent irregularities at 3 months | 6 (4.8%) |
| Uterine synechiae/infertility | 0 (0.0%) |

Patients with successful B-Lynch had lower mean blood loss (1460 ± 380 vs 1920 ± 420 mL, $p < 0.05$) and required fewer transfusion units (2.3 ± 1.0 vs 4.1 ± 1.4, $p < 0.05$). They also had significantly less postoperative morbidity (12.9% vs 43.8%, $p < 0.01$) and shorter hospital stay (4.6 ± 1.3 vs 7.2 ± 2.1 days, $p < 0.01$).

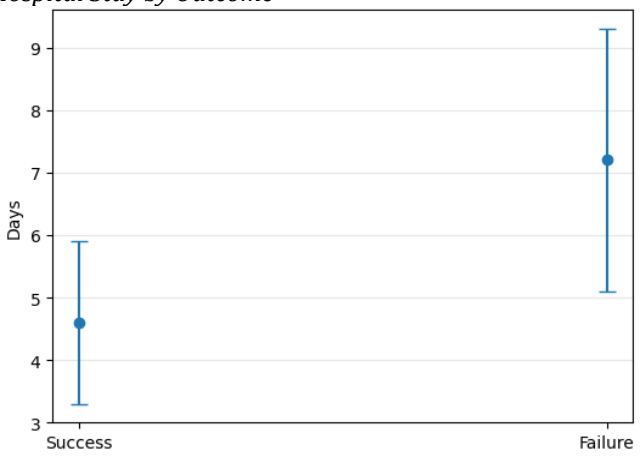
**Table 4**

*Comparison of Successful vs. Failed B-Lynch Outcomes*

| Variable | Successful (n = 108) | Failed (n = 16) | p-value |
|---|---|---|---|
| Mean blood loss (mL ± SD) | 1460 ± 380 | 1920 ± 420 | <0.05 |
| Mean transfusion units | 2.3 ± 1.0 | 4.1 ± 1.4 | <0.05 |
| Postoperative morbidity | 14 (12.9%) | 7 (43.8%) | <0.01 |
| Length of hospital stay (days) | 4.6 ± 1.3 | 7.2 ± 2.1 | <0.01 |

**Figure 3**

*Hospital Stay by Outcome*



## DISCUSSION

In this study, the B-Lynch compression suture demonstrated a high success rate in controlling postpartum hemorrhage (PPH) following cesarean section, with effective hemostasis achieved in 87.1% of patients. Only 12.9% required further interventions, including stepwise devascularization or hysterectomy. These findings reinforce the role of the B-Lynch suture as a reliable, fertility-preserving option for the surgical management of atonic PPH when medical therapy fails. The results are consistent with earlier reports in which success rates of 75%–90% have been described for the B-Lynch technique in similar populations. Previous studies have also highlighted its simplicity, rapid application, and minimal requirement for surgical expertise compared with vascular ligation techniques. In our study, patients who responded to the B-Lynch suture required fewer blood transfusion units and had shorter hospital stays compared with those in whom the procedure failed, a pattern also echoed in earlier literature. This underscores that timely application of compression sutures not only improves survival but also reduces resource utilization [17]. In our cohort, postoperative morbidity was relatively low (16.9%), and complications like pyometra, wound infection, and febrile morbidity were self-limiting and conservatively managed. Importantly, there were no maternal deaths recorded, proving that this method is safe. During the three-month surveillance period, no cases of uterine synechiae or infertility were observed, and follow-up revealed that the majority of patients resumed normal menstruation [18]. Our findings support previous evidence that the B-Lynch suture does not significantly affect subsequent fertility, even though a longer follow-up is required to fully evaluate reproductive outcomes. The B-Lynch suture has significant advantages over more drastic treatments like hysterectomy, especially for young women who want to conceive in the future. Even though hysterectomy is permanent, it has serious psychological and social repercussions, especially in low-resource settings. Alternative conservative measures such as uterine artery embolization, though effective, require interventional radiology services that are often unavailable in developing countries. In contrast, the B-Lynch suture is inexpensive, requires only standard suture material, and can be performed by most obstetricians during cesarean section, making it especially valuable in resource-constrained environments such as Pakistan [19]. Despite its advantages, the B-Lynch technique is not universally successful. In our study, failure occurred in 16 patients, most commonly in association with placenta accreta spectrum or severe coagulopathy. This is consistent with previous findings that a poor response to compression sutures is predicted by abnormal placentation and underlying clotting abnormalities. Early detection and prompt hysterectomy transition may save lives in these situations [20]. The strengths of our study include a relatively large sample size and prospective data collection, which enhance the reliability of the findings. However, certain limitations should be acknowledged. The study was conducted at a single center, which may limit the generalizability of results [21-22]. The follow-up period was limited to three months, and thus long-term reproductive outcomes could not be fully assessed. Additionally, as this was an observational study without a control group, direct comparison with alternative surgical interventions was not possible. Nevertheless, the clinical implications of our findings are significant. The high success rate, favorable safety profile, and fertility-preserving nature of the B-Lynch suture strongly support its use as a first-line surgical option for uncontrolled atonic PPH during cesarean section. Wider dissemination of training in this technique, particularly in peripheral hospitals and low-resource settings, could play a crucial role in reducing maternal morbidity and mortality associated with obstetric hemorrhage.

## CONCLUSION

It is concluded that the B-Lynch compression suture is an effective, safe, and fertility-preserving surgical technique for the management of postpartum hemorrhage following cesarean section. In our study, it successfully controlled hemorrhage in the majority of patients, reduced the need for hysterectomy, and was associated with favorable postoperative outcomes and minimal complications. Given its simplicity, low cost, and applicability in resource-limited settings, the B-Lynch suture should be considered a first-line surgical intervention when medical management fails.

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