



# Association of Postpartum Hemorrhage Complications with its Risk Factors and Surgical Treatment

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**Keywords:** Post-partum risk factors; Post-partum complication; Post-partum hemorrhage and surgical treatment..

## Abstract

**Objective:** Post Partum Hemorrhage (PPH) is defined as the cumulative blood loss of  $\geq 1,000$  ml or bleeding with signs or symptoms of hypovolemia, regardless of the delivery route. Numerous factors directly increase the risk of PPH. Complications may occur because of PPH itself or because of its treatment. We assessed the correlation of PPH complications with its risk factors and surgical interventions.

**Methods:** This hospital-based, retrospective cohort study included 237 females who developed PPH during vaginal or Cesarean Section (CS) deliveries. Patient data were obtained from hospital medical records and analyzed using SPSS Statistics software. Pearson's chi-square test was used to analyze the relationships between complications, risk factors, and interventions.

**Results:** CS (39%) was the most significant risk factor, while anemia (26.2%) was the most common PPH complication, followed by hysterectomy (15.2%). CS and placental abnormalities were significantly correlated with hysterectomy, while anemia did not correlate with any of the risk factors. PPH was managed surgically in 17.7% of patients. Selective arterial embolization was significantly correlated with hysterectomy, whereas the remaining approaches were not significantly associated with PPH complications.

**Conclusion:** Anemia was the most common complication of PPH but was not associated with the PPH risk factors. Hysterectomy was significantly associated with CS and selective arterial embolization. Our findings can guide obstetric physicians to predict PPH complications and inform patients about the risk factors and appropriate surgical interventions.



## Introduction

Postpartum Hemorrhage (PPH) is a medical emergency. Although the absolute risk of PPH-related death is low in high-income countries, it is one of the most common causes of maternal mortality in both high and low-income countries [1]. Prevention of PPH-related mortality requires timely identification and availability of appropriate resources and trained personnel.

In 2017, the American College of Obstetricians and Gynecologists revised their definition of PPH as a total blood loss of  $\geq 1,000$  ml or bleeding associated with signs or symptoms of hypovolemia within 24 h of delivery [1]. The use of this revised definition would reduce the number of females incorrectly diagnosed with PPH. However, despite the new definition, blood loss of  $> 500$  ml during vaginal delivery is considered abnormal and warrants further investigation for its cause [1].

Primary PPH occurs within 24 h after delivery and secondary PPH occurs between 24 h and 6 weeks after delivery [2]. PPH is associated with several complications, including hypovolemia, anemia, and coagulation abnormalities [3,4] and is considered an emergency because of its high mortality rate [5]. Moreover, acute blood loss and hypovolemia decrease the blood supply to pituitary gland, leading to necrosis and loss of function, i.e., Sheehan's syndrome [5]. In addition, PPH patients are at a high risk of postpartum depression [5]. The complications of PPH may be related to its underlying cause as well as its treatment. Balloon tamponade can cause fever, infections, endometritis, cervical tear, colonic pseudo-obstruction, laceration of the vaginal lower segment, and uterine perforation [6]. Selective arterial embolization is a less commonly performed procedure that may cause hematoma formation at the puncture site and external iliac artery thrombosis [7]. Hypogastric artery ligation may cause several complications, including external and internal iliac vein injuries, bladder atony, gluteal muscle ischemia, and external iliac artery thrombosis [8]. The application of uterine compression sutures can cause endomyometritis, postpartum oliguria, blood trapping, and uterine ischemia and necrosis [9].

The risk factors and complications of PPH are categorized into classes I-III. Class I comprises low-risk factors, including singleton pregnancy, fewer than four previous pregnancies, unscarred uterus, and absence of PPH history. Class II consists of medium-risk factors, including prior Cesarean Section (CS) or uterine surgery, more than four previous deliveries, multiple gestations, large uterine fibroids, chorioamnionitis, magnesium sulfate use, and prolonged oxytocin use. Class III comprises high-risk factors, including placenta previa, accreta, increta, or percreta, hematocrit of  $< 30\%$ , bleeding at the time of admission, coagulation defects, history of PPH, and abnormal vital signs (particularly tachycardia and hypotension)[10]. Obstetric hemorrhage is common and unpredictable, causes significant morbidity and mortality; therefore, obstetric personnel should be prepared to treat PPH. In the present study, we assessed the correlation of PPH complications with its risk factors and surgical interventions to aid in improving the obstetric service and reduce PPH-related mortality and morbidity.

## Methods

This hospital-based retrospective cohort study was conducted between June and August 2021 at King Abdulaziz University Hospital, a tertiary academic hospital in Jeddah, Saudi Arabia after obtaining ethical approval from Research Ethics Committee. The study included patients who developed PPH following vagi-

nal or CS delivery between June 2016 and August 2021. Patient data, including age, gravidity, parity, abortion, or fetal demise, PPH risk factors (history of PPH, abnormal placenta, bleeding at admission, prior CS or uterine surgery, multiple gestations, and chorioamnionitis), and medical and surgical interventions, were obtained from hospital medical records. SPSS Statistics for Windows (version 25; IBM Corp., Armonk, NY, USA) was used for statistical analyses. Patient data were analyzed using descriptive statistics. The relationships between variables were analyzed using Pearson's chi-square test. The threshold for significance was  $p < .05$ . Ethical approval was obtained from the King Abdulaziz University Hospital Institutional Review Board prior to the study.

## Results

This study included 237 patients with a mean age of  $31.75 \pm 6.2$  years (range: 17-48 years; **Table 1**). Vaginal (48.5%,  $n = 115$ ) and CS (51.5%,  $n = 122$ ) deliveries were performed in a similar proportion of participants. The majority of patients developed class I PPH (98.7%,  $n = 234$ ), while only a small proportion developed class II PPH (1.3%,  $n = 3$ ). Patients who received misoprostol (mean:  $47 \pm 19.8\%$ ) and oxytocin (mean dose:  $33 \pm 13.9\%$ ). **Table 2** summarizes the PPH risk factors in the patients. Approximately 39.7% ( $n = 94$ ) of patients had a history of CS, 24.1% ( $n = 57$ ) had placenta previa, 15.6% ( $n = 37$ ) had history of dilation and curettage and placental retention each, and 11.0% ( $n = 26$ ) had placenta accreta. A small proportion of patients exhibited other risk factors, including multiple gestations (6.3%,  $n = 15$ ), preeclampsia (5.5%,  $n = 13$ ), chorioamnionitis (4.6%,  $n = 11$ ), placenta in creta (4.2%,  $n = 10$ ), placental abruption (4.2%,  $n = 10$ ), bleeding at admission (3.0%,  $n = 7$ ), placenta percreta (2.5%,  $n = 6$ ), and a history of myomectomy (1.3%,  $n = 3$ ). **Table 3** summarizes the management approaches for PPH. Surgical treatment was performed in 17.7% ( $n = 42$ ) of PPH patients and included hysterectomy (15.2%,  $n = 36$ ), balloon tamponade (2.5%,  $n = 6$ ), arterial ligation (2.1%,  $n = 5$ ), selective arterial embolization (1.3%,  $n = 3$ ), and uterine compression suturing (0.8%,  $n = 2$ ). **Table 4** shows the PPH complications and their management. The most common complication was anemia (26.2%,  $n = 62$ ), followed by hysterectomy (15.2%,  $n = 36$ ). A few patients developed disseminated intravascular coagulation (2.1%,  $n = 5$ ) and uterine rupture (0.8%,  $n = 2$ ). Although the surgical management of PPH was associated with complications, there were no complications related to balloon tamponade, selective arterial embolization, hepatic artery ligation, or uterine compression suturing. We evaluated the association between PPH risk factors and its complications (i.e., anemia and hysterectomy; **Table 5**). The risk factors and complications present in only a few patients were excluded from the analyses. The chi-square test revealed significant associations between hysterectomy and PPH risk factors, including placental retention (0.4%,  $n = 1$ ;  $p = 0.021$ ), placenta accreta (7.2%,  $n = 17$ ;  $p < 0.001$ ), placenta previa (11.0%,  $n = 26$ ;  $p < 0.001$ ), placenta in creta (3.8%,  $n = 9$ ;  $p < 0.001$ ), bleeding at admission (5.9%,  $n = 14$ ;  $p = 0.008$ ), and a history of CS (14.8%,  $n = 35$ ;  $p < 0.001$ ). There were no significant associations between anemia and PPH risk factors ( $p > 0.05$  for all). The distribution of PPH complications and risk factors are shown in **Figure 1**. **Table 6** shows the association between PPH complications and surgical management. Hysterectomy was significantly associated with selective arterial embolization (1.3%,  $n = 3$ ;  $p < 0.001$ ). There was no significant association between anemia and PPH management approaches ( $p > 0.05$  for all). The PPH complications and their surgical management are shown in **Figure 2**.

**Table 1:** Socio demographic and Clinical Characteristics (n = 237).

Demographics	n	Min.	Max.	Mean	SD
Age (years)	237	17	48	31.75	6.2
		Count		%	
Total		237		100.0	
Mode of delivery	Vaginal	115		48.5	
	Cesarean section	122		51.5	
Postpartum hemorrhage	Primary	234		98.7	
	Secondary	3		1.3	
Medication					
Misoprostol		47		19.8	
Oxytocin		33		13.9	

Min: Minimum; Max: Maximum; SD: Standard Deviation

**Table 2:** Risk factors of primary postpartum hemorrhage (n = 237).

Risk Factors	Count (n)	%
History of postpartum hemorrhage	20	8.4
Placental retention	37	15.6
Placenta accreta	26	11.0
Placenta previa	57	24.1
Placenta percreta	6	2.5
Placenta increta	10	4.2
Placental abruption	10	4.2
Bleeding at admission	52	21.9
Previous cesarean section	94	39.7
Dilation and curettage	37	15.6
Myomectomy	3	1.3
Multiple gestation	15	6.3
Chorioamnionitis	11	4.6
Preeclampsia	13	5.5

**Table 3:** Management of postpartum hemorrhage.

Variables	Count	%
Total	237	100.0
Surgical treatment	42	17.7
Balloon tamponade	6	2.5
Uterine compression suturing	2	0.8
Arterial ligation	5	2.1
Selective arterial embolization	3	1.3
Hysterectomy	36	15.2

**Table 4:** Postpartum hemorrhage complications.

Complications	N	%
Postpartum hemorrhage-related		
Anemia	62	26.2
Sheehan's syndrome	0	0.0
Disseminated intravascular coagulation	5	2.1
Hysterectomy	36	15.2
Uterine rupture	2	0.8
Balloon tamponade-related		
Fever	5	2.1
Infection	5	2.1
Endometritis	5	2.1
Cervical tear	5	2.1
Colonic pseudo-obstruction	5	2.1
Vaginal laceration	5	2.1
Uterine perforation	5	2.1
Selective arterial embolization-related		
Hematoma	3	1.3
External iliac artery thrombosis	3	1.3
Hypogastric artery ligation-related		
External iliac vein injury	5	2.1
Internal iliac vein injury	5	2.1
Bladder atony	5	2.1
Gluteal muscle ischemia	5	2.1
External iliac artery thrombosis	5	2.1
Uterine compression suture-related		
Endomyometritis	3	1.3
Postpartum oliguria	3	1.3
Blood trapping	3	1.3
Uterine ischemia and necrosis	3	1.3

**Table 5:** Association between postpartum hemorrhage risk factors and complications.

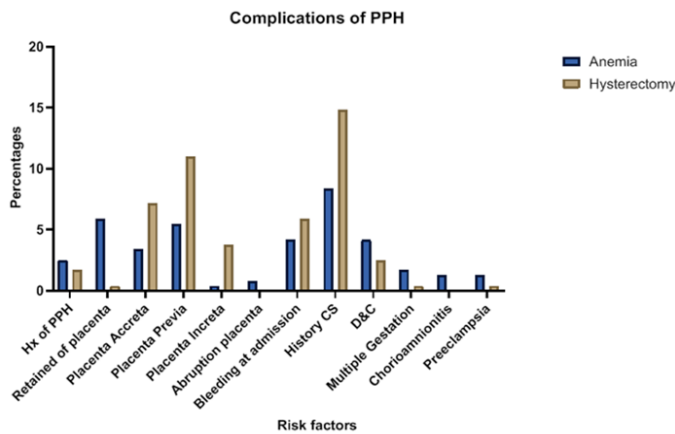
Risk Factors	Anemia		Hysterectomy	
	n (%)	P value	n (%)	P value
History of postpartum hemorrhage	6 (2.5)	0.683	4 (1.7)	0.531
Placental retention	14 (5.9)	0.079	1 (0.4)	0.021 <sup>a</sup>
Placenta accreta	8 (3.4)	0.571	17 (7.2)	< 0.001 <sup>a</sup>
Placenta previa	13 (5.5)	0.509	26 (11.0)	< 0.001 <sup>a</sup>
Placenta increta	1 (0.4)	0.235	9 (3.8)	< 0.001 <sup>a</sup>
Placental abruption	2 (0.8)	0.651	0 (0.0)	0.171
Bleeding at admission	10 (4.2)	0.198	14 (5.9)	0.008 <sup>a</sup>
History of cesarean section	20 (8.4)	0.165	35 (14.8)	< 0.001 <sup>a</sup>
Dilation and curettage	10 (4.2)	0.896	6 (2.5)	0.85
Multiple gestation	4 (1.7)	0.963	1 (0.4)	0.342
Chorioamnionitis	3 (1.3)	0.931	0 (0.0)	0.151
Preeclampsia	3 (1.3)	0.795	1 (0.4)	0.439

<sup>a</sup>Threshold for significance was set at P < 0.05 using Pearson's chi-square test.

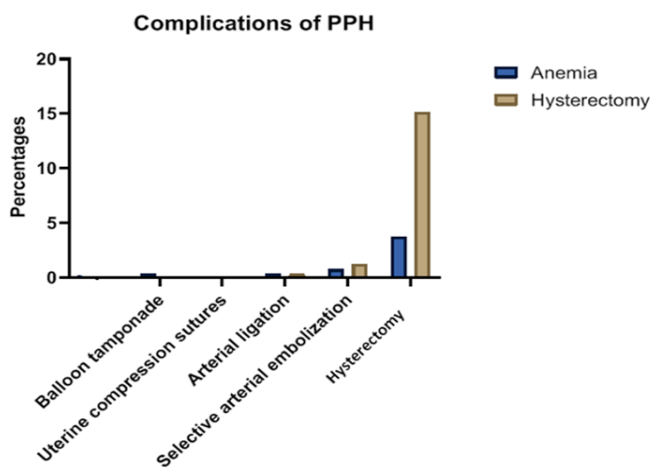
**Table 6:** Association between postpartum hemorrhage complications and surgical management.

Surgical treatment	Anemia		Hysterectomy	
	n (%)	P value	n (%)	P value
Balloon tamponade	1 (0.4)	0.592	0 (0.0)	0.294
Uterine compression suturing	0 (0.0)	0.398	0 (0.0)	0.548
Arterial ligation	1 (0.4)	0.751	1 (0.4)	0.762
Selective arterial embolization	2 (0.8)	0.108	3 (1.3)	< 0.001 <sup>a</sup>
Hysterectomy	9 (3.8)	0.863	36 (15.2)	< 0.001 <sup>a</sup>

A Threshold for significance was set at  $p < 0.05$  for Pearson's chi-square test.



**Figure 1:** Distribution of PPH complications and risk factors.



**Figure 2:** Distribution of PPH complications and surgical management.

**Discussion**

In this single-center retrospective study, we investigated the correlation of PPH complications with its risk factors and surgical interventions. Hysterectomy correlated significantly with the surgical risk factors, including CS and placental abnormalities, and with selective arterial embolization. Although anemia was the most common complication among PPH patients, it was not significantly associated with the risk factors or surgical interventions.

An Indian study reported that 64.86% of females developed severe anemia after PPH [4]. However, few studies have investigated the association between anemia and PPH risk factors [11, 12]. A Pakistani study classified 1,279 females with 500-999 ml of intrapartum blood loss into PPH prevention and treatment

categories and assessed their correlation with anemia. Both categories showed a decrease in hemoglobin levels, but the decrease was greater in the treatment category, which is partially in agreement with our findings [11]. A 15-year retrospective study of PPH patients from the United Kingdom reported that placenta accreta (28%) was the most common indication for hysterectomy [13]. Another 8-year study from the United States reported that 0.08% of PPH patients underwent hysterectomy, most commonly for placental abnormalities [14]. Consistent with previous studies, placental abnormalities were a significant risk factor for hysterectomy in our study. However, it is difficult to establish a causative relationship because hysterectomy is also performed for PPH treatment [15]. There is a lack of studies comparing various PPH surgical interventions. Surgical approaches that preserve fertility and have fewer complications, including balloon tamponade, uterine compression suturing, arterial ligation, and selective arterial embolization, are preferred over hysterectomy. Additionally, we found that selective arterial embolization was significantly associated with hysterectomy, which may be due to the high failure rate of selective arterial embolization, possibly because of technical errors. This leads to a lack of response to embolization in the retained tissues [16].

This study also had a few limitations. It was a single-center retrospective study with a small sample size, which limits the generalizability of our findings. In addition, the patients were not followed up after PPH, so long-term data are not available.

**Conclusion**

Anemia was the most common PPH complication and was not associated with any of the PPH risk factors. Hysterectomy was significantly associated with CS and selective arterial embolization. The correlation between PPH risk factors and complications can aid in the selection of PPH treatment and informing the patients of the prognosis. Further multi-center studies with large sample sizes are required to confirm our findings and assess the significance of PPH risk factors, surgical interventions, and complications.

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