

**Critical concept of risk postpartum readmission following postpartum hemorrhage: A multicenter prospective cohort study**

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**Abstract**

Postpartum hemorrhage (PPH) is a leading cause of maternal mortality and morbidity. Therefore, risk factors need to be investigated to control for this serious complication and prevent readmission. The objective of this study is analysis the risk of postpartum readmission for postpartum hemorrhage within sixty days from a delivery hospitalization. Between January 2017 and February 2018, 369 women age 16-45 years enrolled in a prospective cohort study that conducted at Al-Manathera and Al-Zahraa hospitals/Najaf in Iraq. We evaluated any readmission that occurred within 60 days after delivery hospitalization discharge by Adjusted log linear regression models for only the first readmissions was included in the analysis. A total of 369 patients had a diagnosis of PPH during their delivery in hospital ((214(58%) normal vaginal delivery and 155(42%) caesarian section)); of these 62.4% had isolated PPH, 18.8% had PPH with placenta previa, 12.6% had PPH with hypertention, 10.4% had PPH with DIC, 2.6% had a PPH with pregestational DM, and 1.2% had a PPH with gestational DM. Overall 19(7.011) women were readmitted for a primary indication of postpartum hemorrhage. PPH readmissions were most common 1-14 days after discharge (78% of readmissions) and 15-25 days after discharge (13% of readmissions). 5% of readmissions occurred 26-35 days after discharge and 1% occurred 35-60 days after discharge.

In conclusion, this data show that the women at high risk of PPH needs close follow up to prevent of readmission for postpartum hemorrhage.

**Keywords:** Postpartum hemorrhage; Readmission for postpartum hemorrhage; Caesarian section

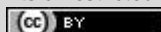
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## Introduction

An estimated 2,87,000 maternal deaths occurred worldwide in 2010. The major causes were primary postpartum hemorrhage (PPH), hypertensive disorders, and sepsis, with an increasing incidence in developed countries [1]. Despite the growing knowledge about risk factors, we are still unable to fully explain the increasing incidence of this obstetric complication. The most common etiology of PPH is uterine atony (impaired uterine contraction after birth), which occurs in about 80 percent of cases. Atony may be related to over distention of the uterus, infection, placental abnormalities, or bladder distention [2]. Although the majority of women who develop PPH have no identifiable risk factors, clinical factors associated with uterine atony, such as multiple gestation, polyhydramnios, high parity, and prolonged labor, may lead to a higher index of suspicion [3]. Other causes of PPH include retained placenta or clots, lacerations, uterine rupture or inversion, and inherited or acquired coagulation abnormalities [4]. postpartum readmissions may be of increasing clinical importance. Overall risk for postpartum readmission is increasing with a recent study finding an increase from 1.72% in 2004 to 2.16% in 2011 [5]. Prior studies have identified risk factors for readmission including advanced age, race, socioeconomic status, chronic comorbidities, multiple gestation, cesarean delivery, and other high-risk pregnancy conditions [6]. However, no study to date has focused on how postpartum hemorrhage is associated with readmission. Prior research has estimated that hemorrhage or retained products of conception are the primary or associated diagnosis in 13% of postpartum readmissions [7]. If women experiencing significant hemorrhage during delivery are at increased risk for readmission, shorter-term postpartum follow up may be indicated [8]. The purpose of this study was to characterize risk for factors associated with readmission for a primary diagnosis of postpartum hemorrhage as well as determine risk for readmission associated with PPH during delivery hospitalizations.

## Patients and Method

### *Patients*

The study population included women with a significant PPH defined as: an estimated blood loss of 1500 mL or more in the 24 hours following childbirth. A prospective cohort study 369 women with a significant PPH defined as: an estimated blood loss of 1500 mL or more in the 24 hours following childbirth. This study was conducted at AlManathera and Al- zahraa teaching hospitals/ Najaf in Iraq between January 2017

and February 2018. To account for multiple readmissions within the first 60 days postpartum, only the first readmission was included in the analysis. Demographic factors included maternal age, mode of delivery (cesarean delivery versus vaginal delivery), diabetes status (pre-gestational diabetes, gestational diabetes, and no diabetes), hypertension status and determined the association between each of these factors and risk for readmission with a primary diagnosis of postpartum hemorrhage.

### Statistics

Differences between unrelated proportions were tested using Chi Squared tests. McNemar's test was used to determine the significance of the difference between paired proportions.

### Results

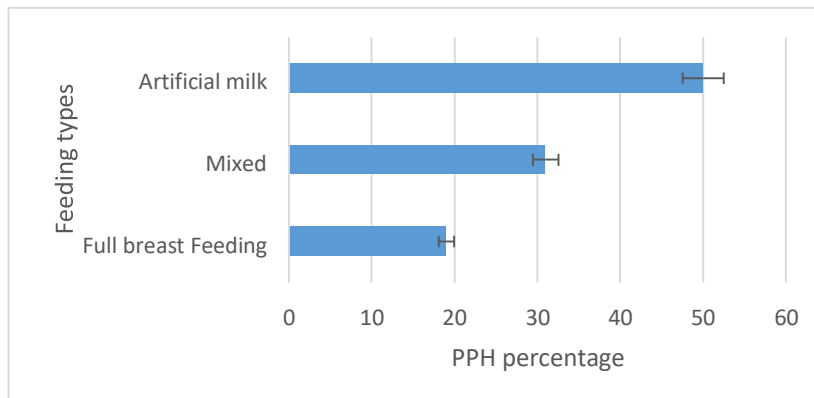
A total of 369 patients had a diagnosis of PPH during their delivery in hospital; of these 62.4% had isolated PPH, 18.8% had PPH with placenta previa, 12.6% had PPH with hypertension, 10.4% had PPH with DIC, 2.6% had a PPH with pregestational DM, and 1.2% had a PPH with gestational DM. Overall 19(7.011) women were readmitted for a primary indication of postpartum hemorrhage (**Table 1**).

**Table 1.**

PPH risk factors; included all factors adjusted RR, risk ratio. aRR, adjusted risk ratio.

PPH Categories	%	RR	95% CI	aRR	95% CI
PPH alone	18.8%	6.57	6.43	6.11	6.13
Vaginal delivery with PPH	58%	4.52	4.21	4.01	4.32
Cesarean with PPH	42%	3.98	3.54	3.12	3.65
placenta previa	18.8%	2.54	2.41	2.02	2.32
PPH with hypertension	12.6%	1.87	1.56	1.05	1.43
PPH with DIC	10.4%	1.32	1.36	1.05	1.29
Pre-gestational DM	2.6%	0.76	0.72	0.63	0.71
Gestational DM	1.2%	0.32	0.35	0.27	0.36

Interestingly from overall, 19% of women with significant PPH were fully breastfeeding in the first postpartum week, 31% with mixed feeding (**Figure 1**), and 50% with artificial milk.

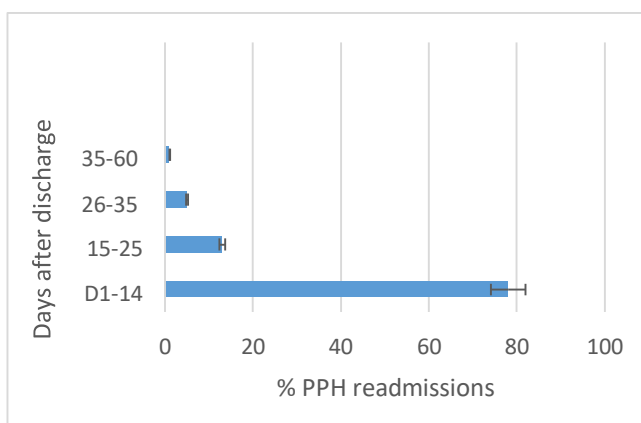


**Figure 1.**

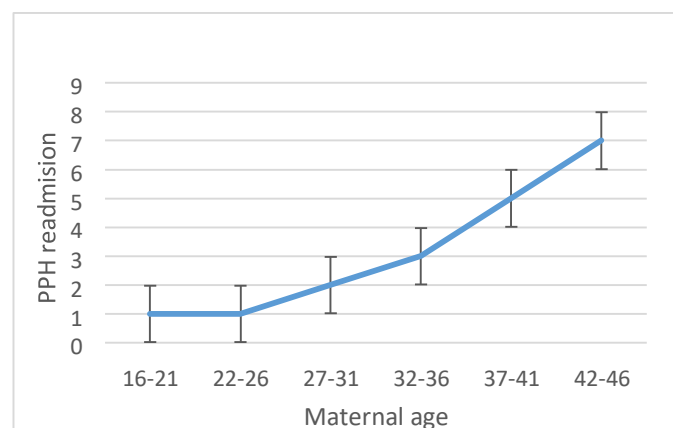
Patient demographics based on postpartum hemorrhage during delivery hospitalization

PPH readmissions were most common 1-14 days after discharge (78% of readmissions) and 15-25 days after discharge (13% of readmissions). 5% of readmissions occurred 26-35 days after discharge and 1% occurred 35-60 days after discharge **Figure 2**.

Furthermore, risk factor associated with readmission for PPH included maternal age 42-46 have high risk for readmission compared with younger age group  $p < 0.02$  as in **Figure 3**.



**Figure 2.**

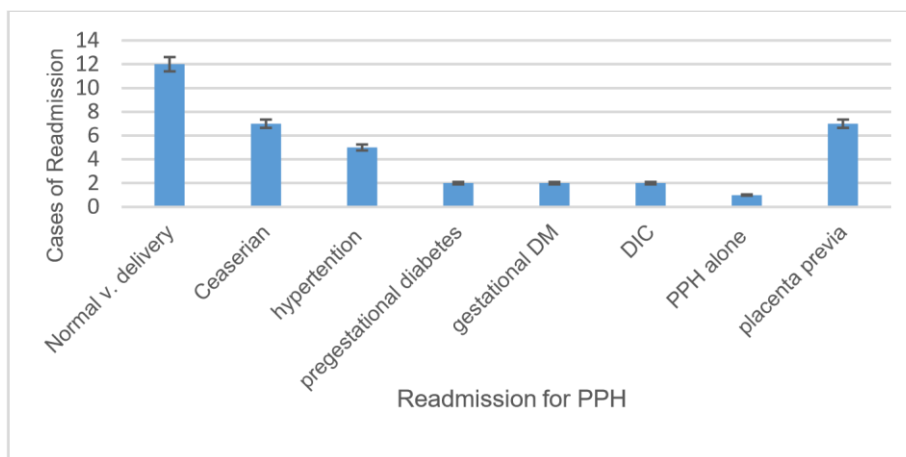


**Figure 3.**

Days after discharge based of PPH readmissions  
maternal age

Readmission for PPH with

Furthermore, normal vaginal delivery had significant associated with PPH readmissions compared with caesarian section  $p < 0.02$ . While PPH readmissions hemorrhage more risk in PPH companied with pregestational diabetes, gestational DM, placenta previa, hypertensive diseases, and DIC compared with PPH alone  $p < 0.01$ .



**Figure 4.**

Patient demographics based on PPH readmission

## Discussion

This cohort prospective study of women with significant PPH in multicenter design study shows that most of the cases of PPH had an identifiable risk factor for developing PPH. The most reasonable risk factor for PPH was uterine atony as the primary direct cause of PPH [10]. The women with combined risk factors significantly related to PPH have more morbidity and mortality like genital tract injuries, coagulation abnormalities, past history of PPH, multiple gestations and placental abnormalities, such as placenta previa or placenta accrete [11]. This resulted data shows that the health personnel should always be well prepared to prevent maternal deaths, as the condition may develop even where there are no identifiable risk factors. Furthermore, our data confirmed previously reported associations with prior caesarean section compared with normal vaginal delivery.

In 2008, a systematic review article was published on the incidence of PPH in different regions showed that the incidence was believed to be around 6% in observational studies [12, 13]. However, there was a wide variation across the different regions of the world, ranging from 2.55% in Asia to 10.45% in Africa [14]. Many other, studies confirmed that labor induction and augmentation, and fetal macrosomia, transverse lie, and marginal umbilical cord insertion in the placenta [15, 16] have also role in PPH. In addition, this resulted data showed that placenta previa have significant role in PPH with similar result with other study that observed increased risks associated with, placenta previa or low-lying placenta, uterine or cervical trauma at delivery, and gestational age < 32 weeks [17].

This data analysis clearly demonstrated that severe PPH were observed for maternal age  $\geq 35$  years, and its consistent with previous study that mentioned old women with age  $\geq 35$  years has high risk for PPH and more accompanied by blood transfusion and/or hysterectomy and were extremely strong with uterine or cervical trauma at delivery [18]. Interestingly, our prospective cohort showed that delays in breastfeeding initiation more associated with PPH and breastfeeding within the recommended time period of one hour after birth, and delays in initiation were more common among women with higher estimated postpartum blood loss and its consistent with other studies [19]. Previous data confirmed our results as higher rates of PPH more appeared in partial breastfeeding and of formula feeding [20].

Furthermore, PPH readmissions were relatively rare, all-cause readmission was relatively common occurring after 1.6% of deliveries [21]. Readmission for PPH is a challenging diagnosis to anticipate given its infrequency and that mean interval to readmission may be two weeks after delivery, or more delay [22]. PPH during delivery retained significance as a risk factor in the adjusted model for this outcome. The temporal distribution of readmissions with more than three quarters of PPH readmissions and two thirds of all cause readmissions occurring  $\leq 20$  days after discharge further supports early follow up. In adjusted analyses, other factors associated with risk for PPH included older maternal age and hypertensive disease of pregnancy during the index hospitalization. Further cost and comparative effectiveness research needed to further clarify optimal postpartum follow up based on maternal risk factors.

The basis on which PPH is associated with all-cause readmission is unclear. In part the readmission risk associated with delivery PPH may be non-causal with PPH associated with other intrapartum complications or underlying comorbidity that in turn are associated with higher risk for conditions leading to readmission. Alternately, for some conditions such as venous thromboembolism PPH is a well characterized risk factor [23]. Large PPH may additionally be linked to risk for infection (secondary in some cases to longer operative time during cesarean delivery), symptomatology related to anemia that may result in patients representing for evaluation leading to subsequent readmission, and cardiovascular complications that occur after discharge as large fluid shifts occur. Valid measurement of PPH is a major clinical concern with definitions differing

### Conclusions

This prospective study reported show that the women at high risk of PPH needs close observation to prevent of PPH readmission and decreased the risk of maternal morbidity and mortality. Furthermore, these findings have implications for postnatal care, as these women may require greater support and education.

### Competing interests

The authors declare that they have no competing interests.

### Authors' contributions

JA participated in the conception and design of the study. JA, AS and SA collected and analyzed the data, JA, AS is interpreted the data, drafted the initial manuscript. All authors read and reviewed the final manuscript.

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