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Original Research Article

Duration of labour and severity of postpartum haemorrhage: a case-control study

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ABSTRACT

Background: Postpartum haemorrhage (PPH) remains one of the leading causes of maternal morbidity and mortality worldwide, contributing significantly to adverse maternal outcomes. Hence, this study aimed to compare the duration of labour in women with and without PPH and among women having PPH with and without risk factors. Also to determine the gradient effect of duration of labour on severe PPH and maternal consequences of PPH.
Methods: A case-control study was conducted in the department of obstetrics, Fernandez hospital, Hyderabad. The required sample size was 197 cases and 397 controls (1:2 ratio) within 8 months duration.
Results: The mean age of the cases and controls were 28±3.66 and 28±3.91 years, respectively. Anaemia was more prevalent among cases (10.15%) than controls (4.03%), with a p=0.001. Hypertension was more common in controls (16.1%) than in cases (9.1%), with a p=0.02. The mode of conception differed significantly, with assisted conception being more prevalent among cases (7.6%) compared to controls (3.8%) (p=0.04). The duration of various labour stages was significantly longer in cases than in controls. Intrapartum fever was significantly higher in cases (37.06%) compared to controls (15.37%), (p≤0.001).
Conclusions: The study results indicate that longer durations of labour, the need for oxytocin augmentation, and specific maternal characteristics such as anaemia and mode of conception are significant predictors of PPH. The gradient effect of labour duration on the risk of PPH suggests that monitoring labour progression and timely intervention are crucial in preventing severe haemorrhage.

Keywords: Postpartum, Haemorrhage, Labour, Anaemia, Obstetric

INTRODUCTION

Post-partum haemorrhage (PPH) is an emergency obstetric life-threatening complication that requires urgent medical intervention.[1] The world health organisation (WHO) defines PPH as "blood loss greater than or equal to 500 ml within 24 hours after vaginal birth and more than 1000 ml in caesarean section." Haemorrhage is conventionally classified into class 1 (loss of 15% of total blood volume, 750 ml) class 2 (15-30% of total blood volume loss, 750-1500 ml) class 3 (30-40% of total blood volume loss, 1500-2000 ml) and class 4 (volume loss over 40% of total blood volume).[2] Stages of PPH based on the CMQCC algorithm are stage 1: Blood loss: >500 ml vaginal or >1000 ml caesarean, or vital signs changes (by >15% or HR ≥110, BP ≤85/45, O_2 saturation <95% stage 2: Continued bleeding with total blood loss up to 1500 ml and stage 3: Total blood loss over 1500 ml, or >2 units PRBCs given or vital signs unstable or suspicion of DIC.[3]

PPH is also referred to as loss of blood enough to present hypovolemia or a 10% reduction in the hematocrit and/or leading to the requirement of blood transfusion.[4] When the blood loss of >1000 ml or decline of at least 4 g/dl of haemoglobin in comparison with the baseline and that of post-partum or requirement of a minimum of 4 units of blood products transfusion is considered as the severe

PPH.[5] Every year around 14 million women present with PPH, of which, around 70 thousand women die worldwide.[6] PPH is one of the major contributors to maternal deaths with approximately 27.1% of maternal deaths globally. Incidence of PPH ranges between 3-8% and is an increasing global obstetric concern.[7] Most of the maternal deaths due to PPH are seen in middle and low-income countries.[8] However, there has been a rise in the incidence of PPH in high-income countries as well. Severe PPH contributes to about 50-75% of cases resulting in mortality. PPH is considered a maternal and obstetric care quality indicator.[9] 4Ts viz., tone, tissue, trauma, and thrombin, are the major causes of PPH. Uterine tone (atony) is the most common cause of PPH with about 70%, followed by trauma of the genital tract contributing to 15 to 20%. Retention of tissues like the placenta or membranes along with coagulation disorders contribute to the rest of the cases.[10] Multiple gestations, foetal macrosomia, prolongation of labour, multiparity, uterine rupture, uterine inversion, abnormal placentation, placental abruption, assisted vaginal delivery and history of previous PPH further increases the risk of postpartum hemorrhage.[11] The association of these factors was backed by systemic reviews as well.[12] A cross-sectional study done in Ethiopia postulated that the prolonged duration of labour of ≥24 hours has a second higher odds ratio next to caesarean section among all the risk factors associated with postpartum hemorrhage.[13] When the duration of labour is prolonged to ≥16 hours, coupled with the use of oxytocin for augmentation of labour, the risk of severe PPH further increases. The propensity score model published recently in 2023 reported that the risk of PPH increases further with the induction of labour, irrespective of the mode of delivery, supporting the existing evidence.[14] Several studies have postulated that prolonged phases of first, second, or third stage labour are associated with the increased severity of PPH.

Despite several studies postulating the association between the duration of labour and PPH, only very few or no Indian studies as per author's knowledge.

Hence the current study was conducted to determine the association of duration of labour with severe PPH in the Indian setting and using the new criteria proposed in WHO intrapartum care for positive birthing experience guide 2018 which redefined that the active phase of labour should be marked from 6 cm dilatation.

Objectives

Primary objective was to compare the duration of labour in women with and without PPH.

Secondary objectives were to compare the duration of labour in women having PPH with and without risk factors, to determine the gradient effect of duration of labour on severe PPH and to ascertain the maternal consequences of PPH.

METHODS

A prospective case-control study was conducted in the department of obstetrics, Fernandez hospital, Hyderabad, India for a study duration of 8 months i.e., from February 2019 to October 2019. The study protocol was reviewed and approved by the institutional ethical committee with reference number 01_2019. All the antenatal booked women with singleton term pregnancy, cephalic presentation, spontaneous or induced labour, presented with or without blood loss of >500 ml in vaginal delivery and >1000 ml in emergency caesarean section delivery within first 24 hours of delivery were included in the study. Women who underwent elective caesarean section, had abnormal placentation, congenital malformations of the uterus, thrombocytopenia (<1.5 lakhs cells/microliter of blood), or referred from other hospitals were excluded from the study.

Considering the results from the study carried out by Nyfløt et al the median duration of labour in cases was taken as 5.4 hours with a dispersion of 6.1, and for controls was 3.8 hours with dispersion of 4.7, sample size was calculated using formula for comparison of means with power=80% and 5% alpha error.[15] With this calculation, the minimum sample size of 197 cases and 397 controls (1:2 ratio) was required for conducting the study (with power=80% and 95% confidence level).

All the pregnant women who visited the hospital and met the inclusion and exclusion criteria were explained about the study and cleared all their doubts to the satisfaction in their understandable language. Those who accepted the participation were included in the study after obtaining a signed informed consent form. All the basic demographic details were collected, and the women were followed up till the labour was completed. Women who had PPH (blood loss of >500 ml in vaginal delivery and >1000 ml in caesarean section delivery within 24 hours of labour) were grouped as cases and those who did not were grouped as controls. Controls and cases were parity and BMI matched. Irrespective of the groups, details like the duration of labour, augmentation, if any, etc. were collected and noted. All the details were entered into an excel sheet and were analysed as per the statistical plan.

Descriptive analysis was done by mean and standard deviation for quantitative variables, frequency, and proportion for categorical variables. All quantitative variables were checked for compliance with normal distribution within each of the groups using visual inspection of histograms and normality Q-Q plots. Shapiro-Wilk test p values were also used for this purpose. The association between the exposure and the outcome was assessed by calculating the odds ratio and 95% Confidence interval of the odds ratio. The chi-square test was used to test statistical significance. Normally distributed quantitative variables were compared between cases and controls using an independent sample t test and non-normally distributed quantitative variables were

compared using the Mann-Whitney U test. Efforts were made to control the confounding by appropriate regression methods, for all the key outcome variables, p<0.05 was considered as statistically significant. Data was analysed using coGuide software 2.0.[16]

RESULTS

The current study has recruited 197 women as cases and 397 women as controls with mean±SD age of 28±3.66 and 28±3.91, respectively. The demographic details of the study groups are provided in Table 1. In the cases and controls group, 10.15% and 4.03% were found to be anaemic which was statistically significant with a p=0.001. The proportion of women with hypertension and delivered babies with different modes of conception in both groups was found to be significantly different with p=0.02 and 0.04, respectively.

Table 2 presents the cause of haemorrhage among cases. This table emphasises that uterine atony is the predominant cause of PPH among the study's cases, significantly more common than trauma or the combination of both factors. The necessity of blood transfusions in a subset of these cases highlights the severity of the haemorrhage experienced.

Duration of first-stage, passive, and active phases of second-stage labor were found to be significantly higher in the cases group. The proportion of women with 4, 4-7, 8-12, and >12 hours of duration of labor along with the proportion of women who required oxytocin were also found to be significantly higher in the cases group. A comparison of these parameters between the groups is tabulated in Table 3.

The odds ratio was calculated for various categories of duration of labour that revealed women with a duration of labour <4 hours and 4-7 hours had an odds ratio of less than 1 and women with a duration of labour of 8-12 hours and >12 hours had an odds ratio of greater than 1. The OR with 95% CI for each category of duration of labour was tabulated in Table 4. A line chart was presented in Figure 2, showing the increasing trend of odds with the increase in labour duration.

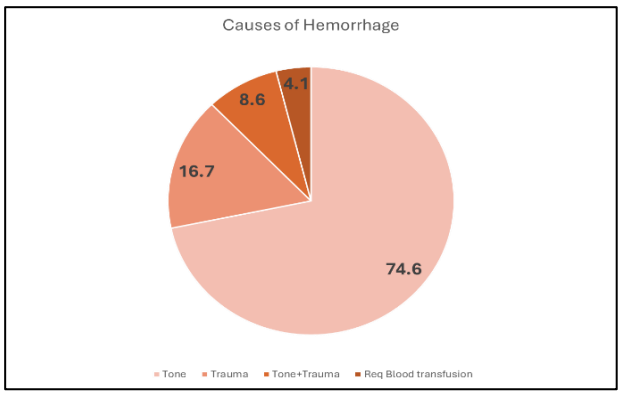

Figure 1: Causes of haemorrhage.

Maternal and neonatal outcomes were compared between the cases and controls in Table 5. Intrapartum fever and incidence of PPH was found to be statistically significant with p<0.001. Among the cases 12.69% underwent LSCS and 37.06% had assisted vaginal delivery, whereas among the controls 14.01% had LSCS and 12.86% ended up with assisted vaginal delivery hence suggesting that the difference in the mode of delivery between cases and controls was statistically significant with p<0.001. Other maternal outcomes like wound infection, anal sphincter injury, and admission to high dependency unit (HDU)/ intensive care unit (ICU) were not significantly different. The association between the birth weight of the babies and the incidence of PPH was found to be statistically significant with a p<0.001, with a higher risk of PPH among LGA babies.

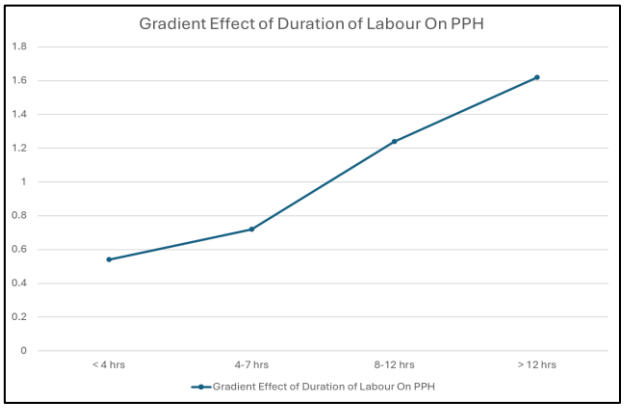

Figure 2: Gradient effect of duration of labour on PPH.

Table 1: Demographic details and risk factors among the study population.

Parameters	Cases, (n=197) (%)	Controls, (n=397) (%)	P value
Maternal age (in years)			
<35	193 (97.7)	381 (95.7)	0.2
≥36	4 (2.3)	16 (4.3)	
Anaemia	20 (10.15)	16 (4.03)	0.001
Mode of conception			
Spontaneous	182 (92.4)	382 (96.2)	0.04
Assisted	15 (7.6)	15 (3.8)	
History of previous caesarean section	8 (4.06)	22 (5.54)	0.43
Uterine fibroids	9 (4.6)	9 (2.3)	0.1
Hypertension	18 (9.1)	64 (16.1)	0.02
Diabetes	40 (20.3)	112 (28.2)	0.1
Type of labour			
Spontaneous	107 (54.31)	229 (57.68)	0.436
Induced	90 (45.69)	168 (42.32)	

Table 2: Causes of haemorrhage among cases.

Causes	N (%)
Tone	147 (74.6)
Trauma (Cervical tears and perineal tears)	33 (16.7)
Tone + trauma	17 (8.6)

*No statistical test was applied since no or zero values in the cells.

Table 3: Comparison of duration of labour between cases and controls.

Parameters	Cases, (n=197) (%)	Controls, (n=397) (%)	P value
Duration of active 1st in stage in min (6-10 cm)	496.67±317.09	429.72±287.58	0.017
Duration of 2nd stage passive in stage in min	106.64±87.12	70.13±67.02	<0.001
Duration of active 2nd in stage in min	39.75±38.43	23.14±26.77	<0.001
Duration of labor			
<4 hours	25 (14.62)	81 (23.75)	0.019
4 To 7 hours	30 (23.39)	77 (27.57)	
8 To 12 hours	49 (22.22)	85 (19.94)	
>12 hours	68 (39.77)	98 (28.74)	
Oxytocin augmentation	97 (49.24)	117 (29.47)	<0.001

Table 4: Gradient effect of duration of labour on PPH.

Duration of labour	Cases, (n=197) (%)	Controls, (n=397) (%)	OR (95% CI)
<4 hours	25 (14.62)	81 (23.75)	0.54 (0.33-0.8)
4 To 7 hours	30 (23.39)	77 (27.57)	0.72 (0.45-1.15)
8 To 12 hours	49 (22.22)	85 (19.94)	1.242 (0.751-1.8)
>12 hours	68 (39.77)	98 (28.74)	1.62 (1.103-2.38)

Table 5: Comparison of maternal and neonatal outcomes.

Parameters	Cases, (n=197) (%)	Controls, (n=397) (%)	P value
Intrapartum fever	73 (37.06)	61 (15.37)	<0.001
Mode of delivery			
Emergency caesarean section	25 (12.69)	51 (12.86)	<0.001
Assisted vaginal delivery	72 (37.06)	51 (12.86)	
Spontaneous vaginal delivery	100 (50.7)	290 (73.04)	
Wound infection	13 (6.59)	20 (5.03)	0.425
Obstetric anal sphincter injuries (OASI) (IIIA, B, C)	4 (2.03)	2 (0.5)	0.05
Admission to HDU/ ICU	20 (10.15)	33 (8.31)	0.4
Birth weight of babies			
AGA	165 (83.76)	316 (79.6)	<0.001
LGA	25 (12.69)	27 (6.8)	
SGA	7 (3.55)	54 (13.6)	
NICU admission	30 (15.23)	43 (10.83)	0.124

DISCUSSION

This study aimed to investigate the relationship between the duration of labour and the severity of PPH by comparing women who experienced PPH (cases) with those who did not (controls). The study included 197 cases and 397 controls, with mean ages of 28±3.66 and 28±3.91 years, respectively.

The prevalence of anaemia among cases (10.15%) compared to controls (4.03%) in this study aligns with findings from previous research. Anaemia has been consistently identified as a significant risk factor for PPH. A previous study by Rukundo et al also reported a higher prevalence of anaemia in women experiencing PPH, suggesting that the compromised oxygen-carrying capacity of anaemic women increases their susceptibility to haemorrhage.[17] This study's finding that hypertension was more common in controls contrasts with several studies where hypertensive disorders in pregnancy were found to be associated with an increased risk of PPH, likely due to the use of antihypertensive medications and their potential impact on blood coagulation.[18] The significant difference in the mode of conception, with assisted

conception being more prevalent among cases, is consistent with studies such as those by Sheiner et al which found that assisted reproductive technologies are linked to higher incidences of PPH.[19]

The current study highlights the significant association between prolonged labour duration and PPH, with cases experiencing longer durations in both the first and second stages of labour. This finding is supported by several studies, including those by Magann et al and Rouse et al which demonstrated that extended labour increases the risk of PPH due to uterine atony and exhaustion of uterine muscles.[20,21] Specifically, this study's data showing longer active first-stage and second-stage durations among cases are consistent with the results reported by these studies, emphasising the critical need for timely intervention in prolonged labour to mitigate PPH risk.

The association between oxytocin augmentation and increased PPH risk found in this study (49.24% in cases vs. 29.47% in controls) is supported by the work of Westhoff et al who found that the use of oxytocin in labour increases the likelihood of uterine atony, a leading cause of PPH.[22] This is due to the potential desensitisation of oxytocin receptors with prolonged or high-dose administration, leading to ineffective uterine contractions.

This study's analysis indicates a gradient effect of labour duration on PPH risk, with shorter durations (<4 hours and 4-7 hours) associated with lower odds and longer durations (8-12 hours and >12 hours) associated with higher odds of PPH. This gradient effect is in line with findings from previous research, such as the study by Sheldon et al which also demonstrated that the risk of PPH increases with labour duration, highlighting the importance of monitoring labour progress and timely interventions.[23]

The predominant cause of PPH in this study was uterine atony (74.6%), followed by trauma (16.7%), and a combination of both (8.6%). These findings are consistent with the literature, where uterine atony is frequently identified as the leading cause of PPH. Studies by Callaghan et al and Evensen et al similarly reported high proportions of PPH cases due to uterine atony, reinforcing the need for effective uterotonic drugs and protocols to manage atonic PPH.[24,25]

The current study observed significantly higher rates of intrapartum fever and assisted vaginal deliveries among cases, which aligns with findings from other studies. For example, the study by Knight et al found that intrapartum infections and assisted deliveries were associated with higher PPH risk due to the increased likelihood of uterine atony and trauma.[26] Additionally, the significant association between higher birth weights and PPH in this study is supported by research from Berhan and Haileamlak et al who reported that large-for-gestational-age (LGA) infants increase the risk of PPH due to the overdistension of the uterus and the potential for labour complications.[27]

It is a prospective observational study conducted in a tertiary care hospital with most of the data being available on electronic medical records and with round-the-clock telephone triage facility, emergency operation theatre services, and ICU, neonatal, anaesthesia, and lab facilities available. In our study population, women with medical comorbidities were also included. The results of this study are compared with other studies.

CONCLUSION

The study also concludes that with the increase in the duration of labour in both active stage and third stage, the odds of presenting PPH also increase. In terms of maternal and neonatal consequences, the current study concluded that intrapartum fever, assisted vaginal delivery, and birth weight of babies are expected to significantly affect women with PPH. There is still a large lacuna in terms of association of risk factors with the PPH, and other maternal and neonatal outcomes in the Indian population. This study recommends that future studies explore this area and create enough evidence to evaluate the risk, postulate recommendations or counsel the women.

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