

STUDY OF FACTORS ASSOCIATED WITH HAEMODYNAMIC CHANGES AROUND PUERPERIUM

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ABSTRACT

BACKGROUND

Leading causes of maternal mortality and morbidity in our country are postpartum haemorrhage and underlying anaemia. The current practice of assessing postpartum haemorrhage is by visual estimation by the birth attendant, which has subjective variation. Correlating the amount of blood lost as estimated by a standardised visual method with haemoglobin, haematocrit and other haematological parameters will help us to determine the utility of employing these measurements for assessing severity.

The aim of the study is to correlate the standardised visual estimate of blood loss with serial measurements of haemoglobin and haematocrit on the day of delivery and postpartum day 1 and 3.

MATERIALS AND METHODS

The present study is a cross-sectional study conducted at District Hospital, Belgaum, on 200 patients presenting to the hospital in latent labour. Outcome measures included measurement of haemoglobin, haematocrit before and after delivery, blood pressure and pulse rate before and after delivery. Measurement of blood loss by visual estimation; mean corpuscular volume, mean corpuscular haemoglobin concentration and red blood corpuscles count before and after delivery.

RESULTS

Three groups were made depending on the amount of blood lost. Comparison of mean haemoglobin, haematocrit and red blood corpuscles in each group showed that there was a direct proportion in reduction with the values from predelivery level to the amount of blood lost. In all 3 groups, significant correlation was seen between the mean blood loss estimated visually and reduction on day 1 day 3 against baseline values of haemoglobin, haematocrit and red blood corpuscles count.

CONCLUSION

The haematological and haemodynamic parameters used for the present study represents a simple procedure that can be easily employed to obtain objective and reliable assessment of blood lost in varying amounts. A fall in systolic blood pressure by 3.53% and 5.13% and diastolic blood pressure by 2.20% and 4.45% on first and third day may suggest postpartum haemorrhage.

KEYWORDS

Haematological and Haemodynamic Parameters, Assessment of Blood Lost, Systolic Blood Pressure, Diastolic Blood Pressure.

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BACKGROUND

India contributes to one fifth of the global burden of absolute maternal deaths.^{1,2} Postpartum Haemorrhage (PPH) is the leading direct cause of maternal mortality worldwide and one third of all maternal deaths in Africa and Asia can be attributed to this condition. The occurrence of PPH is not limited by setting or geographic region- among High-Income Countries (HICs), an increase in maternal deaths from PPH has been recorded that is associated with advanced maternal age, caesarean

delivery, multiple pregnancy and induction of labour. Nevertheless, most maternal deaths are recorded in Low-Income Countries (LICs) and middle-income countries. The disparities in outcomes are believed to reflect differences in quality of care.^{3,4}

India has a maternal mortality ratio of 167/1,00,000 livebirths.^{5,6,7} Leading causes of maternal mortality and morbidity in our country are postpartum haemorrhage and underlying anaemia (25-30%).⁸ The current standard practice of postpartum blood loss assessment is visual estimation by a healthcare provider who looks grossly at the blood lost during delivery and makes a quantitative estimate. This method is highly inaccurate. Moreover, blood loss is not routinely recorded.

Visual estimation of blood loss during delivery by the healthcare provider is liable for subjective variation. Correlating the amount of postpartum blood loss as estimated visually with Haemoglobin (Hb), Haematocrit (Hct) and other haematological and haemodynamic parameters will enable us to determine the utility of

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employing these measurements for assessing the severity of the blood loss.

This study is aimed at determining correlation between a standardised visual estimation of blood loss with haematological and haemodynamic indicators.

MATERIALS AND METHODS

All women presenting for labour and delivery at the District Hospital were the potential study candidates. About 2500 vaginal deliveries take place at the district hospital each year. A hospital-based cross-sectional study was performed on a random sample of approximately 200 women undergoing vaginal delivery at District Hospital in Belgaum.

Women presenting for vaginal delivery with single term pregnancy including high risk who were willing to sign or orally consent to participate in the study. Planned or emergency caesarean section (placenta praevia, abruption placenta, pregnancy-induced hypertension) Hb of less than 7 gm%, episiotomy, instrumental deliveries, those who received Intravascular (IV) fluids or blood and not willing to consent were excluded from the study.

Outcome measures included measurement of Hb, Hct (Hct) before and after delivery, blood pressure and pulse rate before and after delivery. Measurement of blood loss by visual estimation; Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin Concentration (MCHC) and Red Blood Corpuscles (RBCs) count before and after delivery.

Visual Estimation of Blood Loss

Blood loss estimation was done by a single doctor who was trained in estimating the blood loss to avoid interobserver variation. Blood loss estimation was done from the onset of third stage of labour to the end of stoppage of active bleed or up to 1-hour post-delivery, whichever was earlier. The

blood was allowed to drain into a fixed collecting container and was calibrated at the end of 1 hour. Fixed-sized mops were used in the present study. Blood spillage on the delivery table, garments and floor were approximately assessed. At the end of 1 hour, the total amount of blood lost was estimated by adding up the blood in the container, amount of blood in the mops and blood spillage on delivery table, garments and floor.

Laboratory Measurements

Serial Hb (Drabkin’s cyanmethemoglobin method) and haematocrit (Wintrobe’s method) measurements by venous blood sampling was performed for all study participants at the time of admission to labour ward. Serial Hb and Hct was done on day 1 (24 hours after delivery), day 3 (72 hours after delivery). MCV, MCHC, RBCs count, pulse rate and blood pressure were the other parameters that were also recorded on these days.

Comparison in Hb and Hct changes and other parameters between different groups were done by using unpaired t-test and paired t-test. Differences between two were considered significant when p <0.05.

RESULTS

A total of 200 cases were studied to determine haematological and haemodynamic changes before and after delivery and to correlate the standardised visual estimate of blood loss with serial measurements of Hb and Hct, RBCs count, pulse and blood pressure on day of delivery and postpartum day 1 and 3. In 19 cases, out of the total 200 cases studied, Hb, Hct and RBCs were not measured on the third day as they failed to adhere to the study and took voluntary discharge. Only 2 cases failed to comply on first day. These cases were treated as dropouts and not included in the analysis.

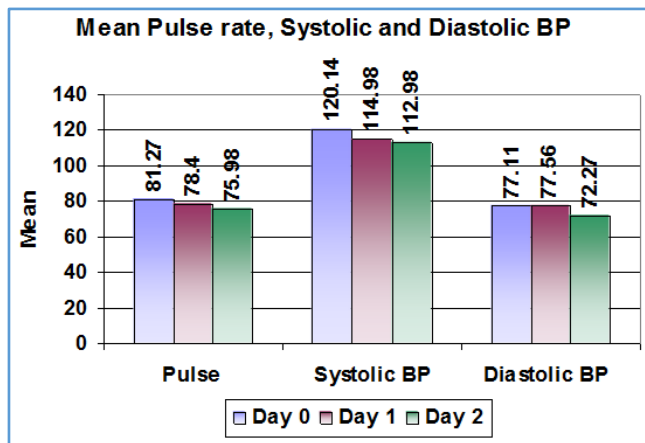
Mean Blood Loss	Mean Hb			Mean HCT			Mean RBC		
	Day 0	Day 1	Day 3	Day 0	Day 1	Day 3	Day 0	Day 1	Day 3
249.28	11.27 ± 142	10.55 ± 1.38	9.88 ± 1.39	35.42 ± 4.42	33.31 ± 3.99	31.45 ± 3.86	3.81 ± 0.56	3.52 ± 0.52	3.31 ± 0.49

Table 1. Haemoglobin (Hb), Haematocrit (Hct) and RBC Changes Postpartum

In the present study, predelivery systolic blood pressure was 120.14 ± 8.50 on day 0, which reduced to 114.98 ± 6.66 on day 1 and 112.98 ± 6.58 on day 3, which were significant. In the present study, predelivery diastolic blood pressure was 77.11 ± 6.72 on day 0, which reduced to 77.56 ± 58.25 on day 1, which was insignificant (p <0.907) and 72.27 ± 4.78 on day 3, which was significant (p <0.002).

Mean Blood Loss	Mean MCHC			Mean MCV		
	Day 0	Day 1	Day 3	Day 0	Day 1	Day 3
249.28	31.86 ± 1.95	31.73 ± 2.39	31.46 ± 2.77	93.92 ± 12.15	96.01 ± 13.64	95.96 ± 15.75

Table 2. Mean Corpuscular Haemoglobin Concentration (MCHC) and Mean Corpuscular Volume (MCV)



MCHC on day 0 was 31.86 ± 1.95 , which had a reduction to 31.73 ± 2.39 on day 1, which was significant and reduced to 31.46 ± 2.77 on day 3, which was not significant in the present study. MCV on day 0 was 93.92 ± 12.15 , which increased to 96.01 ± 12.15 , which was significant and later reduced to 95.96 ± 15.75 , which was not significant.

	Mean Blood Loss	Day 0 Vs. Day 1	Day 0 Vs. Day 3
Hb	249.28	6.13 ± 7.89	12.82 ± 9.0
Hct	249.28	5.61 ± 8.66	11.32 ± 9.73
RBCs	249.28	7.32 ± 8.35	1.72 ± 1.77

Table 3. Peak Reduction of Hb, HCT and Red Blood Corpuscles (RBCs)

In the present study, the peak reduction of Hb on both day 1 and day 3 were significant 'p' value <0.02 , just as Hct with p values $P <0.001$ on both days and peak reduction of p <0.002 on days 1 and 3. The range of reduction in both Hb and Packed Cell Volume (PCV) was between 6-20% in both groups. A significant correlation was seen between Hb, PCV reduction and RBC reduction and estimated blood loss. Maximum reduction was seen on the third day. So, percentage of reduction was calculated between 3rd day value and baseline predelivery day 0 value and also of the first day. Correlations were statistically significant $P \leq 0.001$. Hct is better indicator than Hb in estimating postpartum blood loss and there was a direct proportion between Hb and Hct reduction and blood loss.

One case which was estimated to have blood loss of 1600 mL was included in group >500 mL. In this case, Hct reduction was 19.51% on day 1 and 29.27% on day 3, Hb gm% reduction was 4.62% on day 1 and 16.92% on day 3.

Mean Blood Loss	PR % Reduction		BP-Sys % Reduction		BP-Dia % Reduction	
	Day 0 Vs. 1	Day 0 Vs. 3	Day 0 Vs. 1	Day 0 Vs. 3	Day 0 Vs. 1	Day 0 Vs. 3
249.28	3.33 ± 7.33	8.24 ± 16.19	4.09 ± 5.52	5.69 ± 5.24	-0.38 ± 64.03	6.39 ± 10.88

Table 4. Haemodynamic Changes Depending on Amount of Blood Loss

The peak reductions of pulse rate, systolic and diastolic blood pressure were significant on day 3 and diastolic blood pressure was not significant on day 1 in the present study.

Range of VE Blood Loss	Mean Blood Loss	Mean Hb		
		Day 0	Day 1	Day 3
0-200	116.80 ± 46.74	11.38 ± 1.360	10.66 ± 1.23	10.12 ± 1.24
201-500	305.66 ± 77.98	11.13 ± 1.491	10.55 ± 1.45	9.78 ± 1.40
>501	622.71 ± 233.73	11.23 ± 1.481	10.12 ± 1.65	9.20 ± 1.68

Table 5. Hb Changes Depending on Amount of Blood Loss

In the present study, 0-200 mL blood loss group noted that mean Hb reduced to 10.12 gm% on day 3 from its baseline 11.38 gm% on day 0. In 201-500 mL blood loss group, it was 9.78 gm% on day 3 from its baseline 11.13 gm% on day 0, and in >501 , it was 9.20 gm% on day 3 from its baseline 11.23 gm% on day 0.

Range of Visually-Estimated Blood Loss	Mean Blood Loss	Mean HCT		
		Day 0	Day 1	Day 3
0-200	116.80 ± 46.74	35.69 ± 3.99	33.47 ± 3.55	32.06 ± 3.63
201-500	305.66 ± 77.98	35.18 ± 4.85	33.61 ± 4.29	31.45 ± 4.10
>501	622.71 ± 233.73	35.00 ± 4.73	31.67 ± 4.44	29.00 ± 4.16

Table 6. HCT Changes Depending on Amount of Blood Loss

In the present study, MCV increased to 96.72, 95.68 and 94.18 on day 1, which was significant in 0-200, 201-500 and >500 visually estimated blood loss groups, respectively. On day 3, MCV increased to 97.48, 95.54 in first two groups and decreased to 91.28 from its baseline value 93.08 in group III.

DISCUSSION

Haematological parameters in the present study correlated with diagnostic indices in pregnancy with two authors who stated that Hb range is 11 to 12 gm% and Hct value in the last weeks of pregnancy is between 33-34%. RBC count is 3.7 million/mm³, MCHC is 32-33% and MCV is 93-95 μ³.

According to WHO definition, value of Hb at term should be at least 11.0 gm% before entry to the labour room.⁹ In the present study, Hb value was 11.27 gm%, haematocrit was 35.42%, RBCs was 3.81 million/mm³, MCV 93.92 μ³ and MCHC was 31.86%.¹⁰

Present study indicates that greater the peak reduction in Hb and Hct percentage greater is the blood loss. Above 15% reduction on third day may suggest postpartum haemorrhage. Up to 12% reduction in either of the indices may suggest blood loss less than 500 mL. But, reduction of 10% Hb and 9% reduction of Hct on first day itself may suggest postpartum haemorrhage. Standardised visually

estimated blood loss in present study was 249.28 mL, which is comparable with two different studies, which showed 244.30 mL and 263.81 mL.^{11,12}

Correlation of Blood Loss with Reduction of Hb, Packed Cell Volume (PCV) and RBCs

The mean visually estimated blood loss was higher in the third group >500 mL (622.71 mL), which caused a relative reduction in Hb and PCV (up to 20%) on third day. On first day, the reduction was up to 10%. But, in case of RBCs count, the reduction occurred on first day only (up to 10%), and on third day, the reduction was up to 3% as compared to the baseline value.

In the first two groups, where mean blood loss was 116.80 mL and 305.66 mL reduction was up to 12% on 3rd day and up to 6% on first day in case of Hb% reduction, Hct% reduction was up to 11% on third day and up to 6% on first day, RBC % count reduction was up to 8% on first day and 2% on third day.

The study clearly shows that reduction in Hb and PCV and RBC count is directly proportional to the blood loss, since the expansion of blood volume is in the later stages of pregnancy can be up to 1500 mL in normal pregnant of average size and with a single foetus. As blood loss increases, the peak reductions in Hb, Hct and RBCs count also increases. When the estimated blood loss is less than 200 mL, (average 116.80 mL) by visual method, it is in par with peak reductions of Hb and Hct, but as blood loss increased above 500 mL, peak reductions averaged up to 30%, which indicated that if blood loss is estimated by a standardised visual method, the haematological indices can be correlated reliably.

But, however, if visual estimation is not standardised and the evaluator just looks grossly at the blood and makes an estimate, there is always an underlying tendency to underestimate blood loss, which in an event like severe haemorrhage can fatal. It is better to overestimate rather than underestimate so that necessary precautions and appropriate measures for treatment can be taken.

RBC Indices - MCHC and MCV

A decrease of MCHC with a difference of 0.24% on first day could suggest a blood loss greater than 500 mL, which is significant just as an increase with a difference of 1.10 cubic microns on first day as there is accelerated production of RBCs depending on the amount of blood lost.

Haemodynamic Parameters

A pulse rate reduction of 0.33% and 4.57% on first and third day suggests blood loss greater than 500 mL. Fall in systolic blood pressure of 3.53% and 5.13% and diastolic blood pressure reduction of 2.20% and 4.45% on first and third day may suggest postpartum haemorrhage as compared to predelivery values.¹³

CONCLUSION

There is a good correlation with Hb, Hct and RBCs count with amount of blood loss and there is a direct proportion seen between these parameters. For a certain reduction in percentage, relative blood loss was more. A fall in systolic blood pressure by 3.53% and 5.13% and diastolic blood pressure by 2.20% and 4.45% on first and third day may suggest postpartum haemorrhage. If Hb and Hct is performed on day 1 and 3 routinely, percentage of reduction suggests postpartum haemorrhage of which corrective measures can be taken.

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