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Advantage of Systematic Blood Cell Count 2 Days Post-delivery for the Diagnosis of Postpartum Maternal Anaemia

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Authors' contributions

This work was carried out in collaboration between all authors. Author JMA conception and design, analysis and interpretation of data, drafting the article, final approval of the version to be published. Author NC conception and design, acquisition of data, analysis and interpretation of data, drafting the article final approval of the version to be published. Author OP analysis and interpretation of data, drafting the article, final approval of the version to be published. Author EB substantial contributions to conception and design, acquisition of data. Author JFD statistical analysis and interpretation of data. Author FZA drafting the article, final approval of the version to be published.

Research Article

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ABSTRACT

Aims: To evaluate the advantage of full blood cell count as performed 48h post-delivery for the diagnosis of postpartum maternal anaemia.
Study Design: Observational retrospective study.
Methodology: According to the usual local protocol, haemoglobin assessment is made in all mothers at entry in the labour room (D0), and 2 days post-delivery (D2). The relationship between haemoglobin decrease, anaemia onset, and obstetrical anamnesis has been evaluated by multiple logistic regression analysis.
Results: Four hundred and seven (407) parturient women were included. Of them 13.3% (n=54) had >2g haemoglobin loss and were considered having developed undiagnosed

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postpartum haemorrhage (UDPPH); 10.3% (n=42) had anaemia with <10g/dL haemoglobin at D2. The identified risk factors for postpartum anaemia onset were episiotomy (OR 11.8; 95%CI 4.71-17.5; *P* <0.001), foetal distress (OR 5.99; 95%CI 2.20-16.3; *P* <0.001), duration of labour (OR 1.21; 95%CI 1.05-1.40; *P*<0.008), and presence of perineal and/or vaginal tears (OR 2.9; 95%CI 1.18-7.13; *P* =0.02).
Conclusion: Systematic haemoglobin control in all patients 2 days after vaginal delivery allows the detection and subsequent treatment of UDPPH-related anaemia.

Keywords: Undiagnosed postpartum haemorrhage; post partum; anaemia.

1. INTRODUCTION

Postpartum haemorrhage (PPH) is one of the main causes of death among parturient women in France. Some studies have shown that the amount of blood loss related to delivery was underestimated [1-4]. Systematic fitting of a pouch for the collection of blood loss during delivery appears to improve the evaluation of bleeding [5]. Nevertheless, even if some practitioners systematically prescribe iron supplements at hospital discharge, a significant part of PPH remain undiagnosed and may be the cause of a postpartum anaemia that necessitates being treated [6].

All of the Centre for Disease Control (CDC), American College of Obstetricians and Gynaecologists (ACOG) and Institute of Medicine recommend screening for anaemia only 4 to 6 weeks postpartum, and only in those patients considered to be at high risk of anaemia [7]. Yet, deleterious consequences on quality of life have been shown as associated with postpartum maternal anaemia [6,8-11]; patients exhibit predisposition to fatigue, depression, lack of concentration, and impaired mother-child interaction. Furthermore, the subsequently reduced immune defences predispose to increased infection risk. Serious cases may even necessitate prolonged hospital stay due to the occurrence of cardiovascular symptoms (maternal tachycardia, hypotension) [6,8-11].

The aim of the present study was to show the advantage of systematic full blood cell count at D0 and D2 post-delivery for the retrospective diagnosis and subsequent treatment of undiagnosed postpartum anaemia secondary to PPH. Analysing both labour and delivery should allow the identification of main risk factors for such condition.

2. METHODOLOGY

This 4-months retrospective study was performed in our maternity hospital. According to the usual protocol of care that has been set up in our department, systematic full blood count is carried out at entry in the labour room (D0) and 48h postpartum (D2). Such study consisting in an evaluation of our usual therapeutic practice, no approval of Ethics Committee was necessary.

Meaning the homogeneity of the population to be analyzed, criteria were defined a posteriori: full term pregnancy, i.e., >37 weeks of amenorrhea (WA), and vaginal delivery (VD). Exclusion criteria were the following: preeclampsia, suspected placenta praevia, history of coagulation disorders, lack of haemoglobin data at D0 and D2, caesarean section, and diagnosed PPH (estimated blood loss>500mL).

The following data were collected from the computerized databases made up with the medical and obstetrical files of the patients (DIAMM software): age, parity, body mass index, height, weight, weight gain during pregnancy, spontaneous labour or labour induction, labour duration, engagement and duration of pushing efforts, instrumental delivery (ventouse, spatula or forceps), presence of shoulder dystocia, uterine revision, type of presentation, type of anaesthesia, episiotomy (mediolateral), perineal and/or vaginal tear, foetal distress, and failure to progress. We evaluated also the use of ocytocine, the existence of type I, type II or gestational diabetes, labour-related hyperthermia, presence of thalassaemia, drepanocytosis, history of delivery-related haemorrhage, existence of uterine scar (previous myomectomy or caesarean section), and neonatal height and weight.

Patients were considered to have anaemia when their pre-partum haemoglobin was $\leq$ 11 g/dL or their postpartum haemoglobin $\leq$ 10 g/dL as defined by the CDC [12]. For our analysis, we defined any 2 g fall in haemoglobin at D2 compared with D0 value as a criterion for undiagnosed postpartum haemorrhage (UDPPH).

2.1 Statistical Analysis

The statistical analysis was performed using the SPSS v13 (Chicago, Illinois) software. Qualitative data are presented as percentages while quantitative and ordinal variables are presented as the median value and interquartiles (Q1: first quartile; Q3: third quartile) since Shapiro-Wilk and Kolmogorov-Smirnow tests indicate significant change from normal value. For the univariate analysis we utilized the Chi², Fisher's and Mann-Witney U tests. Correlations between independent variables were expressed by the odds ratios (OR) with the related 95% confidence interval (95%CI). Systolic and diastolic blood pressure and heart rate were analysed by a 2-way ANOVA. All independent variables were included in a multivariate model using a decreasing stepwise logistic regression model. This model and related adjustments were evaluated by the Hosmer-Lemeshow test and the Nagelkercke R^2. Any p value <0.05 was considered significant.

3. RESULTS

The retrospective analysis included 407 women. The median age of the patients was 31.5 years (28.7-35.1) and median BMI was within normal values (21 kg/m²; 19.8-23.3). Quite all (92.1%) underwent epidural anaesthesia. Median labour duration was 6 hours (4h-8h). In about a quarter of the sample (25.1%), labour induction was necessary; episiotomy was carried out in 30.6% and 42.8% had vaginal and/or perineal tears. Ocytocin was used during labour in 43.2% of the patients. Foetal tachyarrhythmia was observed in 8.6%. Median neonatal weight was 3.35 kg (3.08-3.63 kg) and median height was 51 cm (49.5-52.0 cm). Other demographic and clinical characteristics are displayed in Table 1.

Median rate of haemoglobin was 12.3 g/dL (11.7-12.9) at D0, decreasing to 11.7 g/dL (10.9-12.4) at D2. Existing anaemia (already present at D0) was observed in 8.1% of the patients while postpartum (2 days post-delivery) anaemia was observed in 10.3%). A decrease >2g was observed in 54 patients (13.3%), which indicates a rate of 13.3% of UDPPH (n=54).

Table 1. Demographic and clinical characteristics of the study patients

Variable	**Median (min- max)**
Weight (Kg)	58.0 (53.0-65.0)
Height (cm)	165.0 (161.0-170.0)
Weight gain (Kg)	13.0 (10.0-17.0)
Variable	**Percentage**
Twin pregnancy	0.2%
Instrumental delivery	
Spatulas	7.9%
Forceps	2.9%
Vaccum extraction	6.9%
Shoulder dystocia	1.5%
Breech birth	0.2%
Failure to progress	2.5%
Diabetes	2.0%
Hyperthermia	1.5%
Uterine revision	4.4%
Drepanocytosis	0.7%
alpha-Thalassaemia	0.2%
History of PPH	0.5%
Uterine scar	2.5%
Duration of engagement (min)	45 (15 – 90)
Duration of pushing efforts (min)	10 (5 – 16)

Table 2 presents the results of the univariate analysis between the 54 UDPPH patients and the other patients (n=353). In this non-adjusted preliminary analysis, episiotomy appears to be the most important factor, responsible for a 9-fold greater probability of UDPPH ($p<0.001$). The other risk factors identified by this analysis were instrumental delivery (especially using spatulas), and foetal distress. UDPPH patients were significantly had a lower average height than the others ($p=0.044$); they had a haemoglobin level lower at D2, lower parity, and longer durations of engagement, pushing efforts and labour ($P<0.001$ for all) (Table 2).

Adjusted multivariate analysis (Table 3) shows significantly higher values regarding the influence of episiotomy ($P<0.001$) and still strong impact of foetal distress ($P<0.001$). The presence of vaginal and/or perineal tears increases by 3 the risk of UDPPH and any 1 supplementary hour of labour increases that risk by 1.21, e.g. a 3-h increase of total labour duration increases in turn the risk of UDPPH by $1.21^3=1.77$ or 77%. Besides, the effect of instrumental delivery, maternal height, parity, durations of engagement and pushing efforts are no longer significant after multivariate adjustment of other co-variables. Neonatal height and weight gain during pregnancy were not significant and may not be considered risk factors of UDPPH. Repeated measurements of arterial pressure show no significant differences between UDPPH patients and the others ($P=0.953$) (Fig. 1a) but heart rate appeared more rapid ($P=0.039$) (Fig. 1b).

Table 2. Univariate comparison between UDPPH women (n=54) and other patients (n=353)

	Patients with UDPPH	**Other patients**	
Variable	OR (95% CI)	Reference value	*P*
Instrumental delivery	5.35 (2.89–9.88)	–	0.001*
Spatulas	7.60 (3.52–16.4)	–	0.001*
Forceps	3.45 (1.00–11.9)	–	0.038*
Vaccum extraction	2.36 (0.95–5.84)	–	0.058
Epidural anaesthesia	5.10 (0.68–38.1)	–	0.078
Labour induction	1.05 (0.55–2.03)	–	0.875
Episiotomy	9.08 (4.71–17.5)	–	0.001*
Vaginal and/or perineal laceration	0.76 (0.42–1.37)	–	0.362
Foetal tachyarrhythmia	5.53 (2.61–11.7)	–	0.001*
Failure to progress	4.63 (1.26–16.9)	–	0.001*
Diabetes	0.93 (0.11–7.73)	–	0.948
Hyperthermia	3.36 (0,60–18.8)	–	0.144
Ocytocine	1.26 (0.71–2.23)	–	0.435
Uterine revision *	–	–	0.090
Uterine scar	0.72 (0.09–5.80)	–	0.758
History of PPH *	–	–	0.999
Variable	Median (Q1-Q3)		*P*
Age (years)	31.9 (29.4–35.3)	31.5 (28.6–35.0)	0.475
Weight (Kg)	58.0 (54.0–63.0)	58.0 (53.0–65.0)	0.880
Height (cm)	165 (160–169)	166 (162–170)	0.044
BMI (Kg/m²)	21.7 (20.2–23.7)	21.0 (19.7–23.1)	0.109
Weight gain (Kg)	13.5 ((8.0–17.0)	13.0 (10.0–17.0)	0.739
Haemoglobin at D0 (g/dl)	12.6 (11.9–13.1)	12.3 (11.7–12.9)	0.180
Haemoglobin at D2 (g/dl)	10.0 (9.1–10.3)	11.9 (11.1–12.5)	0.001*
Engagement duration (min)	85 (45–160)	40 (10–90)	0.001*
Labour duration (h)	8.8 (6.0–10.0)	5.0 (4.0–7.0)	0.001*
Duration of pushing efforts (min)	15 (10–25)	9 (5–15)	0.001*
Neonatal weight (g)	3345 (3100–3650)	3350 (3070–3630)	0.626
Neonatal height (cm)	51.0 (50.0–52.0)	51.0 (49.5–52.0)	0.082
Parity	1 (1–1)	2 (1 – 2)	0.001*

*OR (95% CI): Odds Ratio (95% confidence interval);Q1-Q3: interquartiles (1st quartile Q1 – 3rd quartile Q3); * OR non calculated the denominator being zero.*

Table 3. Multivariate analysis with a model of descendent stepwise logistic regression of UDPPH (1)

Variables	**Multivariate OR (95%CI) (2)**	*P*
Neonatal height (cm) (3)	1.21 (0.99 – 1.49)	0.068
Labour duration (h) (3)	1.21 (1.05 – 1.40)	**0.008***
Episiotomy	11.8 (4.61 – 30.5)	**0.001***
Vaginal and/or perineal tears	2.90 (1.18 – 7.13)	**0.020***
Weight gain (Kg) (3,4)	0.95 (0.89 – 1.00)	0.082
Foetal tachyarrhythmia	5.99 (2.20 – 16.3)	**0.001***

(1) Nagelkerke R^2 = 0.356. Hosmer-Lemeshow = .493.

(2) OR (95% CI): Odds Ratio adjusted multivariate.

*(3) Risk multiplication, e.g., 2-h augmentation of labour multiplies the risk by 1.21 * 1.21 = 1.46. Similarly, 5-cm augmentation of neonatal height increases the UDPPH risk by 1.21^5 = 2.59.*

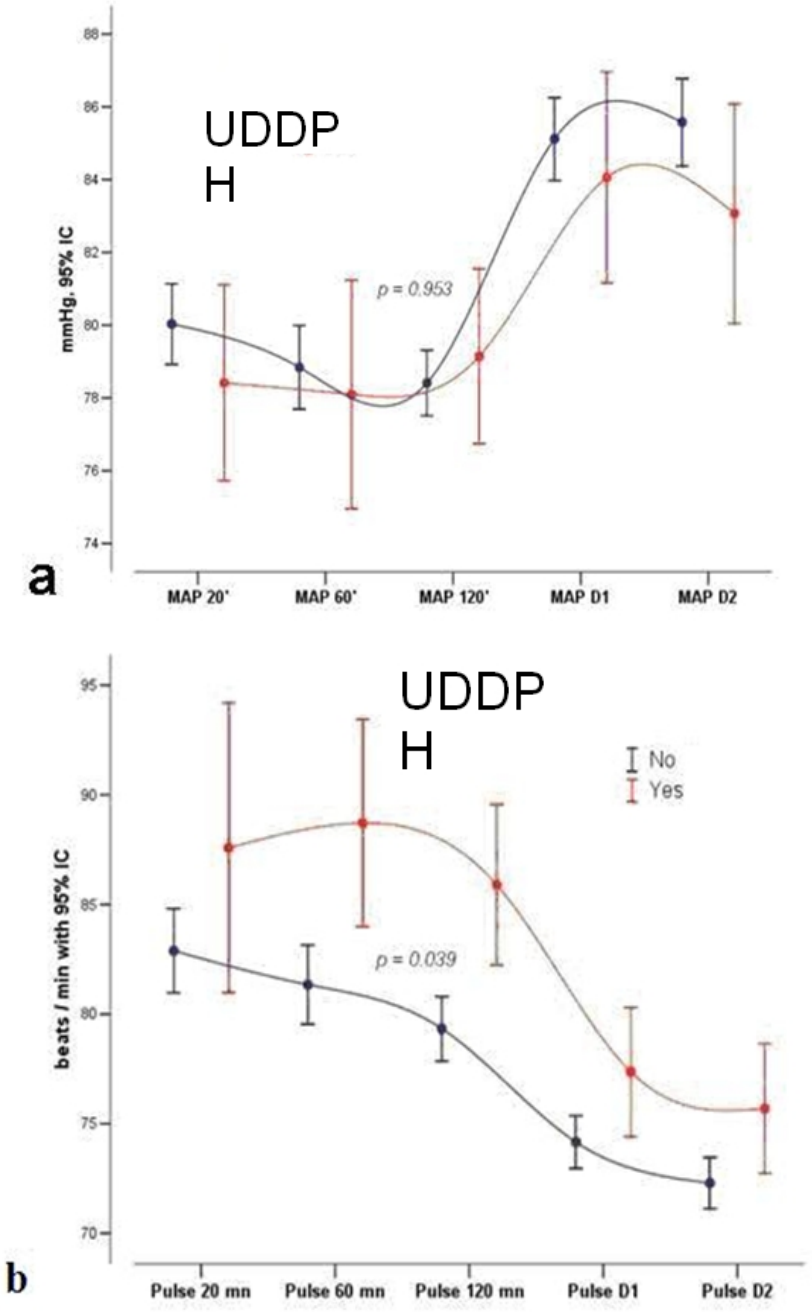

Fig. 1. Repeated measures of mean blood pressure (MBP) in patients of the UDPPH group and the others (Fig. 1a). Repeated measures of heart rate (Pulse) in patients of the UDPPH group and the others (Fig. 1b); P value is calculated using a 2-way ANOVA model

4. DISCUSSION

The present study has identified a rate of 13% of parturient women with PPH and no diagnosis of such disorder; the study has also identified factors of UDPPH risk.

The variables shown to be significantly related to such risk are the following: episiotomy and perineal and/or vaginal tears. in addition to these factors foetal distress during labour appeared to be correlated with UDPPH, which suggests a pathophysiological relationship due to uterine and placental hypo-perfusion in the already anaemic parturient (8.1% in our series) when exposed to the labour stress. No other plausible reason has been identified.

Our study is in accordance with that of Descargue et al. [13] regarding the evaluation of risk factors associated with UDPPH such as primiparity, episiotomy, labour duration, and above all pre-partum anaemia. In fact, fatigue and uterine atonia due to prolonged labour predispose to more serious blood loss. In our study, we observed a risk of UDPPH increased by 1.21 associated to each supplementary hour of labour. Pre-partum anaemia constitutes a risk factor of UDPPH probably by attenuating perfusion, hence coagulation, and by increasing uterine atonia. The study of Descargue et al. [13] showed a rate of UDPPH of 1.63% using as criterion a decrease of the haematocrit of 10 units. The study of Wangalla et al. [14] identified a rate of 3.83% of UDPPH based on a 3 g haemoglobin decrease in patients having undergone caesarean section while ours found a rate of 13.3% using 2g decrease at the haemoglobin assessment. We decided to choose haemoglobin as criterion because of a greater precision provided by this parameter compared to the haematocrit and taking into account the fact that during the postpartum period, marked changes occur in body fluid dynamics. Moreover, Descargue et al did not precisely determine the postpartum period during which haematocrit was to be controlled, unlike our study that carried out this control 48h post-delivery based on the fact that this delay is necessary to adequately reflect changes in blood circulation. Since Hb is measured as a concentration, certainly it shows also high dependence from plasma volume changes. It is questionable if it is really better than Hematocrit therefore. Important is to assess Hemoglobin at a steady state of volume changes which is actually between 48-72 hrs after birth. We set the threshold haemoglobin value at 10 g/dL at D2 so as to detect more patients with postpartum anaemia (10.3%) similarly to the study of Renate et al. [15] in which 22% of the patients had their haemoglobin < 10 g/dL at D2 while 3% had <8 g/dL; it should be reminded that in this study the high rate results from the inclusion of women having undergone caesarean delivery.

Episiotomy is known to carry an increased risk of blood loss during delivery, especially when mediolateral. Our series showed a rate of about 31% which is far less than the rate of 95% reported by Descargue et al. [13]. Such difference may be explained by the fact that at the time of this study (1997-1999), episiotomy was performed quite systematically in most parturient women. We did not find that locoregional analgesia (especially the epidural anaesthesia) and use of ocytocine were significantly correlated with UDPPH even though these factors were shown to be correlated to PPH in three studies [3,16,17]. In 2001, Descargue et al. [13] have evidenced similar correlation but with UDPPH. We were able to exclude from analysis all patients with PPH owing to the use of pouches meant to collect blood during delivery. In addition, as already experienced by Sosa et al. [18] in a study of 2009 having involved 24 maternity units in Argentina and Uruguay, visual estimation of blood loss during delivery may lack precision and underestimation is likely to occur [1-4]. Two randomized studies have also focused on the same topic. The first, in India, has found a difference of 33% between visual estimation and those pouches specifically designed for blood collection [19]. The second compared calibrated and non-calibrated bed sheets to

estimate blood loss after simulated vaginal delivery and observed that visual estimation with calibrated sheets was associated with <15% error for all volumes whereas with non-calibrated sheets, blood loss was underestimated with 16% error for 300 ml to 41% error for 2.000 ml [20].

In fact, previous studies such as that of Nicol et al. [21] in 1997 have observed that in clinically stable patients with an estimated blood loss <500 mL - based on visual estimation - routine determination of postpartum haematocrit lacks value. In addition, such visual estimation lacks precision, as already mentioned.

The value of our study lies in the fact that the sole measurement of haemoglobin at D0 and D2 allowed detecting 13% of those parturient women with UDPPH. We have also identified all underlying risk factors, which makes us more aware of the risk carried by the patients with these risk factors during labour and able to minimize consequently associate comorbidities during the postpartum period.

The advantage of performing haemoglobin determination at D2 may be debated since most postpartum patients receive iron supplements. However, we do believe that our strategy helps evaluating the degree of anaemia and consequently set up the adequate amount of iron or even parenteral support before discharge. This study highlights also the fact that number of patients can leave hospital with undiagnosed hence untreated anaemia.

4. CONCLUSION

PPH is still a major cause of maternal morbidity and mortality. Despite systematic use of blood collection pouches, some delivery haemorrhages remain unnoticed and undiagnosed resulting in untreated anaemia. Systematic assessment of haemoglobin at D0 and D2 in all women having undergone vaginal delivery allows retrospective diagnosis of PPH and treatment of the resulting anaemia.

CONSENT

Not applicable.

ETHICAL APPROVAL

Not applicable.

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None.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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