Transfusion practices in postpartum hemorrhage: a population-based study.

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Transfusion Practices in Postpartum Haemorrhage: a Population-Based Study

Running headline: Transfusion in Postpartum Haemorrhage

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Conflicts of interest

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Abstract

Objective: To describe transfusion practices and blood loss severity in women with postpartum haemorrhage (PPH), according to the clinical context.

Design: Population-based cohort study

Setting: 106 French maternity units (146781 deliveries, December 2004-November 2006)

Population: All women with PPH (n=9365)

Methods and main outcome measures: We determined the rate of red blood cell (RBC) transfusion in PPH overall and according to transfusion guidelines. Transfusion practices and blood loss severity were described by mode of delivery and cause of PPH in women given RBCs within 12 hours after clinical PPH diagnosis (early transfusion group).

Results: 701 women received RBCs (0.48±0.04% of all women and 7.5±0.5% of women with PPH). Half the women with clinical PPH and haemoglobin lower than 7.0 g/dL received no RBCs. In the group with clinical PPH and early transfusion (n=426), operative vaginal delivery was associated with a larger maximal haemoglobin drop, more frequent administration of fresh-frozen plasma (FFP) and pro-haemostatic agents (OR: 3.54, 95%CI 1.12-11.18), transfusion of larger volumes of RBCs and FFP, a higher rate of massive RBCs transfusion (OR: 5.22, 95%CI 2.12-12.82), and more frequent use of conservative surgery (OR: 3.2, 95%CI 1.34-7.76), compared with spontaneous vaginal delivery.

Conclusions: Omission of RBC transfusion for PPH was observed in a large proportion of women with low haemoglobin level. Compared with spontaneous vaginal delivery, operative vaginal delivery is characterised by higher blood loss and more transfusions and, consequently, deserves specific attention.

Key words: Obstetrics, practices, postpartum haemorrhage, blood transfusion

Abbreviations

95%CI: 95% confidence interval

DIC: disseminated intravascular coagulation

FFP: fresh frozen plasma

Hb: haemoglobin

ICU: intensive care unit

IQR: interquartile range

NA: not appropriate

OR: odd ratio

PPH: postpartum haemorrhage

RBC: red blood cell

SD: standard deviation

Key message

Blood transfusion for PPH is given in 1 of every 200 women in France. Omission of RBC transfusion for PPH was observed in a large proportion of women with low haemoglobin level. Operative vaginal delivery is characterized by higher blood loss and more transfusions than spontaneous vaginal delivery.

Introduction

Postpartum haemorrhage (PPH) is a common complication of delivery whose incidence has increased recently in several countries (1-4). PPH is associated with substantial maternal morbidity and mortality (5). In high-resource countries, PPH is the main obstetrical reason for intensive care unit (ICU) admission, and the rates of severe adverse outcomes after PPH, such as hysterectomy, have also increased recently (2, 5). Progression from excessive to severe haemorrhage is probably dependent not only on individual characteristics of women and deliveries, but also on factors related to medical care (6). Transfusion is an important part of PPH management, especially in case of on-going haemorrhage. The goals of appropriate blood product transfusion are to maintain circulating blood volume and tissue oxygenation and to prevent or reverse coagulopathy. The lack of access to blood products can result in death of the mother (7). Better knowledge of transfusion practices in PPH may help to understand the impact on maternal outcomes.

Several studies have evaluated transfusion practices in women with PPH (3, 8-15). However, these studies either used a single-centre retrospective design (8-11), and therefore had limited external validity, or relied on hospital discharge databases, which were not designed for clinical research (3, 15). Transfusion practices were also described in recent nationwide prospective observational studies, but only as secondary outcomes and in women requiring invasive second-line treatments for PPH (12-14). Information on transfusion practices is needed to identify situations associated with specific blood-product needs and to understand the reasons for these specific needs. This information is also necessary to optimise healthcare resource allocation and to improve PPH management.

Our objective here was to describe transfusion practices and blood loss severity in women with PPH, overall and in subgroups defined based on obstetrical contexts, in a large population-based cohort of women with PPH in France.

Material and methods

The Sud Est III Institutional Review Board and the French Data Protection Authority approved this study (QH 04 2005). The ethics committee waived the requirement for informed consent.

Population

The source population was the cohort of women included in the Pithagore6 trial, a cluster-randomised trial performed in 106 French maternity units grouped into six regional perinatal networks (16) and accounting for 20% of all deliveries in France. A 1998 French statute aimed at optimising the organisation of obstetric care requires every maternity unit to belong to a perinatal network built around one or more level-three units (reference centres with an onsite neonatal ICU) and including level-1 units (no facilities for non-routine neonatal care) and level-2 units (with a neonatal care unit), whether public or private. Among the 106 maternity units in Pithagore6, 11% were in university hospitals, 56% in non-teaching public hospitals, and 33% in non-teaching private hospitals; 56% were level 1, 36% level 2, and 8% level 3. The annual number of deliveries was less than 500 in 14% of the maternity units, between 500 and 1500 in 46%, and greater than 1500 in 40%. Data were collected over 1 year in each unit, between December 2004 and November 2006. The aim of Pithagore6 was to evaluate a multifaceted educational intervention for reducing the rate of severe PPH. As no significant differences in severe PPH rates were found between the groups (16), all participants were pooled in a single cohort of women with PPH.

In the Pithagore6 trial, PPH was assessed clinically by the medical staff or defined as a greater than 2.0 g/dL decline in the haemoglobin level. The clinical definition of PPH was blood loss greater than 500 mL or excessive blood loss prompting manual removal of the

placenta or examination of the uterine cavity (or both). The prepartum haemoglobin was collected as part of routine prenatal care during the last few weeks of pregnancy. Postpartum haemoglobin was the lowest haemoglobin found within 3 days of delivery (nadir of haemoglobin), whether the woman had been transfused or not before. It was neither measured routinely, nor as part of the study protocol. Instead, the decision was left to the clinicians. Birth attendants in each unit identified all women with PPH and reported them to the research team. Additionally, a research assistant reviewed the delivery-suite logbook of each unit monthly and checked any available computerised woman charts. For each woman with a note of PPH, uterine cavity examination, or manual removal of the placenta, the obstetric ward file was reviewed to verify the diagnosis of PPH. During the study period, among 146,781 deliveries, 9365 (6.4%) were complicated by PPH, including 6660 (71.1%) diagnosed clinically and 2705 (28.9%) diagnosed only on a haemoglobin decline (Figure 1).

By definition, women with PPH defined by a haemoglobin decline, with no clinical diagnosis of PPH, did not receive specific acute care for PPH. Consequently, in our study, these women were excluded from the analysis of transfusion practices and blood loss severity. Our analysis was thus restricted to women with clinical PPH requiring red blood cell (RBC) transfusion within 12 hours after the diagnosis (clinical PPH with early transfusion, clinical PPH with early transfusion group, n=426). Indeed, this situation indicates significant acute PPH, where transfusion is an essential part of the management and can be lifesaving.

Study variables

During the Pithagore6 trial, a standardised case-report form was used to extract data from the medical chart of each woman with PPH.

We looked at compliance with 2002 national French transfusion guidelines (17) and 2004 French guidelines on PPH management (18). These guidelines indicate that RBCs

should be transfused when the haemoglobin level is lower than 7.0 g/dL, especially in case of acute anaemia. The haemoglobin concentration should be interpreted according to blood loss and vital signs and should be kept between 7.0 and 10.0 g/dL as long as the haemorrhage continues. RBC transfusion is usually unnecessary when the haemoglobin level is greater than 10.0 g/dL (18). French transfusion guidelines are widely diffused and freely available on the websites of the French Society of Anaesthesiology (http://www.sfar.org/article/198/hemorragies-du-post-partum-immediat-rpc-2004) and National College of Obstetricians and Gynaecologists (http://www.cngof.asso.fr/D_PAGES/PURPC_12.HTM). Data on the existence of an algorithm in each maternity unit were not collected in the Pithagore6 trial. However, such algorithms are not intended to modify national guidelines but instead to describe local implementation modalities.

The following baseline characteristics were recorded: maternal age in years, body mass index (weight (Kg)·[height (m)]$^{-2}$), primiparity, prior PPH, previous caesarean section, and multiple pregnancy, all handled as binary variables; gestational age in, and prenatal haemoglobin level (g/dL). We also recorded the characteristics of the delivery: epidural or spinal analgesia/anaesthesia (binary variable); mode of delivery in four categories (spontaneous vaginal delivery, operative vaginal delivery, caesarean section before labour, caesarean section during labour); birth weight (grams), and postpartum haemoglobin measurement (binary variable). PPH was documented using the time from delivery to PPH as a continuous variable. The cause of PPH was recorded using five categories: coagulation disorders, trauma, abnormal placenta insertion, uterine atony or retained tissues, and unidentified cause. In PPH due to multiple causes, only one cause was recorded, in the order reported above.

Transfusion was studied during the whole postpartum hospital stay. We evaluated the nature of the blood product (RBC, fresh frozen plasma [FFP], platelets) or blood-derived product (fibrinogen concentrates) administered, use of the RBC+FFP+platelet+fibrinogen combination, and use of massive transfusion (10 or more RBC units), all studied as binary variables. The transfused volume of each blood product (in units) and the fibrinogen dose (g) administered were studied as continuous variables. In women who received both RBC and FFP, the FFP/RBC ratio was computed and analysed both as a continuous variable and as a categorical variable (FFP/RBC ratio of 0.5 or more and FFP/RBC ratio less than 0.5). The administration of pro-haemostatic agents (recombinant activated factor VII, other synthetic coagulation factors, tranexamic acid, anti-thrombin III, aprotinin) was handled as a binary variable. Time from PPH diagnosis to RBC transfusion initiation was analysed as a continuous variable. Acute adverse events of transfusion were looked for specifically in the medical chart, where they were spontaneously reported.

Concerning blood loss severity, the nadir of haemoglobin and the greatest haemoglobin (g/dL) drop versus baseline were studied as continuous variables. Secondary disseminated intravascular coagulation (DIC), defined as a coagulation disorder not present before the diagnosis of PPH (platelet count less than $50 \cdot 10^3 \cdot mm^{-3}$, or prothrombin time less than 50%, or combination of platelet count between 50 and $100 \cdot 10^3 \cdot mm^{-3}$ and/or prothrombin time between 50% and 65% and/or fibrinogen level less than 1 g/L), was studied as a binary variable. Components of the second-line management of PPH were handled as binary variables; these components included arterial embolisation, conservative surgery (vascular ligation and/or uterine suture), hysterectomy, and ICU admission.

Statistical analysis

The rate of blood transfusion was calculated for all deliveries and for all PPH cases during the study period, overall and according to the mode of diagnosis of PPH and to the mode of delivery (vaginal or caesarean delivery).

We calculated the rates of haemoglobin measurements and of RBC transfusion among women with haemoglobin levels lower than 7.0 g/dL and among those with haemoglobin levels lower than 6.0 g/dL.

The characteristics of the women, pregnancies, and deliveries were compared between the clinical PPH with early transfusion group and the other women with clinical PPH (not transfused or transfused more than 12 hours after PPH diagnosis). In the clinical PPH with early transfusion group, we compared transfusion practices according to mode of delivery and according to cause of PPH, separately in the women with vaginal delivery and caesarean section.

Normality plots were constructed to assess normality of distribution of continuous data. Categorical variables were compared using the chi-square test or Fisher's exact test as appropriate. For continuous variables, parametric tests (unpaired t test or analysis of variance followed by Bartlett's test) or non-parametric tests (Mann-Whitney test or Kruskal-Wallis test) were used as appropriate. Analyses were performed using STATA v10.1 software (Stata Corporation, College Station, TX, USA).

Results

For the 146,781 deliveries during the study period, the RBC transfusion rate for PPH was 0.48±0.04% overall, 0.34±0.03% after vaginal delivery (n=117,606), and 1.03±0.11% after caesarean delivery (n=29,175). PPH with transfusion of at least four RBC units occurred in 0.17% of deliveries. The 701 RBC-transfusion recipients accounted for 7.5±0.5% of women with PPH (n=9365), 5.5% of women with PPH after vaginal birth and 14.4% of women with PPH after caesarean delivery. The RBC transfusion rate was 9.7±0.7% (n=647) among women with clinically diagnosed PPH (n=6660) (Figure 1).

RBC transfusion was given to less than half of the women with clinical PPH and haemoglobin levels lower than 7.0 g/dL and to three quarters of women with clinical PPH and haemoglobin levels lower than 6.0 g/dL (Table 1). Five transfusion-related adverse events were recorded. Only one was severe, with pulmonary oedema requiring ICU admission.

Of the 647 women with clinical PPH who required RBC transfusions, 426 (65.8%) received RBCs within 12 hours of the diagnosis (clinical PPH with early transfusion group) and 157 (24.3%) received RBCs later on. In the remaining 64 (9.9%) women, the time from PPH diagnosis to RBC transfusion was unknown. Women with clinical PPH and early transfusion were significantly older and had significantly lower prenatal haemoglobin, higher prevalences of prior PPH, prior caesarean section, multiple pregnancy, caesarean delivery, as well as younger gestational age at delivery and lower birth weight than did the other women with clinical PPH (Table 2).

Transfusion practice and blood loss severity in clinical PPH with early transfusion

The following results only concern women with clinical PPH and early transfusion (clinical PPH with early transfusion group, n=426). In this population, more than half of the

women received a combination of blood products (Table 3). In women with PPH after operative vaginal delivery, the median volumes of RBC and FFP units transfused were larger compared to the women with spontaneous vaginal delivery (p=0.001 for RBC and p=0.004 for FFP). Overall, 11% of the women with PPH after a vaginal delivery received 10 or more RBC units, and receiving 10 or more RBC units was significantly more common after operative than after spontaneous vaginal delivery (p<0.001, OR: 5.22, 95%CI 2.12-12.82). The use of prohaemostatic agents was significantly more common in the operative vaginal delivery group (p=0.04 between spontaneous and operative vaginal delivery, OR: 3.54, 95%CI 1.12-11.18), with 5 out of the 9 women who received recombinant activated factor VII included in this group.

The maximal haemoglobin drop was significantly higher after operative than after spontaneous vaginal delivery (p=0.003), as was the rate of conservative surgical procedures (p=0.006, OR: 3.22, 95%CI 1.34-7.76) (Table 4).

Uterine atony or retained tissues was the most common causes of PPH overall (47.4%) and in case of vaginal or caesarean delivery. The distribution of PPH causes significantly differed between vaginal and cesarean delivery, abnormal placenta insertion and coagulation disorders being more frequent in case of cesarean delivery. Among vaginal delivery, the distribution of PPH causes significantly differed between spontaneous and operative vaginal delivery (p=0.002). Trauma was the leading cause of PPH requiring transfusion within the first 12 hours in operative vaginal delivery (42.6%).

In PPH after vaginal delivery, coagulation disorders and abnormal placenta insertion were the causes associated with the highest rates of combined blood-products transfusion and of massive transfusion, the largest blood product volumes, the greatest maximal haemoglobin drops, and the highest DIC rate (Table S1). In PPH after caesarean delivery, these two causes

were associated with larger RBC volumes, larger FFP volumes, and higher rates of massive transfusion (Table S2).

Discussion

This study shows that 1 woman in every 200 giving birth received a RBC transfusion for PPH in France. Contrasting with French transfusion guidelines, omission of RBC transfusion for PPH was observed in a large proportion of women with low haemoglobin level. In women with early RBC transfusion, operative vaginal delivery was associated with a higher rate of FFP transfusion, larger volumes of blood products, higher rate of massive transfusion and greater severity of haemorrhage than spontaneous vaginal delivery.

The RBC transfusion rates we reported is consistent with several findings from previous studies (2, 15, 19, 20). In a population-based retrospective study from the United States, the overall RBC transfusion rate in the obstetric population was 0.48% (1994-2004) (20). Another retrospective population-based cohort study from Canada reported a national rate of PPH with RBC transfusion of 0.39%, without any significant change over time during the study period (1991-2004) (2). In a prospective cohort study performed in several hospitals from Uruguay and Argentina, the rate of transfusion for PPH after vaginal birth was 0.35%.(19). A recent population-based Danish study from Holm and co-workers reported a RBC transfusion rate of 1.92% of all deliveries (15). This higher rate may be ascribable to the inclusion of all cases of RBC transfusion --whether related to PPH or to other causes of postpartum anaemia-- and of all RBC transfusions given within 7 days after delivery.

Our data have documented omission of RBC transfusion in a significant proportion of PPH women with haemoglobin levels lower than the recommended trigger. These results suggest that undertransfusion may exist in this context. Moreover, our results suggest that women with PPH in our study may have received smaller volumes of RBCs compared to those in the LEMMoN study, a recent nationwide study of severe acute maternal morbidity

performed in the Netherlands (21). In this study, PPH with transfusion of at least four RBC units occurred for 0.6% of deliveries, three times more frequently than in our study. Failure to recognize severe haemorrhage may result in less frequent RBC transfusion. Omission of RBC transfusion for PPH with low haemoglobin level and small RBC volumes were also found in a previous study of maternal death secondary to PPH in France, where they certainly contributed to the fatal issue (7). In contrast, a trend towards over-transfusion of women has been reported in the United States (8), the United Kingdom (9) and the Netherlands (22). That the RBC transfusion rate in our study was comparable to that in other countries despite omission of transfusion for PPH with low haemoglobin level may be ascribable to the greater severity of PPH in our population. Various aspects of labour, delivery, and their management, as well as delayed PPH initial treatment and place of delivery, have been shown to increase the risk of severe blood loss in women with PPH (6), and may contribute to increase PPH severity in France. The use of a low transfusion threshold in our study may be ascribable to greater concern among physicians about the risk of maternal alloimmune reactions compared to the risk of acute anaemia in woman who usually have no history of coronary artery disease. In addition, the persistent reluctance to use blood transfusion generated in France by the human immunodeficiency virus epidemic probably made a major contribution. (23). The impacts of low haemoglobin trigger for RBC transfusion on women outcomes has to be evaluated, in order to determine if transfusion guidelines should be strictly followed or if the physicians' attitude is justified.

In our study, almost 20% of the women with PPH and early RBC transfusion received fibrinogen concentrates. This proportion appears to be high considering the absence of scientific evidence for an efficacy of this treatment. The use of fibrinogen concentrates could have been influenced by results from experimental laboratory and animal studies that strongly suggested a potent haemostatic effect of fibrinogen substitution (24, 25), and from few

observational studies. Virally inactivated fibrinogen concentrate offers rapid restoration of fibrinogen levels, with a small volume infusion and minimal preparation time (26). It is effective in treating patients with congenital hypofibrinogenemia (27), but there are very few reports of its use in obstetric hemorrhage. The 2004 French recommendations stated that the use of fibrinogen concentrates in PPH was controversial (18). Before recommending the early use of fibrinogen concentrates in PPH, prospective studies designed to assess its efficacy and tolerance, such as the FIB-TRIAL are required (28).

Previous studies have established operative vaginal delivery as a risk factor for PPH (19, 29, 30). Our results show that operative vaginal delivery is also a risk factor for transfusion among women with PPH. Haemorrhage after operative vaginal delivery required larger blood-product volumes compared to spontaneous vaginal delivery, as previously reported by James et al., without any clear explanation (11). Operative vaginal delivery was also associated with a significantly higher rate of invasive procedures compared with spontaneous vaginal delivery. These differences seem ascribable to greater blood loss severity in operative than in spontaneous vaginal delivery, as illustrated by the significantly greater haemoglobin drop and higher ICU admission rate. Decreased accuracy of visual blood loss assessment after operative vaginal delivery has been reported (31). Thus, delayed PPH management due to challenges in blood loss assessment, together with the high rate of secondary coagulopathy after operative vaginal delivery -- as observed in our study -- may contribute to increase blood loss severity in operative vaginal deliveries.

As previously reported, coagulation disorders and abnormal placenta insertion were associated with higher blood loss and more transfusion use than other causes of PPH (12, 14, 32). These findings suggest that, in the event of operative vaginal delivery, coagulopathy, or abnormal placenta insertion, very close monitoring of postpartum blood loss and of its

consequences is particularly needed. Point-of-care tests for haemoglobin level and coagulation may be useful tools in these contexts (33).

Due to the paucity of data, transfusion guidelines in women are often derived from data and recommendations for trauma patients. We found several similarities in transfusion practices between trauma and obstetrical patients: as with trauma patients, the number of RBC units transfused per woman varied widely; the FFP/RBC ratio in trauma patients was similar to that in our study (34), suggesting that transfusion practices for acute haemorrhage with coagulopathy may be comparable in trauma and PPH (35). Nevertheless, most of the studies of transfusion practices in trauma patients found considerably higher transfusion rates (45% to 55%) (34, 36) and larger transfused volumes of RBC (36) than in our women with PPH. Morbidity and mortality rates due to haemorrhagic shock are higher in trauma patients than in women with PPH, with severe acute haemorrhage requiring aggressive transfusion therapy being more common among trauma patients than among women with PPH. Therefore, transfusion guidelines for trauma patients may be relevant only to women with heavy haemorrhage.

This study has several strengths. We used a population-based cohort composed of all women who delivered in a predefined geographic area, and whose characteristics were comparable to those of the overall population of women delivering in France (37). These features support the external validity of our results. The large number of deliveries provided robust estimates of transfusion practices in women with PPH and produced sufficient statistical power for comparisons of various obstetrical situations. Moreover, contemporary French guidelines on PPH management (38) and on transfusion in patients with acute haemorrhage (17) are similar to those from other high-resource countries (39, 40), making international comparisons of transfusion practices possible. In the present study, the prospective identification of PPH cases and review of delivery-suite logbooks and

computerised woman charts probably ensured a high ascertainment rate. Finally, we collected detailed data on transfusion practices in PPH. Three previous prospective population-based studies described transfusion practices but were confined to women with severe PPH requiring invasive second-line treatments such as uterine compression suture, pelvic vessel ligature, interventional radiological techniques (12, 13), and/or hysterectomy (13, 14), which limited the total number of transfused women included. Moreover, in these studies, data on transfusion practices were limited, with no information on the FFP/RBC ratio, time from PPH diagnosis to transfusion, or use of fibrinogen, although these items constitute important information on the quality of transfusion management and may have a major impact on woman outcomes (23, 41).

This study has some limitations. The haemoglobin trigger for RBC transfusion was not directly available in the collected data. However, it could be indirectly assessed through the postpartum nadir of haemoglobin, especially among women who were not transfused. Indeed, the absence of RBC transfusion in a great proportion of women with haemoglobin nadir lower than 7g/dL -level recommended as a trigger for RBC transfusion- suggests that the actual haemoglobin trigger for RBC transfusion is frequently lower than recommended. Importantly, this trigger should be interpreted in conjunction with the clinical context. Thus, transfusion requirements differ between women with stable anaemia and those with acute haemorrhage. In the event of active haemorrhage, clinical symptoms of acute anaemia should be given more weight than the haemoglobin trigger. Consequently, using only the haemoglobin to select women for transfusion may be overly restrictive. Nevertheless, most of the studies evaluating the appropriateness of RBC transfusion both in women with stable anaemia and in those with acute haemorrhage relied on the haemoglobin (42, 43). Another limitation of our study is the absence of maternity unit-specific data on organisational features such as local blood-bank resources, blood availability, and the supply chain. Consequently, we were unable to analyse

the differences in transfusion practices according to local organisation. We used data from the Pithagore6 trial, which evaluated the impact of an educational intervention for early PPH management on the incidence of severe PPH (16). Designing this trial might have changed transfusion practices in PPH. However, no significant differences were found between the two trial arms regarding the rates of severe PPH and of blood transfusion. Thus, transfusion practices were probably not influenced by the Pithagore6 trial.

Conclusion

Contrasting with transfusion guidelines, omission of RBC transfusion for PPH was found in a large proportion of women with low haemoglobin level. This poor compliance with guidelines may be explained by poor integration of transfusion guidelines into everyday practice, fear of transfusion complications, French transfusion tradition, or factors related to healthcare organisation. The impact on maternal outcomes of this transfusion strategy remains to be determined. Transfusion practices varied according to delivery mode and cause of PPH, with operative vaginal delivery, coagulation disorders, and abnormal placenta insertion being characterised by higher blood loss and more transfusions. Knowledge of transfusion practices may improve the quality of care by helping clinicians to identify obstetrical situations at risk for transfusion.

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Legends to Figures and Tables

Figure 1: Study population

a:PPH defined only by a greater than 2 g/dL decline in the haemoglobin level

b: Clinical PPH: defined as a blood loss greater than 500mL or an excessive blood loss prompting manual removal of the placenta or examination of the uterine cavity (or both)

[c]: Late transfusion: transfusion starting more than 12 hours following PPH diagnosis

[d]: Early transfusion: transfusion starting within the 12 first hours after PPH diagnosis

Hb: haemoglobin

Table 1: Haemoglobin measurements and red-blood-cell transfusion during the whole postpartum hospital stay in women with postpartum haemorrhage

PPH, postpartum haemorrhage; Hb, haemoglobin; RBC, red blood cells; SD, standard deviation; IQR, interquartile range

[a]: lowest haemoglobin level measured during the 3 first postpartum days, whether the women were transfused or not before

Table 2: Among women with clinical postpartum haemorrhage, comparison of women given early transfusion[a] and of other women

Data on transfusion timing was lacking for 64 women with clinical postpartum haemorrhage, who were not included in the comparison.

Data are number of women (%) unless otherwise specified.

Data were missing for less than 5% of transfused women, except for body mass index (12.9%)

[a]: Women with transfusion started within 12 first hours following the diagnosis of clinical postpartum haemorrhage

[b]: Other women with clinical PPH (not transfused or with transfusion started more than 12 hours after PPH diagnosis).

Hb: Haemoglobin, PPH: postpartum haemorrhage, IQR: interquartile range; SD: standard deviation

Table 3: Transfusion characteristics according to mode of delivery in women with clinical postpartum haemorrhage and early transfusion[a]

Data are number of women (%) unless otherwise specified.

[a]: Women with transfusion started within 12 first hours following the diagnosis of clinical postpartum haemorrhage

[b]: Test for comparison across the four groups

RBC: red blood cells; FFP: fresh frozen plasma; IQR: interquartile range; SD: standard deviation; NA: not applicable

Table 4: Blood loss severity in women with clinical postpartum haemorrhage and early transfusion[1]

Data are number of women (%).

[1]: Women with transfusion started within 12 first hours following the diagnosis of clinical postpartum haemorrhage

[2]: Test for comparison across the four groups

SD: standard deviation; DIC: disseminated intravascular coagulation; ICU: intensive care unit

Tables

Table 1: Haemoglobin measurements and red-blood-cell transfusion during the whole hospital stay in women with postpartum haemorrhage

	Clinical PPH N=6660	**Clinical PPH and Hb<7.0 g/dL N=858**	**Clinical PPH and Hb<6.0 g/dL N=289**
Postpartum Hb measurements n (%)	5776 (86.7%)	858 (100)	289 (100)
RBC transfusion n (%)	647 (9.7%)	423 (49.3%)	219 (75.8%)
Nadir of haemoglobin in case of RBC transfusion (g/dL) (mean (SD))	6.6 (±1.4)	5.8 (±0.8)	5.2 (±0.7)
Number of RBC units transfused (median (IQR))	3 (2-5)	3 (2-5)	3 (2-6)

PPH, postpartum haemorrhage; Hb, haemoglobin; RBC, red blood cells; SD, standard deviation; IQR, interquartile range

[a]: lowest haemoglobin level measured during the 3 first postpartum days, whether the women were transfused or not before

Table 2: Among women with clinical postpartum haemorrhage, comparison of women given early transfusion[a] and of other women

Population characteristics	**PPH with early RBC transfusion[a] (N=426)**	**Other clinical PPH[b] (n=6170)**	***p* value**
Women and pregnancies			
Maternal age (years)			
<25	65 (15.3)	970 (15.7)	
25-35	257 (60.3)	4062 (65.8)	0.009
>35	104 (24.4)	1137 (18.4)	
Body mass index (Kg/m^2)			
≤18	22 (5.2)	284 (4.6)	
19-25	255 (59.9)	3837 (62.2)	0.29
26-30	55 (12.9)	848 (13.8)	
>30	25 (5.9)	415 (6.7)	
Primiparous	173 (40.6)	3130 (50.7)	<0.001
Prior PPH	29 (6.8)	287 (4.7)	0.04
Prior caesarean delivery	70 (16.4)	554 (9.0)	<0.001
Multiple pregnancy	33 (7.8)	216 (3.5)	<0.001
Mean prenatal Hb level (g/dL) (SD)	11.5 (±1.4)	12.0 (±1.2)	<0.001
Labour and delivery			
Gestational age <37 weeks	59 (13.8)	394(6.4)	0.0001
Mode of delivery			<0.001
Vaginal delivery	231 (54.2)	5345 (86.6)	

Spontaneous vaginal delivery	170 (73.6)	4147 (77.6)	
Operative vaginal delivery	61 (26.4)	1198 (22.4)	
Caesarean delivery	195 (23.1)	824 (13.4)	
Caesarean delivery before labour	109 (55.9)	439 (53.3)	
Caesarean delivery during labour	86 (44.1)	385 (46.7)	
Epidural or spinal analgesia/anaesthesia	336 (78.9)	4984 (80.8)	0.51
Mean birth weight (g) (SD)	3236 (±704)	3377 (±568)	<0.001
Median time from delivery to PPH diagnosis (IQR)	12 min (2-45)	15 min (9-30)	0.08

Data on transfusion timing was lacking for 64 cases of clinical postpartum haemorrhage, who were not included in the comparison.

Data are number of women (%) unless otherwise specified.

Data were missing for less than 5% of transfused women, except for body mass index (12.9%)

[a]: Women with transfusion started within 12 first hours following the diagnosis of clinical postpartum haemorrhage

[b]: Other women with clinical PPH (not transfused or with transfusion started more than 12 hours after PPH diagnosis).

Hb: Haemoglobin, PPH: postpartum haemorrhage, IQR: interquartile range; SD: standard deviation

Table 3: Transfusion characteristics according to mode of delivery in women with clinical postpartum haemorrhage and early transfusion[a]

	Total (N=426)	Spontaneous vaginal delivery N=170 (40.0%)	Operative vaginal delivery N=61 (14.3%)	Caesarean delivery before labour N=109 (25.5%)	Caesarean delivery during labour N=86 (20.1%)	*p* value[b]
RBC only	168 (39.4)	65 (38.2)	17 (27.9)	46 (42.2)	40 (46.5)	0.13
FFP	248 (58.1)	102 (60.0)	44 (72.1)	59 (54.1)	43 (50.0)	0.04
Fibrinogen	83 (19.5)	31 (18.2)	12 (19.7)	23 (21.1)	17 (19.8)	0.95
Platelets	52 (12.2)	18 (10.6)	13 (21.3)	15 (13.8)	6 (7.0)	0.06
RBC+FFP+Platelets+Fibrinogen	32 (7.5)	14 (8.2)	8 (13.1)	7 (6.4)	3 (3.5)	0.17
Median transfused quantity (IQR)						
RBC (units)	3 (2-6)	3 (2-5)	4 (3-9)	3 (2-6)	4 (2-5)	0.01
FFP (units)	4 (2-6)	3 (2-4)	4 (2-6)	4 (3-6)	3 (2-4)	0.004
Fibrinogen (g)	3 (3-4.5)	3 (1.5-4.5)	3 (3-7.5)	4 (3-5.5)	3 (2-4.5)	0.37
Platelets (units)	1 (1-2)	1 (1-2)	1 (1-2)	1 (1-2)	2 (1-2)	0.39
≥10 RBC units	46 (10.8)	10 (5.9)	15 (24.6)	16 (14.7)	5 (5.8)	<0.001

FFP/RBC						
Median (IQR)	0.8 (0.5-1)	0.7 (0.6-1)	0.8 (0.5-1)	0.8 (0.6-1)	0.6 (0.5-1)	0.38
FFP/RBC≥0.5	209 (84.3)	85 (83.3)	39 (88.6)	52 (88.1)	33 (76.7)	0.36
Median time from PPH diagnosis to RBC administration, hours (IQR)	2 h 18 min (1h18min-3h 54min)	2 h 30 min (1h24min-4h18min)	2 h 12 min (1h18min-3h 48min)	2 h 00 (48min-3h36 min)	2 h 12 min (1h06min-3h48min)	0.12
Use of pro-haemostatic agents	17 (4.0)	6 (3.5)	7 (11.5)	2 (1.8)	2 (2.3)	NA

Data are number of women (%) unless otherwise specified.

[a]: Women with transfusion started within 12 first hours following the diagnosis of clinical postpartum haemorrhage

[b]: Test for comparison across the four groups

RBC: red blood cells; FFP: fresh frozen plasma; IQR: interquartile range; SD: standard deviation; NA: not applicable

Table 4: Blood loss severity in women with clinical postpartum haemorrhage and early transfusion[a]

	Total N=426	**Spontaneous vaginal delivery N=170 (40.0%)**	**Operative vaginal delivery N=61 (14.3%)**	**Caesarean delivery before labour N=109 (25.5%)**	**Caesarean delivery during labour N=86 (20.1%)**	***p* value[b]**
Mean maximal Hb drop (g/dL) (SD)	4.7 (1.9)	4.6 (1.8)	5.6 (2.0)	4.1 (1.9)	4.8 (1.8)	<0.001
Secondary DIC	110 (25.8)	42 (24.7)	19 (31.2)	22 (20.2)	27 (31.4)	0.23
Embolisation	106 (24.9)	49 (28.8)	19 (31.2)	22 (20.2)	16 (18.6)	0.12
Conservative surgery	58 (13.6)	12 (7.1)	12 (19.7)	23 (21.1)	11 (12.8)	0.004
Hysterectomy	64 (15.0)	23 (13.5)	13 (21.3)	23 (21.1)	5 (15.0)	0.01
ICU admission	180 (42.3)	64 (37.7)	33 (54.1)	45 (41.3)	38 (44.2)	0.16

Data are number of women (%).

[a]: Women with transfusion started within 12 first hours following the diagnosis of clinical postpartum haemorrhage

[b]: Test for comparison across the four groups

Hb: Haemoglobin; SD: standard deviation; DIC: disseminated intravascular coagulation; ICU: intensive care unit