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F. Deleu, C. Deneux-Tharoux, C. Chiesa-Dubruille, A. Seco, M.P. Bonnet

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1 **A retrospective analysis of French transfusion practices for women experiencing severe**
2 **postpartum hemorrhage**

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4 F Deleu, ^{a,b} C Deneux-Tharaux, ^a C Chiesa-Dubruille, ^a A Seco, ^a MP Bonnet, ^{a,c} for the
5 EPIMOMS study group (see Appendix A)

6
7 ^a *Obstetrical, Perinatal and Pediatric Epidemiology Research Team (EPOPé), Center for*
8 *Epidemiology and Statistics, Sorbonne Paris Cité (CRESS), DHU Risks in Pregnancy,*
9 *INSERM UMR 1153, Paris Descartes University, 53 avenue de l'Observatoire, 75014 Paris,*
10 *France*

11 ^b *Department of Anesthesia, Louis Mourier University Hospital, AP-HP, Paris Diderot*
12 *University, 178 rue des Renouillers, 92700 Colombes, France*

13 ^c *Department of Anesthesia and Crit Care, Paris Centre University Hospitals, AP-HP, Paris*
14 *Descartes University, 27 rue du faubourg Saint Jacques, 75014 Paris, France*

15
16 **Corresponding author:** Marie-Pierre Bonnet

17 Needs mailing address

18 *E-mail address:* marie-pierre.bonnet@aphp.fr

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36 **Abstract**

37 **Background:** Transfusion is a major therapy for severe postpartum hemorrhage but there are
38 few population-based descriptions of practice. The objective of this retrospective French
39 population-based study was to describe transfusion practices in women with severe
40 postpartum hemorrhage and the compliance with guidelines.

41 **Methods:** Study data were sourced from a prior prospective population-based study of 182
42 309 deliveries in France between 2012 and 2013. Transfusion practices and compliance with
43 French national guidelines were described for all women with severe postpartum hemorrhage
44 who had been transfused with red blood cells.

45 **Results:** In 1495 women with severe postpartum hemorrhage (0.8% of all deliveries), 35.1%
46 were not transfused, 50.0% were transfused during active bleeding and 14.9% exclusively
47 after control of bleeding. Among 697 women with a hemoglobin level <7 g/dL, 21.4% were
48 not transfused. In 747 women transfused during active bleeding, 68.8% also received fresh
49 frozen plasma (fresh frozen plasma to red blood cell ratio between 0.5 and 1 in 80.4%). Forty-
50 four percent received fibrinogen concentrate (including 37.4% with a plasma fibrinogen level
51 >2 g/L) and 8.6% had a massive transfusion. Among 223 women transfused after bleeding
52 was controlled, 5.4% received fresh frozen plasma and 13% had a hemoglobin level >7 g/dL.

53 **Conclusions:** One in five women with severe postpartum hemorrhage and a low hemoglobin
54 concentration did not receive blood transfusion, which does not comply with French national
55 recommendations. Over-transfusion occurred in women in whom bleeding had been
56 controlled. The use of tools to help clinicians with transfusion decision-making should be
57 developed.

58

59 **Keywords**

60 Postpartum hemorrhage, severe; Transfusion; Guidelines; Epidemiology

61

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68 Obstetric Anesthesia (CARO).

69

70 **Introduction**

71 Severe postpartum hemorrhage (SPPH) occurs in 1% of deliveries in high-resource countries
72 and is the leading cause of severe maternal morbidity and mortality worldwide.¹⁻³ Individual
73 risk factors are poor predictors of postpartum hemorrhage (PPH).⁴ Consequently, interest has
74 focused on care practices, since changes in management may affect maternal morbidity and
75 mortality.⁵ Blood transfusion is an essential component of SPPH management by maintaining
76 the circulating blood volume and tissue oxygenation, and for hemostatic support.⁶

77 There are few prospective population-based studies on transfusion practices in SPPH.

78 Previous studies are monocentric^{7,8} or retrospective based on hospital databases,⁹⁻¹² while
79 population-based studies focus on massive transfusion¹³ or are older.¹⁴ Population-based and
80 prospectively-collected data could provide a snapshot of transfusion practices in SPPH, assist
81 clinicians in decision-making and identify areas that are performed well or poorly.

82 International and national transfusion guidelines for SPPH differ depending on whether the
83 bleeding is active or has been controlled.¹⁵⁻¹⁷ However, transfusion practices in obstetric
84 hemorrhage have not been described according to the status of bleeding. The EPIMOMS
85 study, a French population-based study of severe acute maternal morbidity performed in 2012
86 and 2013, provided prospective data on women with SPPH and detailed information about
87 transfusion management and active or controlled bleeding.^{18,19}

88 The objective of this retrospective study was to describe transfusion practices in women with
89 SPPH based on data from a prospective population-based study. Women in whom transfusion
90 started during active bleeding and those in whom transfusion started only after the control of
91 bleeding were analyzed separately. The study evaluated the compliance with some specific
92 components of transfusion management from contemporary French national guidelines,
93 endorsed by the French National Agency for the Safety of Medicines and Health Products
94 (ANSM)^{16,20} and by the National College of French Gynecologists and Obstetricians
95 (CNGOF).^{17,21}

96

97 **Methods**

98 The source population was extracted from the EPIMOMS study, a prospective observational
99 population-based study of severe acute maternal morbidity, defined by expert consensus using
100 a national Delphi process, and conducted during one year in 119 maternity units and 136
101 intensive care units of six French regions (April 2012 to November 2013; 182 309
102 deliveries).^{18,19} Caregivers prospectively identified women with severe acute maternal

103 morbidity and the completeness of case ascertainment was validated by a review of delivery
104 logbooks, birth registers, hospital discharge databases and laboratory records. Detailed
105 information on sociodemographic characteristics, medical and obstetric history, antenatal
106 care, delivery and obstetric hospitalization was collected from medical charts.

107 The study population included all the women from the EPIMOMS study who had SPPH,
108 defined as a hemorrhage with at least one of the following criteria: blood loss >1500 mL,
109 transfusion of four red blood cell (RBC) units or more, arterial embolization, conservative
110 uterine surgery (arterial ligation or uterine compression sutures), hysterectomy, acute organ
111 dysfunction (cardiovascular, respiratory, renal, hepatic or neurologic dysfunction), admission
112 to an intensive care unit, acute severe postpartum anemia (hemoglobin (Hb) level <7 g/dL) in
113 the absence of chronic anemia, acute thrombocytopenia <50.10⁹/L, disseminated intravascular
114 coagulopathy (DIC), or maternal death.^{18, 19}

115 During the study period, 1655 women had SPPH (0.9% of deliveries, Fig. 1). For this
116 analysis, women with congenital bleeding disorders or antepartum diagnosis of morbidly
117 adherent placenta were excluded because specific transfusion strategies were planned in
118 advance for those patients. Secondary SPPH, occurring more than 24 h after delivery, was
119 excluded because its causes and management, including transfusion strategy, differ from
120 primary PPH. The analysis was therefore restricted to women with primary SPPH for whom
121 transfusion strategy was not anticipated (n=1495).

122 The time when bleeding was controlled (corresponding to the cessation of the bleeding as
123 diagnosed by the clinicians) and the time when RBC transfusion was started were specifically
124 collected in the EPIMOMS study. Women with SPPH were included in the “transfusion
125 started during active bleeding” group if RBC transfusion started prior to the control of
126 bleeding, and in “transfusion started after bleeding control” if RBC transfusion started after
127 the time of bleeding control. Women transfused before and after bleeding control were
128 classified in the group “transfusion started during active bleeding”.

129 Maternal demographics, pregnancy, delivery and hospital markers of the severity of PPH
130 (total blood loss; nadir Hb level; nadir plasma fibrinogen level; hemorrhagic shock as defined
131 in the EPIMOMS study by a systolic blood pressure <90 mmHg for >60 min or unresponsive
132 to plasma expansion); DIC as defined in the EPIMOMS study by a platelet count <50.10⁹/L
133 and/or a prothrombin time <60% and/or a serum fibrinogen level <2 g/L; components of PPH
134 management; and causes of SPPH such as placenta accreta, placenta previa, placental
135 abruption, uterine rupture, amniotic fluid embolism, surgical causes, perineal trauma or
136 episiotomy, placental retention, uterine atony, other causes and unidentified causes) were

137 collected. If SPPH arose from multiple causes, only one was recorded in the order of priority
138 mentioned above.

139 Transfusion practices were explored: type and total quantity of blood products administered,
140 the intervals between the diagnosis of PPH and the start of RBC transfusion and between the
141 first administration of RBC and of fresh-frozen plasma (FFP) or fibrinogen concentrate (FC),
142 the FFP:RBC ratio administered within three hours of the first RBC transfusion, and last Hb
143 level measured before transfusion.

144 At the time of the study, French national guidelines were available for transfusion in SPPH, as
145 part of general guidelines on blood transfusion^{16, 20} and as a specific section of obstetric
146 guidelines on the management of PPH.^{17, 21} These guidelines were similar to those in Europe
147 and North America at the time.^{22, 23} The transfusion strategies differed according to the
148 presence or absence of active bleeding. In adults with acute anemia not associated with active
149 bleeding and without cardiovascular disease, the transfusion trigger was a Hb level <7 g/dL.
150 In adults with active bleeding, RBC were indicated if the patient was hemodynamically
151 unstable and/or to keep Hb 7–10 g/dL, but were usually not indicated when the Hb
152 concentration was >10 g/dL.

153 French guidelines advocate the monitoring of the plasma fibrinogen level both to predict the
154 severity of PPH and to guide the administration of coagulation factors. In SPPH, FFP
155 transfusion is recommended early using a FFP:RBC ratio between 1:2 and 1:1.

156 Administration of fibrinogen concentrate or FFP is also suggested if the plasma fibrinogen
157 level is <2 g/dL. Non-compliance with French transfusion guidelines was considered to have
158 occurred if there had been no RBC transfusion despite a Hb level <7 g/dL, RBC transfusion
159 despite a Hb level >10 g/dL, early FFP and RBC transfusion with a FFP:RBC ratio lower than
160 1:2, absence of FFP or fibrinogen concentrate administration in women with a fibrinogen
161 level <2 g/dL or DIC, and administration of fibrinogen concentrate to women with a
162 fibrinogen level ≥ 2 g/dL.

163 The characteristics of the women, pregnancy, labor, delivery, the maternity unit, PPH
164 severity, PPH management and causes of SPPH were collected and described separately for
165 women with RBC transfusion started during active bleeding, women with RBC transfusion
166 started after the control of bleeding, and women without a RBC transfusion. Transfusion
167 practices and their compliance with French guidelines were described accordingly.

168 Values are expressed as n (%), means (SD), or medians (IQR) as appropriate. Analyses were
169 performed using STATA version 13.1 (College Station, TX, USA).

170 The French Data Protection Authority and the French Advisory Committee on Information
171 Processing in Research in the field of Health approved the EPIMOMS study (CNIL 912210,
172 CCTIRS 12.060). All the women were informed of anonymized data collection during the
173 EPIMOMS study.

174

175 **Results**

176 Of the 1495 women with SPPH, 970 (64.9%) were transfused; 747 (50.0%) had RBC
177 transfusion started during active bleeding and 223 (14.9%) had RBC transfusion started only
178 after control of bleeding (Fig. 1).

179 The proportions of sub-Saharan African women, multiparous women, women with previous
180 PPH, multiple pregnancy, emergency cesarean delivery, and women who did not receive
181 prophylactic uterotonic drugs were higher among women with RBC transfusion started during
182 active bleeding than among women transfused only after control of bleeding (Table 1). The
183 proportions of women under 30 years of age, primiparous, having antepartum anemia, and
184 having an operative vaginal delivery were higher among women transfused after control of
185 bleeding than among women with RBC transfusion started during active bleeding.

186 Uterine atony was the commonest etiology of SPPH not only overall but also in each
187 subgroup according to transfusion management (Table 2). Clinical and biologic markers of
188 PPH severity and invasive procedures were frequently observed in women with RBC
189 transfusion started during active bleeding (Table 2). Among these women, two-thirds received
190 FFP, 43.9% received FC and 8.6% had a massive transfusion (≥ 10 RBC units) (Table 3a).
191 Among women with RBC transfusion started after control of bleeding, 5.4% received FFP
192 and 4.0% FC.

193 Regarding non-compliance with guidelines, for women with SPPH and a nadir Hb < 7 g/dL,
194 21.4% were not transfused (Table 3b), while in women with RBC transfusion started during
195 active bleeding, 47.6% had a nadir Hb < 7 g/dL. In this subgroup of women with transfusion
196 started during active bleeding, the FFP:RBC ratio within the first three hours of RBC
197 transfusion was < 0.5 in 10.3% of women transfused with both RBC and FFP, and the plasma
198 fibrinogen was ≥ 2 g/L in 37.4% of those who received FC. Among women with RBC
199 transfusion started after control of bleeding, 13.0% had a nadir Hb between 7 and 10 g/dL.

200

201 **Discussion**

202 In women with severe postpartum hemorrhage, half had RBC transfusion started during active
203 bleeding, 15% were transfused exclusively after bleeding control and 35% were not

204 transfused. A fifth of the women with SPPH and a Hb level <7 g/dL were not transfused with
205 RBC. Conversely, one in eight women with Hb level ≥ 7 g/dL and control of bleeding
206 received RBC. Two-thirds of women with transfusion started during active bleeding were
207 treated with FFP, including 80% with an FFP:RBC ratio between 1:2 and 1:1. Fibrinogen
208 concentrate was also used in almost half of these women, but this included only a third of
209 those with a plasma fibrinogen of <2 g/dL.

210 The characteristics of patients and transfusion practices in SPPH differed between women in
211 whom transfusion was started during active bleeding and those transfused only after control
212 of bleeding. Women transfused during active bleeding were more frequently from sub-
213 Saharan Africa, multiparous and delivered by a cesarean. In addition, they received more
214 diverse types of blood products and in larger quantities than women in whom transfusion was
215 started after the control of bleeding. These results suggest the need to explore transfusion
216 practices separately in these two different contexts.

217 The gap between clinical practice and the French transfusion guidelines suggests under-
218 transfusion, as a fifth of the women with SPPH and a nadir Hb <7 g/dL were not transfused.
219 A restrictive transfusion strategy, considering RBC transfusion indicated for patients with a
220 Hb level <7 g/dL, is recommended in obstetric and non-obstetric settings.^{22, 23, 24} Severe
221 maternal anemia is associated with increased maternal mortality and morbidity, and should be
222 corrected.²⁵ Our results show that this transfusion trigger and the need for RBC transfusion in
223 SPPH with severe anemia should be regularly communicated to practitioners.

224 In the context of transfusion started during active bleeding, two-thirds of the women had a Hb
225 level >7 g/dL at the start of transfusion, which is consistent with the 2004 French guidelines.²¹
226 Half the women transfused during active bleeding had a nadir Hb <7 g/dL during their
227 management, which may reflect the severity of PPH but also the clinical challenge of
228 transfusion decision-making. In ongoing SPPH, maintenance of Hb levels between 7 and 10
229 g/dL is recommended but may be difficult to achieve. Monitors providing real-time perfusion
230 indices, such as tissue oxygen saturation (StO₂) measured by near-infrared spectroscopy,
231 coupled with laboratory data, are probably the next frontier in the management of
232 hemorrhagic shock.²⁶ Delays in transfusing blood products are also possible, but this remains
233 speculative in the absence of data showing that transfusions were specifically triggered after a
234 Hb <7 g/dL had been confirmed.

235 The administration of FFP was observed in 68.8% of women with SPPH and transfusion
236 started during active bleeding, and in agreement with 2012 French guidelines it was used in a
237 FFP:RBC ratio between 0.5 and 1 in 80% of these women.²⁰ Fixed FFP:RBC ratios for initial

238 transfusion in major bleeding are extrapolated from the trauma and cardiovascular surgery
239 literature,²⁷ but there are few data on its use in SSPH and its relevance is currently
240 challenged.²⁸ The transfusion strategy based on FFP:RBC ratio greater than 1:2 in ongoing
241 bleeding may not be appropriate for all clinical settings, in particular in the absence of
242 coagulation factor deficiencies. Recent studies in major obstetric hemorrhage suggest that
243 prothrombin time and activated partial thromboplastin time (as markers of coagulopathy) are
244 poorly correlated with blood loss and are abnormal in a minority of women with very large
245 blood losses.^{13,29} A systematic review including randomized controlled trials that compared
246 the use of point-of-care thromboelastometry or thromboelastography with usual care, to guide
247 transfusion strategy in bleeding patients, concluded that these devices reduced the proportion
248 of patients transfused with RBC, FFP or platelets and may reduce mortality.³⁰ However, this
249 review did not include obstetric patients and its results were mainly based on elective cardiac
250 surgery. There was a high risk of bias due to heterogeneity. Goal-directed coagulation factor
251 therapy based on visco-elastic algorithms for the treatment of coagulopathy in SSPH should
252 be evaluated further.³¹

253 An increasing use of pro-hemostatic agents was seen in women transfused during active
254 bleeding: both FC and tranexamic acid were administered to more than 40% of the women
255 with a transfusion started during active bleeding. Changes in transfusion practice have
256 anticipated changes in guidelines.³² Fibrinogen concentrate was given before the first RBC
257 unit in half the cases, which may be explained by its immediate availability while awaiting
258 delivery of FFP or RBCs. It could also be explained by knowledge about publications that
259 have highlighted the association between an early fall in plasma fibrinogen and progression to
260 SSPH.^{33,34}

261 For women transfused after bleeding control, a minority was transfused when above the
262 recommended transfusion triggers: 13% received RBC despite a Hb >7 g/d, and 5.4%
263 received FFP and 4.0% FC. The use of FFP or FC after bleeding has been controlled is not in
264 accordance with the French guidelines.²⁰ Clinicians may have used these products to correct
265 biological abnormalities or out of concern about a recurrence of bleeding. The results
266 highlight the need for improving postpartum anemia management in France and may be a
267 comment on the limited guidelines with respect to patient blood management in obstetrics.
268 The recent NATA patient blood management guidelines in obstetrics are a step forward as
269 they recommend the administration of intravenous iron to women with postpartum Hb level
270 of 6–9 g/L.²⁴

271

272 This study has several strengths. We used a large population-based cohort of pregnant women
273 with characteristics comparable to the national profile,³⁵ and the definition of SPPH was
274 reproducible and easily applied. The prospective inclusion of women using predefined SPPH
275 criteria ensured the completeness of the cases in the source population. The design allowed
276 differentiation between women transfused during active bleeding and those exclusively
277 transfused after control of bleeding. However, the study also has limitations. Despite detailed
278 data having been collected on transfusion practice in SPPH, some data on timing of
279 subsequent blood products administered (including platelet transfusions) were not recorded.
280 The time period between the last pre-transfusion Hb measurement after delivery and the onset
281 of RBC transfusion was not standardized as data were extracted from an observational study.
282 Also, we did not have access to hematological indices closest to the time of hospital
283 discharge, so we could not determine the extent of anemia or hemostatic derangement among
284 these patients in the early postpartum period. We did not have patient-centric information to
285 assess whether patients with anemia were symptomatic. We were also unable to determine
286 provider-specific transfusion decision-making and whether providers used other point-of-care
287 technologies, such as visco-elastic testing in their transfusion decision-making.
288 In conclusion, our findings suggest that moderate variability exists in French transfusion
289 practices during the acute period of bleeding and after arrest of bleeding for women with
290 SPPH. Further research is needed to explore decision-making approaches to transfusion and
291 to examine the degree to which these are influenced by national guidelines. Although
292 standardizing practices may be challenging during the dynamic period of blood loss, there is a
293 need to study the impact of patient blood management practices for the treatment of
294 postpartum anemia after SPPH.

295

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297

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308

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415 **Appendix A**

416

417 **The following are members of the EPIMOMS study group:**

418 For the Naître en Alsace perinatal network: Bruno Langer

419 For the Rhône-Alpes Aurore perinatal network: Corinne Dupont, René-Charles Rudigoz

420 For the Auvergne perinatal network: Françoise Vendittelli

421 For the Basse-Normandie perinatal network: Gaël Beucher

422 For the MYPAs perinatal region, Ile de France region: Patrick Rozenberg

423 For the Naître dans l'Est Francilien network, Ile de France region: Lionel Carbillon

424 For the Paris Nord perinatal network: Elie Azria, Nathalie Baunot

425 For the 92 Nord perinatal network, Ile de France region: Catherine Crenn-Hebert, Gilles

426 Kayem

427 For the Lorraine perinatal network: Jeanne Fresson

428 For the Société Française d'Anesthésie Réanimation (SFAR): Alexandre Mignon

429 For the Pôle Santé Publique, Hospices Civils de Lyon: Sandrine Touzet

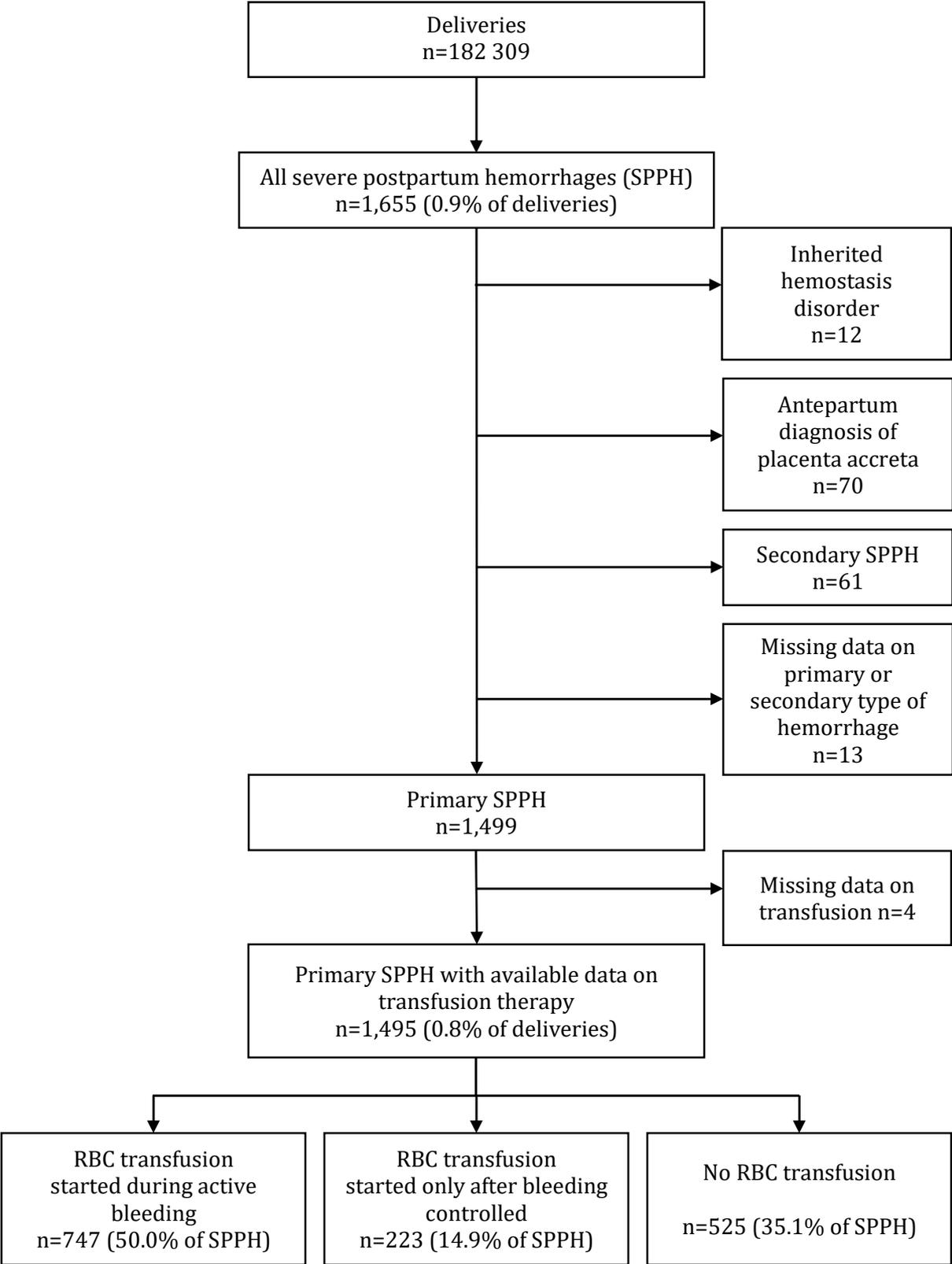
430 For the Inserm Epopé research team: Marie-Pierre Bonnet, Marie-Hélène Bouvier-Colle,

431 Anne Chantry, Coralie Chiesa-Dubruille, Catherine Deneux-Tharaux, Aurélien Seco.

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433

Fig.1. Study population



SPPH: severe postpartum hemorrhage. RBC: red blood cell.

Table 1. Characteristics of women with severe postpartum hemorrhage, stratified by use of red blood cell transfusion.

	All women			Women receiving RBC during active bleeding			Women receiving RBC after bleeding control			Women not receiving RBC		
	(n=1,495)			(n=747)			(n=223)			(n=525)		
	n	n	(%)	n	n	(%)	n	n	(%)	n	n	(%)
Patient characteristics												
Age (y)	1495			747			223			525		
<30	628(42.0)			302(40.4)			113(50.7)			213(40.6)		
30-39	779(52.1)			401(53.7)			99(44.4)			279(53.1)		
≥40	88 (5.9)			44 (5.9)			11 (4.9)			33 (6.3)		
Nationality	1405			700			213			492		
European	1141(81.2)			551(78.7)			177(83.1)			413(84.0)		
North African	95 (6.8)			47 (6.7)			9 (4.2)			39 (7.9)		
Sub-Saharan African	108 (7.7)			63 (9.0)			14 (6.6)			31 (6.3)		
Other (Asian, American)	61 (4.3)			39 (5.6)			13 (6.1)			9 (1.8)		
Parity	1483			739			221			523		
primiparous	712(48.0)			340(46.0)			126(57.0)			246(47.1)		
multiparous without previous CD	507(34.2)			260(35.2)			58(26.3)			189(36.1)		
multiparous with previous CD	264(17.8)			139(18.8)			37(16.7)			88(16.8)		
Previous PPH	1495 90 (6.0)			747 49 (6.6)			223 6 (2.7)			525 35 (6.7)		
Multiple pregnancy	1494 140 (9.4)			747 76(10.2)			222 13 (5.9)			525 51 (9.7)		
Antepartum anemia	1423 374(26.3)			699 193(27.6)			216 81(37.5)			508 100(19.7)		
Labor induction or augmentation	1495 763(51.0)			747 381(51.0)			223 125(56.1)			525 257(49.0)		
Mode of delivery	1495			747			223			525		
spontaneous vaginal delivery	575(38.5)			273(36.6)			95(42.6)			207(39.4)		
operative vaginal delivery	250(16.7)			125(16.7)			59(26.5)			66(12.6)		
emergency CD during labor	302(20.2)			160(21.4)			28(12.5)			114(21.7)		
emergency CD before labor	162(10.8)			92(12.3)			21 (9.4)			49 (9.3)		
scheduled CD before labor	206(13.8)			97(13.0)			20 (9.0)			89(17.0)		
Prophylactic uterotonic drug	1495 1334(89.2)			747 651(87.1)			223 209(93.7)			525 474(90.3)		
Maternity unit characteristics												
Status	1495			747			223			525		
university hospital	658(44.0)			314(42.0)			92(41.2)			252(48.0)		
non-university public hospital	624(41.7)			326(43.7)			90(40.4)			208(39.6)		
private hospital	213(14.3)			107(14.3)			41(18.4)			65(12.4)		
Number of deliveries per year	1495			747			223			525		
≥3000	421(28.2)			196(26.2)			54(24.2)			171(32.6)		
1500-2999	672(44.9)			344(46.1)			97(43.5)			231(44.0)		
<1500	402(26.9)			207(27.7)			72(32.3)			123(23.4)		

Data presented as n (%).

The total number of women may vary slightly from one characteristic to another because of missing data.

RBC: red blood cells. CD: cesarean delivery. PPH: postpartum hemorrhage.

Table 2. Etiology and management of women with severe postpartum hemorrhage, stratified by use of red blood cell transfusion.

	Women receiving RBC during active bleeding			Women receiving RBC after bleeding control			Women not receiving RBC		
	(n=747)			(n=223)			(n=525)		
	n	n	(%)	n	n	(%)	n	n	(%)
Cause of PPH^a	747			223			525		
Uterine atony		335	(44.8)		66	(29.6)		198	(37.7)
Placental retention		80	(10.7)		46	(20.6)		85	(16.2)
Perineal wound or episiotomy		82	(11.0)		56	(25.1)		62	(11.8)
Surgical cause		71	(9.5)		21	(9.4)		78	(14.9)
Amniotic fluid embolism		14	(1.9)		0	(0.0)		0	(0.0)
Uterine rupture		21	(2.8)		1	(0.5)		7	(1.3)
Placental abruption		33	(4.4)		7	(3.1)		9	(1.7)
Placenta previa		19	(2.5)		0	(0.0)		22	(4.2)
Placenta accreta		32	(4.3)		1	(0.5)		5	(0.9)
Others		14	(1.9)		7	(3.1)		4	(0.8)
Unidentified		46	(6.2)		18	(8.1)		55	(10.5)
Characteristics of PPH severity									
Total blood loss (mL)	588	1750 (1500,2200)		165	1000 (750,1500)		468	1500 (1100,1700)	
Nadir s. fibrinogen level (g/L)	670			140			338		
<1		61	(9.1)		2	(1.4)		3	(0.9)
1-1.9		169	(25.2)		15	(10.7)		30	(8.9)
≥2		440	(65.7)		123	(87.9)		305	(90.2)
Hemorrhagic shock	747	104	(13.9)	223	12	(5.4)	525	21	(4.0)
DIC	747	302	(40.4)	223	28	(12.6)	525	38	(7.2)
Characteristics of PPH management									
Tranexamic acid	747	338	(45.2)	223	33	(14.8)	525	118	(22.5)
Arterial embolization	747	138	(18.5)	223	10	(4.5)	525	27	(5.1)
Conservative uterine surgery	747	173	(23.2)	223	1	(0.4)	525	67	(12.8)
Peripartum hysterectomy	747	83	(11.1)	223	2	(0.9)	525	5	(1.0)

Data presented as n (%), median [interquartile range]

The total number of women may vary slightly from one characteristic to another because of missing data.

^a In exclusive categories.

RBC: red blood cells. PPH: postpartum hemorrhage. Shock: Systolic blood pressure <90 mmHg of duration >60 min or unresponsive to plasma expansion. DIC: Disseminated intravascular coagulopathy defined by thrombocytopenia <50 x 10⁹/L or s. fibrinogen level <2 g/L or prothrombin ratio <60%

Table 3a. Transfusion-related data for women with severe postpartum hemorrhage transfused with red blood cells during or after active bleeding.

	Women with RBC during active bleeding (n=747)			Women with RBC after bleeding control (n=223)		
	n	n	(%)	n	n	(%)
	Characteristics of RBC transfusion					
Hb level before RBC transfusion (g/dL)	683			220		
<6.0		91	(13.3)		59	(26.8)
6.0-6.9		141	(20.7)		123	(55.9)
7.0-7.9		140	(20.5)		26	(11.8)
≥8.0		311	(45.5)		12	(5.5)
Time from PPH diagnosis to RBC transfusion		690 1h38 (52min,2h53)			200 32h (22h,58h)	
Total number of RBC units		743	3 (2,5)		221	2 (2,3)
≥10 RBC units			64 (8.6)			0 (0.0)
Characteristics of FFP transfusion						
FFP transfusion		747	514 (68.8)		223	12 (5.4)
Time from RBC to FFP transfusion ^a		467	28min (4,59)			
Total number of FFP units ^a		511	3 (2,5)			
Characteristics of FC administration						
FC administration		747	328 (43.9)		223	9 (4.0)
Time from RBC to FC administration ^b		290	-1min (-37,46)			
Total quantity of FC ^b (g)		319	3 (1.5,4.5)			
Platelets transfusion		747	132 (17.7)		223	5 (2.2)

Data presented as n(%), median [interquartile range]

The total number of women may vary slightly from one characteristic to another because of missing data.

^a Among women with RBC transfusion started during active bleeding and transfused with FFP (n=514).

^b Among women with RBC transfusion started during active bleeding and who received FC (n=328).

RBC: red blood cells. Hb: hemoglobin. PPH: postpartum hemorrhage. FFP: fresh frozen plasma. FC: fibrinogen concentrate.

Table 3b: Anemia management and hemostatic support among women with severe postpartum hemorrhage

	Women receiving RBC during active bleeding			Women receiving RBC after bleeding control			Women not receiving RBC		
	(n=747)			(n=223)			(n=525)		
	n	n	(% ^a)	n	n	(% ^a)	n	n	(% ^a)
RBC transfusion according to nadir Hb level									
Women with nadir Hb <7g/dL (N=697)	354 (50.8)			194 (27.8)			149 (21.4)		
	n	n	(% ^b)	n	n	(% ^b)	n	n	(% ^b)
Management of acute anemia									
Nadir Hb (g/dL)	743			223			523		
<7	354 (47.6)			194 (87.0)			149 (28.5)		
7-10	360 (48.5)			29 (13.0)			312 (59.7)		
>10	29 (3.9)			0 (0.0)			62 (11.9)		
Hemostatic support									
FFP:RBC within the first 3 h of RBC transfusion ^c	368								
<0.5	38 (10.3)								
0.5 - 1	296 (80.4)								
>1	34 (9.3)								
Fibrinogen level before FC administration ^d (g/L)	286			7					
<2	103 (36.0)			2 (28.6)					
≥2	107 (37.4)			1 (14.3)					
not measured	76 (26.6)			4 (57.1)					
Neither FFP nor FC transfusion despite fibrinogen <2g/L ^e	230	24 (10.4)		17	8 (47.1)				
Neither FFP nor FC transfusion despite DIC ^f	302	37 (12.3)		28	17 (60.7)				

The total number of women may vary slightly from one characteristic to another because of missing data.

^a Expressed as row percentage.

^b Expressed as column percentage.

^c Among women with RBC transfusion started during active bleeding and transfused with FFP (n=514).

^d Among women transfused with RBC and who received FC (N=337).

^e Among women transfused with RBC and who had a nadir fibrinogen <2g/L (n=247).

^f Among women transfused with RBC and who had a DIC (N=330).

RBC: red blood cells. Hb: hemoglobin. PPH: postpartum hemorrhage. FFP: fresh frozen plasma. FC: fibrinogen concentrate. DIC: disseminated intravascular coagulopathy defined by thrombocytopenia <50 x 10⁹/L or fibrinogen level <2g/L or prothrombin ratio <60%.