Journal of Gynecology Obstetrics and Human Reproduction xxx (2018) xxx–xxx

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Original Article

Postpartum hemorrhage: incidence, risk factors, and causes in Western French Guiana

Mathilde Firmin[a,*], Gabriel Carles[a], Bénédicte Mence[a], Nikila Madhusudan[a], Emilie Faurous[a], Anne Jolivet[b,c]

[a] Department of Gynecology and Obstetrics, Centre Hospitalier de l'Ouest Guyanais, Saint-Laurent du Maroni, French Guiana
[b] Department of Public Health, Centre Hospitalier de l'Ouest Guyanais, Saint-Laurent du Maroni, French Guiana
[c] INSERM, Sorbonne Université, Institut Pierre Louis d'Epidémiologie et Santé Publique, Department of Social Epidemiology, Paris, France

ARTICLE INFO

Article history:
Received 30 September 2018
Received in revised form 20 November 2018
Accepted 22 November 2018
Available online xxx

Keywords:
Postpartum hemorrhage
Incidence
Risk factors
French Guiana
Case control study

ABSTRACT

Introduction: Postpartum hemorrhage remains the leading cause of maternal death in France. Parturients in western French Guiana have specific sociodemographic features and a high rate of pathological pregnancies. The objective of this study was to determine the incidence of immediate postpartum hemorrhage (IPPH) in western French Guiana, and to describe the etiologies and risk factors.
Methods: A case control study with incident cases was conducted in the Maternity Department of the Western French Guiana Hospital over a period of one year. The cases included women giving birth to a child of 22 weeks' GA and/or a child weighing 500 g, and who presented with IPPH. Two control subjects were included per case (after pairing for mode of delivery). The data were collected by questionnaire and from medical records. Multivariate analyses by logistic regression were conducted.
Results: 154 cases and 308 controls were included. The incidence rate of IPPH was 6.7%. The primary etiologies were: atony, placenta retention, and cervico-vaginal lesions. The factors associated with IPPH were: past history of IPPH (ORadj = 3.36 [1.65–6.87]), pre-eclampsia (ORadj = 2.56 [1.07–6.14]), labor induction by oxytocin (ORadj = 2.03 [1.03–3.99]), the absence of managed placental delivery (ORadj = 2.46 [1.24–4.91]), a gap of more than 30 min between birth and placental delivery (ORadj = 10.92 [2.17–54.99]), and macrosomia (ORadj = 6.38 [1.97–20.67]).
Conclusion: The incidence rate of IPPH is similar to that found in metropolitan France and in the literature. The risk factors identified here will enable the development of appropriate preventive protocols.

Introduction

Postpartum hemorrhage remains the leading cause of maternal death in France, even though its contribution to these deaths has decreased [1].

French Guiana is an overseas French department situated in South America. It covers almost 84,000 km^2 of territory and shares borders with Brazil and Suriname. In 2012, the fertility rate was 3.5 children per woman compared to 2.01 in France overall (excluding Mayotte) [2]. French Guiana has a demographic growth rate comparable to some developing countries. The birth rate was 30.4‰ per year between 1999 and 2009, compared to 12.8‰ in metropolitan France.

Saint-Laurent du Maroni is the second largest city in French Guiana. It is located on the border with Suriname, and is only separated from Suriname by a river, the Maroni. The Centre Hospitalier de l'Ouest Guyanais (CHOG, Western French Guiana Hospital Center) thus provides care for patients from a wide area (the Kourou Hospital Center is more than 2 h away by car), including patients from Suriname [3]. The hospital is estimated to serve a population of approximately 100,000 people. In western French Guiana, parturients have some specific features: high to very high multiparity, young primiparity, and varied ethnic origin (parturients of African origin (approximately 70%) or Amerindian parturients, for example) [4]. The presence of hemoglobinopathies (sickle cell disease, thalassemia), disadvantaged socioeconomic conditions, and widespread pica involving consumption of substances such as white clay lead to a higher prevalence of anemia than that found in metropolitan areas [5,6]. There is also an elevated rate of pre-eclampsia and diseases that have virtually disappeared from metropolitan areas, such as lead poisoning [7].

* Corresponding author. Current address: Service gynéco-obstétrique de l'Hôpital Nord, Assistance Publique des Hôpitaux de Marseille, Chemin des Bourrely, 13015 Marseille, France.
E-mail address: m.firmin48@gmail.com (M. Firmin).

http://dx.doi.org/10.1016/j.jogoh.2018.11.006
2468-7847/

No recent study has investigated IPPH in this specific population. The primary objective of this study was to determine the incidence of IPPH in western French Guiana, to describe its causes and risk factors to develop suitable management strategies, and to analyze how these causes and risk factors change. The secondary objective was to identify factors associated with the IPPH severity.

Materials and methods

Study design and study population

A case control study with incident cases was carried out at the CHOG maternity ward over the course of one year (September 2014 – September 2015). The study population was comprised of women delivering at the CHOG after 22 weeks' GA and/or who delivered a 500 g child. The case group included all patients exhibiting IPPH, defined clinically by blood loss of $\geq$ 500 ml in the delivery room for vaginal deliveries or $\geq$ 1 L for cesarean sections in the operating room and the recovery room. The control group included women without IPPH: two control patients per case. The women in this group were matched for delivery method to the women in the case group and delivered after the women in the case group (according to the birth record).

The study was conducted by a team of trained midwives, who, several times per week, identified all patients exhibiting IPPH and selected control subjects. All of the patients were informed (informational letter translated into the local languages) and gave their consent to participate in the study. Oral consent from one of the two parents was required for minors. If a patient declined to participate, the corresponding control subjects were not included. If a control subject declined to participate, another control subject was chosen according to the same criteria.

Severe IPPH was defined as a loss of at least four hemoglobin points between delivery and the lowest blood test value, transfusion of at least four units of packed red blood cells, conservative or non-conservative surgery, and/or maternal death. We chose not to consider volume of blood loss, to minimize bias due to missing or inexact measurements of blood loss.

Managed placental expulsion was induced by prophylactic injection of 5 or 10 IU of oxytocin at delivery of the child's anterior shoulder or just after the child's birth. Post-natal IPPH prevention consisted of prophylactic administration of oxytocin or misoprostol after delivery. Prevention was systematically indicated in some situations (previous IPPH, parity $\geq$ 4).

Data collection

The patients' sociodemographic characteristics were recorded by the trained midwife using a questionnaire, and medical data were collected from the medical files: medical and obstetric antecedents, pregnancy complications, labor and delivery progress, IPPH prevention, and IPPH characteristics (severity and etiology).

Statistical analysis

The incidence rate was calculated from the number of deliveries (after 22 weeks' GA and/or of a child weighing more than 500 g) that took place during the study period. The sociodemographic and medical characteristics were compared between the patients and the control subjects using a Chi2 test for qualitative variables. The alpha risk was set at 5%. A multivariate analysis was then performed using a logistic regression model to identify factors associated with risk of IPPH. Explanatory variables with a 20% threshold were included in a multivariate model and then progressively removed from the model in a stepwise manner to obtain a final model that only contained variables that were significant at a 5% threshold. A second analysis was performed to identify factors associated with IPPH severity; that is, once hemorrhage had been diagnosed, whether certain criteria could be linked to aggravation of IPPH. Severe IPPH cases were compared to non-severe IPPH cases. The above steps were repeated (bivariate analysis then multivariate analysis according to the same procedure). The statistical analysis was performed using Stata v13.0 software.

This study was approved by the CHOG Local Ethics Committee.

Results

Out of 2495 deliveries that took place between 9/8/2014 and 9/7/2015, 167 patients exhibited IPPH, for an incidence rate of 6.69%. Out of these, 154 were included in the study (and therefore 308 control subjects), for a participation rate of 92.2%.

Our study population was primarily composed of women who were 18 to 35 years old (75.1%), and born in French Guiana (43.3%) or Suriname (45.9%) (Table 2). In total, 76.6% of the women spoke nengue tongo as a first language; this language originated with escaped slaves of African origin. Slightly less than half of the patients were French, and 31.6% were undocumented immigrants. Approximately one quarter of the patients did not have valid health insurance, 18% had never attended school, and only 8% had attended college. Overall, 180 patients stated that they relied on financial help from family members or doing odd jobs (41.3%), 212 relied on welfare (48.6%), and only 38 (6.4%) patients stated that they earned a salary. The majority of our study population did not have any pre-existing disease prior to pregnancy (92.4%). In total, 9.5% had previously had IPPH and 15.6% had uterine scarring. The average parity in our population was 4.15 children (with a range of 1 to 15), with 21.4% primiparas and 38.7% grand multiparas ($\geq$ 5). The average age of the primiparas was 20.4. In total, 64.7% of patients had at least one complication during their pregnancy. The most common complication was anemia (< 10.5 g/dL up until 28 weeks' GA, and < 11 g/dL after), which was observed in 36.2% of patients. The prevalence of pre-eclampsia was 6.9%. In total, 74.7% of patients experienced spontaneous labor. Labor was induced in 19% of cases, and cesarean before labor was performed in 6.3% of patients. The duration of labor could not be recorded for 25.5% of cases due to late arrival of the patients to the maternity ward. Overall, 3% of patients exhibited hyperthermia during labor. Oxytocin was administered during labor to 25.3% of patients. A very large majority of patients had a spontaneous vaginal birth (82.5%). In total, 3.9% underwent instrument-assisted delivery, and 13.6% had a cesarean. Overall, 89.8% of patients had a managed placental delivery. The average time between birth and placental expulsion was 7.8 min (from 0 to 90 min). In total, 78.4% of patients benefitted from post-natal IPPH prevention. The average newborn weight was 3.140 kg (from 700 to 4900 g), with 4.1% of babies weighing 4000 g or more.

Table 1 shows the IPPH etiologies that were found. Atony was the primary etiology, as it was the sole cause in 41.6% of cases and was associated with other etiologies in 14.3% of cases. Retained placenta was the second most common etiology. Cervico-vaginal (CV) lesions represented the third most common etiology, as they were solely responsible in 5.8% of cases and were associated with other etiologies in 5.2% of cases. The etiology was not identified in 20.8% of cases.

The risk factors for IPPH are presented in Table 2. We did not find any significant link between IPPH and demographic characteristics (age), socioeconomic characteristics (place of birth, maternal language, legal status, level of education, type of healthcare coverage, place of residence), or care received during

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Table 1
IPPH etiologies.

IPPH Etiology	N	%
Unknown	32	20.8%
Atony only	64	41.6%
Cervico-vaginal (CV) lesions only	9	5.8%
Retention of the placenta only	20	13.0%
Disseminated intravascular coagulation (DIC) only	4	2.6%
Cesarean on anterior placenta previa	1	0.6%
Multiple:	24	15.6%
Atony + CV lesions	*3*	
Atony + retained placenta	*14*	
CV lesions + retained placenta	*2*	
Atony + DIC	*2*	
Atony + CV lesions + retained placenta	*3*	
TOTAL	**154**	**100%**

the pregnancy. Based on the bivariate analysis, the factors that were significantly associated with IPPH were: previous IPPH ($p < 10^{-3}$) and retroplacental hematoma (RPH) ($p = 0.001$). Pre-eclampsia, anemia at birth, and lead poisoning (defined as blood lead levels $\geq$ 100 µg/l) were at the limit of significance ($0.05 < p < 0.1$). Induction appeared to be statistically associated with IPPH, as 25.9% of patients who experienced IPPH were induced compared with 15.6% of control subjects. When the different types of induction were analyzed more specifically, only induction with oxytocin was significantly associated with IPPH (ORcrude = 2.86, CI = [1.52–5.35]). Similarly, when induction by oxytocin was compared with spontaneous labor managed with oxytocin, only induction by oxytocin appeared to be linked to IPPH. Patients who experienced IPPH were significantly less likely to have a managed placental delivery than control patients (84.4% vs. 92.5%, $p = 0.007$). A lack of post-natal IPPH prevention was statistically associated with IPPH ($p < 10^{-3}$). However, some of these patients did not have time to receive post-natal IPPH prevention given the rapid onset of IPPH. When these patients were removed from the analysis, the significance of the association between post-natal IPPH prevention and IPPH occurrence disappeared, as 16.9% of controls did not receive post-natal IPPH prevention vs. 13.9% of patients with a time from diagnosis to delivery of greater than 5 min ($p = 0.474$).

The multivariate analysis identified a final model in which the variables that were significantly associated with IPPH were: previous IPPH (ORadj = 3.36 ; CI = [1.65–6.87]), pre-eclampsia (ORadj = 2.56 ; CI = [1.07–6.14]), lead poisoning (ORadj = 2.04 ; CI = [1.01–4.10]), labor induced by oxytocin (ORadj = 2.03; CI = [1.03–3.99]), the absence of a managed placental delivery (ORadj = 2.46; CI = [1.24–4.91]), gap between birth and placental delivery of more than 30 min (ORadj = 10.92; CI = [2.17–54.99]), the absence of post-natal IPPH prevention (ORadj = 2.33; CI = [1.41–3.86]), and macrosomia (ORadj = 6.38; CI = [1.97–20.67]).

Table 3 compares the characteristics of the women who experienced severe IPPH and those who had non-severe IPPH. Pre-eclampsia was significantly more common in patients with severe IPPH (18% vs. 7%), but this association was not significant in the multivariate analysis. Induction was significantly more common in patients with severe IPPH (ORadj = 3.79, CI = [1.09–13.15] in patients induced without oxytocin, and ORadj = 4.92, CI= [1.75–13.84] in patients induced with oxytocin). An elapsed time of more than 30 min between birth and placental delivery occurred more often in patients with severe IPPH (ORadj = 6.59, CI = [1.42–30.60]). Anemia at birth was significantly associated with non-severe IPPH. It was found in 51.3% of patients with non-severe IPPH vs. 30.8% of patients with severe IPPH ($p = 0.026$, ORadj = 0.27, CI = [0.11-0.65]). Five patients in our study experienced RPH, and these five patients all exhibited severe IPPH and, in the case of four of them, DIC.

Discussion

The incidence of IPPH varies widely throughout the world, from 7% in Oceania to 26% in Africa [8]. In France, according to many studies, the incidence of IPPH is approximately 6% [9,10]. This variation is due in part to different definitions of IPPH. Some definitions include blood loss during the 24 preceding hours, others define IPPH as blood loss of at least 500 ml, regardless of the delivery mode, and others include biological data in the definition by including patients whose hemoglobin levels decrease by more than 2 g/dL. Our incidence of 6.7% therefore appears to be a typical incidence rate. Thirty-nine of the 154 patients included in this study experienced severe IPPH. Taking into account the 13 patients who declined to participate in the study, the incidence of severe IPPH in our population is therefore between 1.6% and 2.1%. In the previously cited study, the incidence was 1.7% [9]. Thus, despite the geographic, social, cultural, and demographic situation in western French Guiana, the incidence of IPPH, whether severe or non-severe, appears to be comparable to the incidence found in metropolitan France.

Atony was the primary etiology of found for IPPH, followed by retention of the placenta. Cervico-vaginal lesions were the sole cause of IPPH in only approximately 6% of cases. This low percentage could be due to several different factors. A large part of our population was multiparous. There was little need for instrument-assisted delivery or episiotomy: 6% of patients required extraction and 4% required an episiotomy in French Guiana compared with 12% and 20%, respectively, in metropolitan France [11]. Our conclusions regarding IPPH etiology were nevertheless limited by the information available from the medical records, which sometimes did not contain enough information to determine the etiology.

The factors associated with an elevated risk of IPPH found in this study by multivariate analysis were as follows: previous IPPH, pre-eclampsia, lead poisoning, labor induction by oxytocin, a gap of more than 30 min between birth and placental delivery, and macrosomia. The protective factors that were identified included managed placental delivery and post-natal IPPH prevention. The factors found here have already been identified in the literature [9,12,13]. Previous IPPH was one of the most expected risk factors due to consensus among all studies [14]. This factor is important in our population, given the elevated average parity [4,14]. We did not collect specific data regarding IPPH recurrence, but according to a study by Oberg et al., the risk is even more significant if there is a recurrence [15]. Lead poisoning was explored because it is highly prevalent in our population (9.3%). We found a link between lead poisoning and IPPH, which remained after adjusting for pre-eclampsia. The association between pre-eclampsia and lead poisoning has been reported in the literature [16], but we did not find any studies that have reported a link between lead poisoning and IPPH. It would be interesting to explore this link further in future studies.

Pre-eclampsia was common in our sample (6.9% of patients). This is three times higher than the figures reported during the most recent national perinatal study [11]. Similar to other reports in the literature, pre-eclampsia was a risk factor for IPPH in our study [17].

A birth weight of 4 kg or higher was also found to be a risk factor for IPPH in our study. This has been previously reported in the literature [18], as well as other factors contributing to uterine hyperdistension such as hydramnios and multiple pregnancies, which we were unable to investigate in our study.

A gap between birth and placental delivery of more than 30 min was one of the factors that was most closely linked with IPPH in our study. This has been reported in the literature previously [14]. Out of 11 cases in which placental delivery took more than 30 min, nine

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Table 2
Comparison of maternal, pregnancy, labor, and delivery characteristics between patients with IPPH and control subjects.

					Logistic regression models	
		Control subjects (n = 308)	Cases (n = 154)	p-value	Bivariate: crude OR [CI95%]	Multivariate: adjusted OR [CI95%]
Place of birth	France	149 (48.4%)	66 (42.9%)	0.262		
Maternal language	French	47(15.6%)	17 (11.1%)	0.197	0.68 [0.38-1.23]	
Legal status	French or legal immigrant	207 (69.2%)	94 (63.5%)	0.225		
Education	None	58 (20.1%)	25 (17.1%)	0.265		
	Elementary/middle school	113 (39.1%)	69 (47.3%)			
	High school/college	118 (40.8%)	52 (35.6%)			
Healthcare coverage	None	74 (24.3%)	39 (25.5%)	0.774		
Age	<18 years	26 (8.5%)	11 (7.1%)	0.797		
	18-34 years	232 (75.3%)	115 (74.7%)			
	35 years or more	50 (16.2%)	28 (18.2%)			
History	IPPH	16 (5.2%)	28 (18.2%)	**$<10^{-3}$**	**4.06 [2.12-7.76]**	**3.36 [1.65-6.87]**
	Uterine scarring	52 (16.9%)	20 (13%)	0.276		
Parity	1	68 (22.1%)	31 (20.1%)	0.924		
	2 to 4	123 (39.9%)	61 (39.6%)			
	5 to 7	72 (23.4%)	40 (26%)			
	8 or more	45 (14.6%)	22 (14.3%)			
Term	<37 weeks of amenorrhea	44 (14.3%)	15 (9.7%)	0.164	0.80 [0.59-1.10]	
Pregnancy complications	Anemia	107 (34.7%)	60 (39%)	0.373		
	Anemia at birth	115 (37.3%)	71 (46.1%)	0.070	1.44 [0.97-2.12]	
	Pre-eclampsia	17 (5.5%)	15 (9.7%)	0.092	1.85 [0.90-3.81]	**2.56 [1.07-6.14]**
	Diabetes	12 (3.9%)	10 (6.5%)	0.217		
	Lead poisoning	23 (7.5%)	20 (13%)	0.054	1.85 [0.98-3.48]	**2.04 [1.01-4.10]**
	RPH	0	5 (3.2%)	**0.001**	–	–
Hyperthermia	Yes	7 (2.8%)	7 (5.79%)	0.162	2.11 [0.72-6.17]	
Mode of entry into labor	Spontaneous unmanaged labor	201 (65.3%)	80 (52%)	**0.015**	1	1
	Spontaneous managed labor	42 (13.6%)	22 (14.3%)		1.32 [0.74-2.34]	
	Labor induced without oxytocin	26 (8.5%)	15 (9.7%)		1.45 [0.73-2.88]	
	Labor induced with oxytocin	22 (7.1%)	25 (16.2%)		**2.86 [1.52-5.35]**	**2.03 [1.03-3.99]**
	Cesarean before labor	17 (5.5%)	12 (7.8%)		1.77 [0.81-3.88]	
Managed placental delivery	Not performed	23 (7.5%)	24 (15.6%)	**0.007**	**2.29 [1.25-4.20]**	**2.46 [1.24-4.91]**
Post-natal IPPH prevention	Not performed	52 (16.9%)	48 (31.2%)	**$<10^{-3}$**	**2.23 [1.42-3.51]**	**2.33 [1.41-3.86]**
Time elapsed between birth and placental delivery (in minutes)	15 or less	277 (91.7%)	125 (83.3%)	**0.001**	1	1
	More than 15 and up to 30	23 (7.6%)	16 (10.7%)		1.54 [0.79-3.02]	
	More than 30	2 (0.7%)	9 (6%)		**9.97 [2.12-46.83]**	**10.92 [2.17-54.99]**
Weight of the baby (in grams)	Less than 2500	32 (10.4%)	8 (5.2%)	**$<10^{-3}$**	0.52 [0.23-1.16]	**0.37 [0.15-0.92]**
	2500 to 4000	272 (88.3%)	131 (85.1%)		1	**1**
	4000 or more	4 (1.3%)	15 (9.7%)		**7.79 [2.53-23.92]**	**6.38 [1.97-20.67]**

cases of IPPH were observed. While our sample size is small, it seems necessary to be extremely vigilant in our practice in cases where there is a gap of 30 min or more between birth and placental delivery.

It is interesting to note that induction with oxytocin, but not misoprostol or dinoprostone, was a risk factor for IPPH. In contrast, administration of oxytocin during spontaneous labor did not appear to be linked to IPPH. According to the results from the 2010 Perinatal Study, oxytocin was administered to 58% of laboring women [19]. In our population, only 18.6% of patients in spontaneous labor received oxytocin. The fact that only oxytocin induction appeared to be linked to IPPH seems to be associated with a dose effect. This was recently corroborated by the Pithagore 6 study, which identified a dose effect linking oxytocin to IPPH [20]. The use of oxytocin during managed placental delivery was identified in our study, as well as in the literature [21,22], as protecting against IPPH. All of these elements highlight the need for good obstetric practice and support recent recommendations to limit oxytocin use during labor to patients who need it [23], as well as to systematically prevent IPPH by, at the very least, providing managed placental delivery [24].

RPH was also statistically associated with IPPH in our study. This seems logical, as blood that collects between the mother's uterine wall and the placenta is expelled at birth or during a cesarean, and antenatal and post-natal blood loss are therefore combined.

Other common risk factors were not found in our study. We did not find a statistically significant link between IPPH and uterine scarring, parity, age, or anemia. While uterine scarring has been linked to IPPH in the literature [25], and its prevalence was higher in our study (15.6%) than that found in metropolitan France (11%, most likely due to higher average parity) [11], no link was found. Similarly, the prevalence of anemia was high, as approximately one out of three patients was anemic during pregnancy. We would have expected these patients to be at higher risk of IPPH, as demonstrated in some studies [25], but our data did not show

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Table 3
Comparison of maternal, pregnancy, labor, and delivery characteristics between patients with severe IPPH and patients with non-severe IPPH.

					Logistic regression models	
		Non-severe cases (n = 115) n (%)	Severe cases (n = 39) n (%)	p-value	Bivariate: crude OR [CI95%]	Multivariate: adjusted OR [CI95%]
Place of birth	France	50 (43.5%)	16 (41%)	0.789		
Maternal language	French	15 (13.2%)	2 (5.1%)	0,168	0.36 [0.08-1.64]	
Legal status	French or legal immigrant	71 (64.6%)	23 (60.5%)	0.657		
Education	None	21 (19.4%)	4 (10.5%)	0.440		
	Elementary/middle school	49 (45.4%)	20 (52.6%)			
	High school/college	38 (35.2%)	14 (36.9%)			
Healthcare coverage	None	27 (23.7%)	12 (30.8%)	0.381		
Age	<18 years	8 (7%)	3 (7.7%)	0.988		
	18-34 years	86 (74.8%)	29 (74.4%)			
	35 years or more	21 (18.2%)	7 (17.9%)			
History	IPPH	2 (19.1%)	6 (15.4%)	0.600		
	Uterine scarring	13 (11.3%)	7 (17.9%)	0.286		
Parity	1	19 (16.5%)	12 (30.8%)	0.246		
	2 to 4	46 (40%)	15 (38.5%)			
	5 to 7	32 (27.8%)	8 (20.5%)			
	8 or more	18 (15.7%)	4 (10.2%)			
Term	<37 weeks of amenorrhea	8 (7%)	7 (17.9%)	**0.045**	1.71 [0.99-2.95]	
Pregnancy complications	Anemia	49 (42.6%)	11 (28.2%)	0.111	1.89 [0.86-4.16]	
	Anemia at birth	59 (51.3%)	12 (30.8%)	**0.026**	**0.42 [0.19-0.91]**	**0.27 [0.11-0.65]**
	Pre-eclampsia	8 (7%)	7 (17.9%)	**0.045**	2.93 [0.99-8.69]	
	Diabetes	6 (5.2%)	4 (10.3%)	0.270		
	Lead poisoning	13 (11.3%)	7 (17.9%)	0.286		
	RPH	0	5 (12.8%)	**0.000**	–	–
Hyperthermia	Yes	3 (3.2%)	4 (15.4%)	**0.018**	**5.58 [1.16-26.74]**	
Mode of entry into labor	Spontaneous unmanaged labor	70 (60.9%)	10 (25.6%)	**0.002**	1	1
	Spontaneous managed labor	16 (13.9%)	6 (15.4%)		2.63 [0.83-8.28]	
	Labor induced without oxytocin	9 (7.8%)	6 (15.4%)		**4.67 [1.37-15.92]**	**3.79 [1.09-13.15]**
	Labor induced with oxytocin	14 (12.2%)	11 (28.2%)		**5.5 [1.96-15.42]**	**4.92 [1.75-13.84]**
	Cesarean before labor	6 (5.2%)	6 (15.4%)		**7 [1.89-25.98]***	**9.40 [2.34.37.80]***
Managed placental delivery	Not performed	18 (15.6%)	6 (15.4%)	0. 968		
Post-natal IPPH prevention	Not performed	33 (28.7%)	15 (38.5%)	0.255		
Time elapsed between birth and placental delivery (in minutes)	15 or less	94 (84.7%)	31 (79.5%)	0.099	1	1
	More than 15 and up to 30	13 (11.7%)	3 (7.7%)		0.70 [0.19-2.62]	
	More than 30	4 (3.6%)	5 (12.8%)		3.79 [0.96-15.01]	**6.59 [1.42-30.60]**
Weight of the baby (in grams)	Less than 2500	5 (4.3%)	3 (7.7%)	0.172	1.64 [0.37-7.25]	
	2500 to 4000	96 (83.5%)	35 (89.7%)		1	
	4000 or more	14 (12.2%)	1 (2.6%)		0.20 [0.02-1.55]	

this link. The average parity in our population is higher than that found in metropolitan France. This could point to a greater risk of IPPH in multiparous and highly multiparous women, hypothetically because of a higher potential for uterine tiring, which could lead to IPPH due to atony. This was not found in our study. In addition, being older than 35, which is a frequently reported risk factor [17,26], was not found in to be a risk factor in our study.

The proportion of women who had at least one of the six risk factors identified in this study (previous PPH, pre-eclampsia, lead poisoning, labor induction by oxytocin, more than 30 min elapsed between birth and placental delivery, and macrosomia) was 53.3% for the patients and 22.7% for the control subjects. Thus, a little under half of the patients did not exhibit any of the risk factors identified here. This finding serves as a reminder that vigilance is necessary for all patients, and highlights that even though at-risk patients need to be closely monitored, monitoring of other patients should not be neglected.

Only induction and a gap of more than 30 min between birth and placental delivery were statistically associated with severe IPPH. These results are interesting because IPPH can be managed even more quickly and actively when one of these factors is present. Having a cesarean before labor begins also appears to be associated with severe IPPH, but this result was biased by the five patients who had RPH and therefore required a cesarean before labor began. Rather, this finding rather RPH severity (four out of these five patients also exhibited DIC), which is already known to represent a major threat to the life of the mother and the fetus. Even though our cohort was very small, our findings confirm the necessity of extremely rapid management. A non-significant trend linked parity to severe IPPH (p = 0.246). In total, 30.8% of patients who experienced severe IPPH were primiparous, whereas only 16.5% of patients with non-severe IPPH were primiparous. Based on the multivariate analysis, pre-eclampsia did not appear to be associated with severe IPPH. It should be

Please cite this article in press as: M. Firmin, et al., Postpartum hemorrhage: incidence, risk factors, and causes in Western French Guiana, J Gynecol Obstet Hum Reprod (2018), https://doi.org/10.1016/j.jogoh.2018.11.006

noted, however, that our analyses were limited by the small number of cases of severe IPPH.

Strengths and weaknesses of the study

This case control study based on incident cases had a number of strengths: a high rate of participation (92.2%), a relatively large number of women interviewed (154 cases and 308 control subjects), and data collection conducted in local languages by midwives working in the maternity ward. This study provides a useful basis for reference, as it is the first study of IPPH in this population in western French Guiana.

However, there were some limitations. The primary limitation was selection bias, as the volume used to define IPPH is determined by the healthcare teams and can be inexact. We decided to not include biological data in our definition of IPPH. This could have limited that exhaustiveness of our non-severe IPPH sample. Moreover, the definition of IPPH is not based on the recent CNGOF recommendation. We choose to apply the definition from the current service protocol, which, at that time, used a different definition between cesarean sections (>1 L) and vaginal deliveries (>500 ml).

Conclusion

This study provides descriptive and analytical data on IPPH in a complex overseas French territory whose sociodemographic, epidemiological, and healthcare characteristics are at the interface between those of developing countries and wealthy countries. The incidence rate of IPPH is similar to that found in metropolitan France and in the literature. The risk factors identified here will enable the development of appropriate preventive and management protocols.

Declaration of interest

The authors received no specific funding for this work.
None of the authors have any conflict of interests to declare.

Acknowledgments

The authors would like to thank the entire team that contributed to this article, especially the many midwives who were involved in the data collection process: Couratin Nicolas, Gleizes Nathalie, Guine Anne-Marie, Hochart Caroline, Kramer Rainer, Raynel Floriane, Rico Caroline and Tergny Etienne. We thank Valérie Folie for feedback on the article and for her support. We also thank the patients from western French Guiana who made this study possible by agreeing to participate.

References

[1] Les morts maternelles en France : mieux comprendre pour mieux prévenir. 5e rapport de l'Enquête Nationale Confidentielle sur les Morts Maternelles (ENCMM), 2010-2012. Saint-Maurice : Santé publique France, 2017. 230 p. Disponible à partir de l'URL : www.santepubliquefrance.fr.
[2] INSEE. Bilan démographique. Insee Première - N° 1429 [Internet]. . . [cité 25 janv 2018]. Disponible sur: https://www.insee.fr/fr/statistiques/1281416.
[3] Jolivet A, Florence S, Lebas J, Paquet C, Chauvin P. Migration, santé et soins en Guyane. BEH InVS. 2012;(n°2-3-4):48–51.
[4] Données. issues du registre d'issue de grossesse informatisé (RIGI) du CHOG. 2013.
[5] Louison-Ferté A, Jolivet A, Lambert V, Bosquillon L, Carles G. Lutte contre l'anémie de la femme enceinte dans l'Ouest guyanais : diagnostic et mise en oeuvre d'actions par le réseau Périnat Guyane autour d'une évaluation des pratiques professionnelles. Rev Médecine Périnatale 2014;6(2)116–21 1 juin.
[6] Lambert V, Boukhari R, Misslin-Tritsch C, Carles G. Geophagia: progress toward understanding its causes and consequences. Rev Med Interne 2013;34(2)94–8 févr.
[7] Rimbaud D, Restrepo M, Louison A, Boukhari R, Ardillon V, Carles G, et al. Blood lead levels and risk factors for lead exposure among pregnant women in western French Guiana: the role of manioc consumption. J Toxicol Environ Health A. 2017;80(6):382–93.
[8] Calvert C, Thomas SL, Ronsmans C, Wagner KS, Adler AJ, Filippi V. Identifying regional variation in the prevalence of postpartum haemorrhage: a systematic review and meta-analysis. PLoS One 2012;7(7)e41114.
[9] Dupont C, Rudigoz R-C, Cortet M, Touzet S, Colin C, Rabilloud M, et al. Frequency, causes and risk factors of postpartum haemorrhage: a population-based study in 106 French maternity units. J Gynecol Obstet Biol Reprod (Paris) 2014;43(3)244–53 mars.
[10] Dupont C, Deneux-Tharaux C, Touzet S, Colin C, Bouvier-Colle M-H, Lansac J, et al. Pithagore6 group. Clinical audit: a useful tool for reducing severe postpartum haemorrhages? Int J Qual Health Care J Int Soc Qual Health Care. 2011;23(October (5)):583–9.
[11] INSERM D. Enquête nationale périnatale Rapport 2016 Les naissances et les établissements Situation et évolution depuis 2010. 2017.
[12] Nyfløt LT, Sandven I, Stray-Pedersen B, Pettersen S, Al-Zirqi I, Rosenberg M, et al. Risk factors for severe postpartum hemorrhage: a case-control study. BMC Pregnancy Childbirth 2017;17(1)17 10 janv.
[13] Waterstone M, Bewley S, Wolfe C. Incidence and predictors of severe obstetric morbidity: case-control study. BMJ 2001;322(7294)1089–93 5 mai discussion 1093-1094.
[14] Combs CA, Murphy EL, Laros RK. Factors associated with postpartum hemorrhage with vaginal birth. Obstet Gynecol. janv 1991;77(1):69–76.
[15] Oberg AS, Hernandez-Diaz S, Palmsten K, Almqvist C, Bateman BT. Patterns of recurrence of postpartum hemorrhage in a large population-based cohort. Am J Obstet Gynecol. mars 2014;210(3)229 e1-8.
[16] Kennedy DA, Woodland C, Koren G. Lead exposure, gestational hypertension and pre-eclampsia: a systematic review of cause and effect. J Obstet Gynaecol J Inst Obstet Gynaecol. août 2012;32(6):512–7.
[17] Kramer MS, Berg C, Abenhaim H, Dahhou M, Rouleau J, Mehrabadi A, et al. Incidence, risk factors, and temporal trends in severe postpartum hemorrhage. Am J Obstet Gynecol 2013;209(5)449 nov e1-7.
[18] Sharp GC, Saunders PTK, Greene SA, Morris AD, Norman JE. Intergenerational transmission of postpartum hemorrhage risk: analysis of 2 Scottish birth cohorts. Am J Obstet Gynecol 2014;211(1)51 juill e1-7.
[19] Belghiti J, Coulm B, Kayem G, Blondel B, Deneux-Tharaux C. Oxytocin administration during labor. Results from the 2010 French National Perinatal Survey. J Gynecol Obstet Biol Reprod (Paris) 2013;42(7)662–70 nov.
[20] Belghiti J, Kayem G, Dupont C, Rudigoz R-C, Bouvier-Colle M-H, Deneux-Tharaux C. Oxytocin during labour and risk of severe postpartum haemorrhage: a population-based, cohort-nested case-control study. BMJ Open 2011;1(2)e000514.
[21] Rogers J, Wood J, McCandlish R, Ayers S, Truesdale A, Elbourne D. Active versus expectant management of third stage of labour: the Hinchingbrooke randomised controlled trial. Lancet Lond Engl. 1998;351(9104)693–9 7 mars.
[22] Pierre F, Mesnard L, Body G. For a systematic policy of i.v. Oxytocin inducted placenta deliveries in a unit where a fairly active management of third stage of labour is yet applied: results of a controlled trial. Eur J Obstet Gynecol Reprod Biol 1992;43(2)131–5 31 janv.
[23] Dupont C, Carayol M, Le Ray C, Barasinski C, Beranger R, Burguet A, et al. Oxytocin administration during spontaneous labour: guidelines for clinical practice. Guidelines short text. Gynecol Obstet Fertil Senol. janv 2017;45 (1):56–61.
[24] Dupont C, Ducloy-Bouthors A-S, Huissoud C. Clinical and pharmacological procedures for the prevention of postpartum haemorrhage in the third stage of labor. J Gynecol Obstet Biol Reprod (Paris). déc 2014;43(10):966–97.
[25] Wang X, Tan H, Zhou S, He Y, Shen L, Liu Y, Hu L, Xu X. Incidence and risk factors for postpartum hemorrhage in Liuyang, China. Zhong Nan Da Xue Xue Bao Yi Xue Ban. févr 2014;39(2):151-156.
[26] Lao TT, Sahota DS, Cheng YKY, Law LW, Leung TY. Advanced maternal age and postpartum hemorrhage - risk factor or red herring? J Matern-Fetal Neonatal Med Off J Eur Assoc Perinat Med Fed Asia Ocean Perinat Soc Int Soc Perinat Obstet. févr 2014;27(3):243–6.

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