



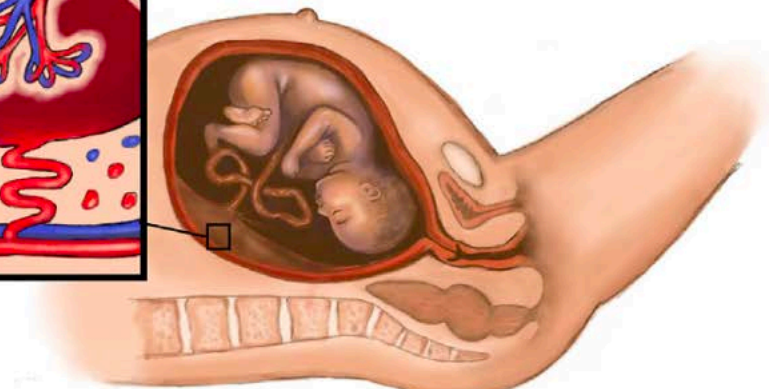
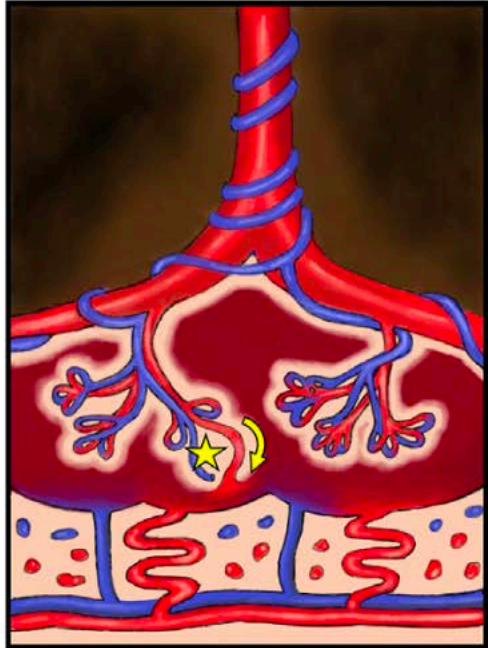
3^{ème} Journée « Yves Brossard »
d'hémobiologie fœtale et néonatale

Vendredi 28 Janvier 2022
Maison des Océans – Paris

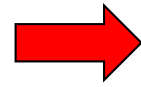
CIRCONSTANCES DE DÉCOUVERTE DES HÉMORRAGIES FŒTO-MATERNELLES

Dr Paul Maurice, Centre National de Référence en Hémobiologie Périnatale
Service de Médecine Fœtale, Hôpital Trousseau, AP-HP. Sorbonne Université

Définition - Incidence



Brèche au niveau d'une villosité choriale



Passage de sang fœtal dans la
chambre intervillieuse

- ✓ Passage de faible volume très fréquent sans conséquence
- ✓ Volume important avec retentissement 1/1000 – 1/5000 naissances

Quel volume

Test de Kleihauer-Betke

Résultat = nombre d'hématies fœtales pour 10000 hématies adultes

Volume sanguin fœtal (mL) = Résultat/2

Kleihauer et al. Klin Wochenschr 1957

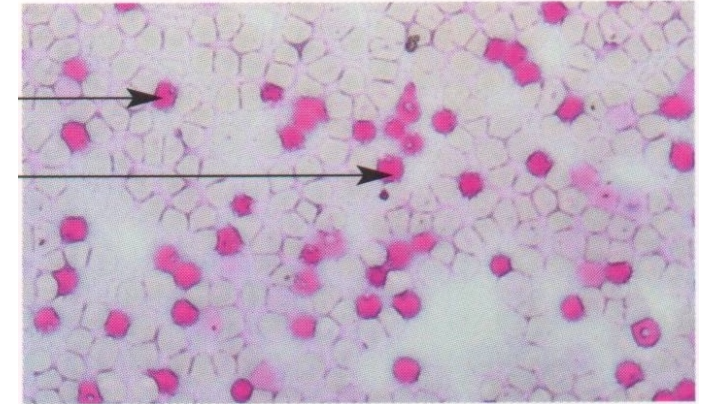


Table 2. Prognosis of Fetomaternal Hemorrhage as a Function of Fetal Volume Transfused

Volume (mL/kg)	n	Kleihauer Routine (Rh-negative)	Gestational Age at Diagnosis (wk)	Fetal Death	Preterm Delivery, Induced	Transfer to NICU	Transfusion	Adverse Outcome*	Follow-up†
0–9.9	9	9 (100)	38.1±1.9 (35–41)	–	–	–	–	–	7 (78)
10–19.9	16	14 (87.5)	37.9±2.6 (30–41)	–	–	1 (6.3)	–	1 (6.3) NS	12 (75)
20–39.9	9	5 (55.6)	37.1±3.4 (31–40)	–	2 (22.2)	3 (33)	1 (11.1)	5 (55.5)‡	6 (67)†
40–79.9	8	1 (12.5)	34.9±4.7 (27–40)	2 (25)	2 (33.3)	3 (50)	2 (33.3)	5 (62.5)§	5 (83)
80 or more	6	0	32.8±7.2 (22–40)	4 (66.7)	–	2 (100)	2 (100)	6 (100)‡	1 (50)

NICU, neonatal intensive care unit; NS, not significant.

Data are expressed as n (%) or mean±standard deviation (range).

* Each cutoff point (10, 20, 40, and 80 mL/kg) was tested separately (one class versus all lower volume classes).

† Except for the child with mitochondrial cytopathy, no neonatal deaths or long-term sequelae were observed.

‡ $P < .01$.

§ $P < .05$.

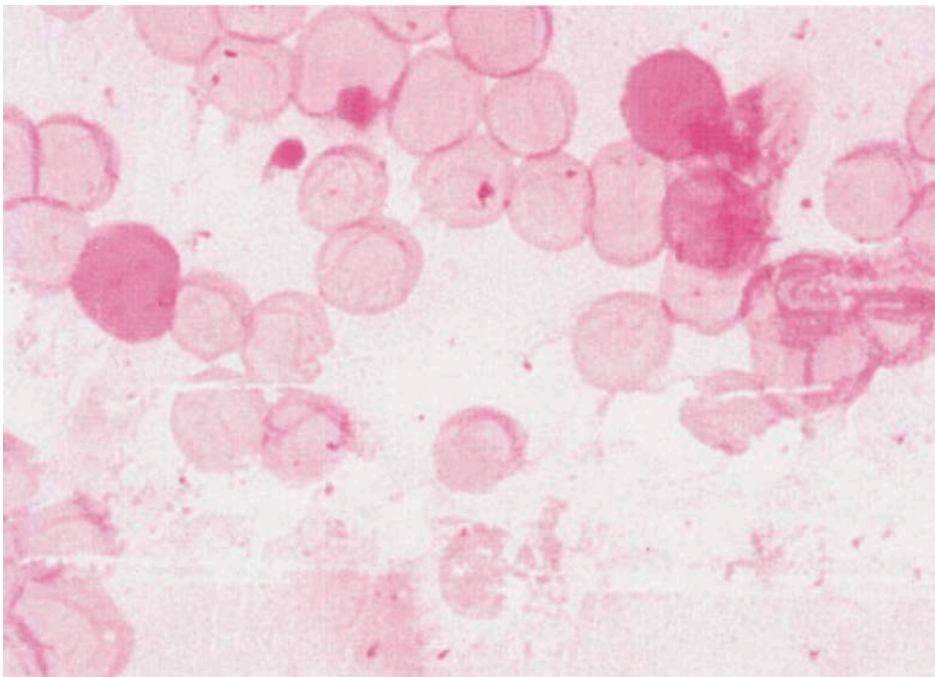
Rubod et al. Obstet Gynecol 2007

Cohorte CNRHP

01/01/06 – 31/12/20

Test de Kleihauer-Betke en prénatal
> 40/10000

Indication ?



Age gestationnel médian (SA) [IQR]

35⁺⁶ [28⁺⁵ ; 38⁺⁶]

Motif (N = 47)

Diminution ressentie des mouvements foetaux	22 (46.8)
Traumatisme	6 (12.8)
Anasarque	5 (10.6)
MFIU	5 (10.6)
Anomalies du RCF	3 (6.4)
Métrorragies	3 (6.4)
Suspicion d'anémie	3 (6.4)

Anémie (N = 15)

Transfusion in utero	8 (20)
Transfusion néonatale	8 (20)



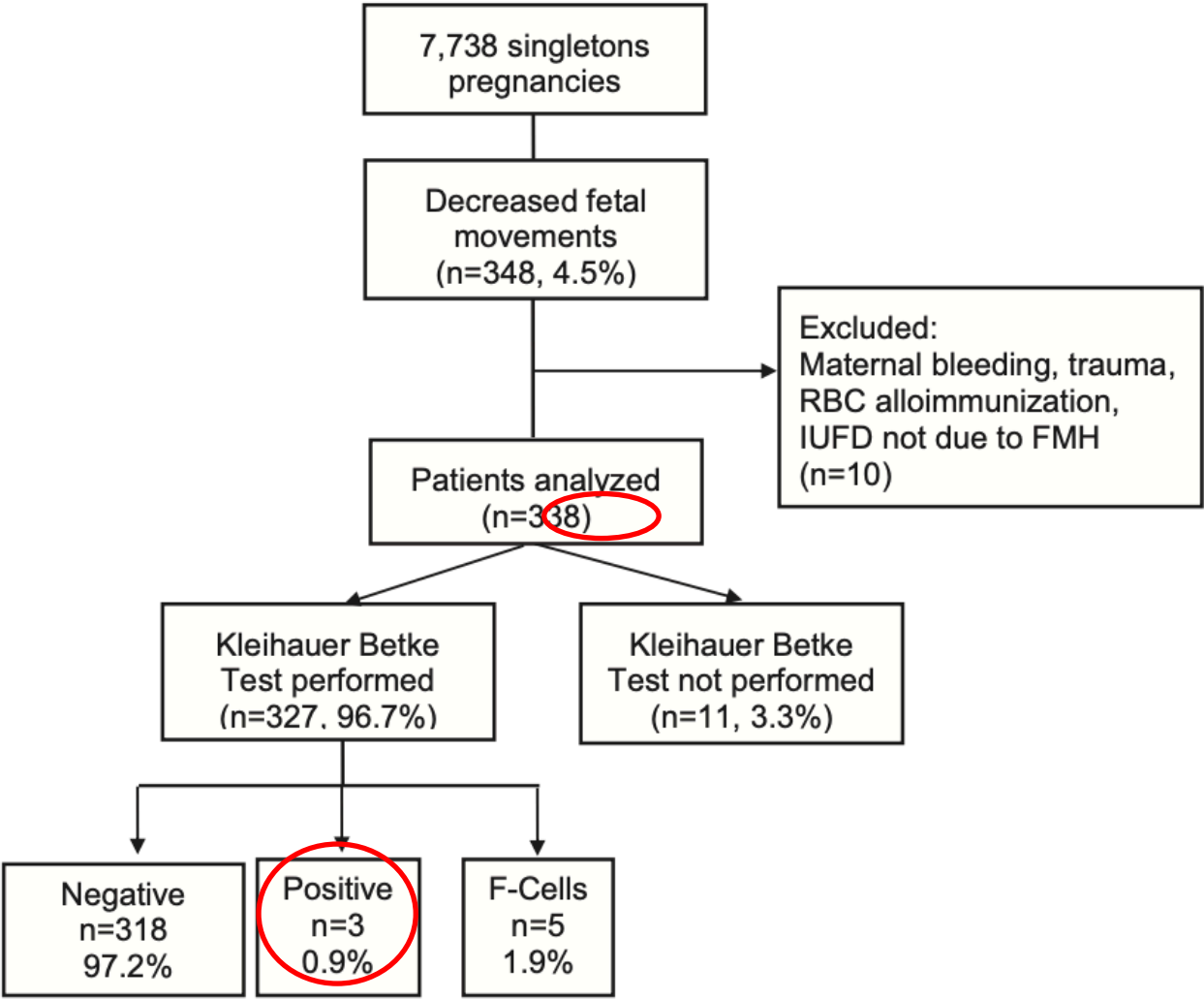
Reduced fetal movement during pregnancy: Is the Kleihauer-Betke test really useful?

Yoann Athiel^a, Emeline Maisonneuve^{a,b,*}, Cécile Bléas^a, Paul Maurice^{a,b}, Anne Cortey^{a,b}, Cécile Toly-Ndour^c, Stéphanie Huguet-Jacquot^c, Agnès Mailloux^c, Jean-Marie Jouannic^{a,b}

Table 2
Accuracy of CTG, Kleihauer-Betke test

Accuracy of CTG (N = 327)
Severe neonatal anemia
N = 1
Accuracy of Kleihauer-Betke test (N = 10)
Neonatal anemia
N = 10
Severe neonatal anemia
N = 1
Accuracy of MCA-PSV Doppler (N = 10)
Neonatal anemia
N = 10
Severe neonatal anemia
N = 1

Hb: hemoglobin, CTG: cardiotocography, MCA-PSV: middle cerebral artery peak systolic velocity. Hb cut-off are expressed in grams/decililte



	PPV	PNV
1/1	100%	326/326
2/3	66.7%	317/318
1/3	33.3%	318/318
1/2	50%	156/164
1/2	50%	164/164

1/2: velocity of the middle cerebral artery. Hb cut-

MORT FŒTALE IN UTERO



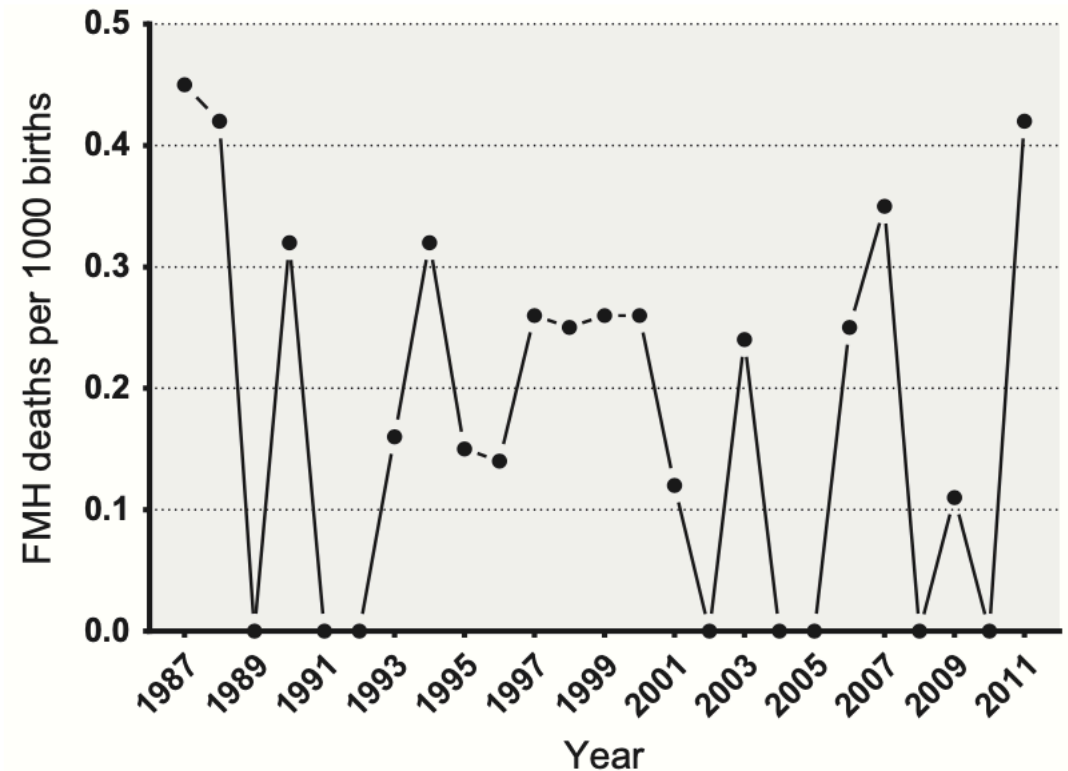
Mort foétale in utero

AOGS ORIGINAL RESEARCH ARTICLE

The contribution of massive fetomaternal hemorrhage to antepartum stillbirth: a 25-year cross-sectional study

BOBBY D. O'LEARY¹, COLIN A. WALSH², JOAN M. FITZGERALD³, PAUL DOWNEY⁴ & FIONNUALA M. MCAULIFFE^{1,2}

192 132 naissances $\geq 500\text{g}$
34/828 MFIU (4.1%)
0.18/1000 naissances



Mort foétale in utero

Table 1. Overall characteristics of study population.

Characteristic	Result
Maternal age (years)	29 (18–41)
Male	10 (29.4%)
Female	24 (70.6%)
Nulliparous	21 (62%)
Singleton pregnancy	30 (88%)
Gestational age (weeks)	38 (25–41)
Term gestation (37 ⁺ weeks)	25 (74%)
Birthweight (g)	2900 (510–4420)
Fetomaternal hemorrhage (mL fetal cells)	105 (5–500)
Fetomaternal hemorrhage (mL/kg)	38 (3–133)
Fetomaternal hemorrhage (% total fetal blood volume)	44 (3–100)
Risk factor identified	11 (32%)*

Mort foétale in utero

OBSTETRICS

Fetomaternal hemorrhage: evaluation of recurrence within a large integrated healthcare system

Marie J. Boller, MD; Gaea S. Moore, MD; Yun-Yi Hung, PhD; Miranda L. Ritterman Weintraub, PhD, MPH
Galen M. Schauer, MD

American Journal of Obstetrics & Gynecology

375 864 grossesses
340 grossesses avec HFM
décès périnatal : 80, 23.5%

Examen fœtopathologique

Fœtus

Pâleur

Pétéchies intra-thoraciques absentes

Augmentation hématopoïèse intra-hépatique et intra-rénale

GR nucléés

(Hydrops)

Carles et al. Pediatr Dev Pathol 2014

Placenta



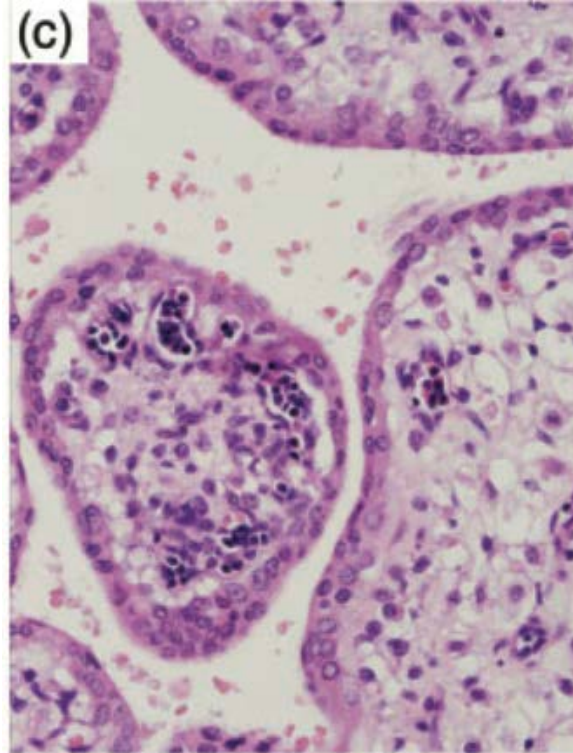
pâleur placentaire



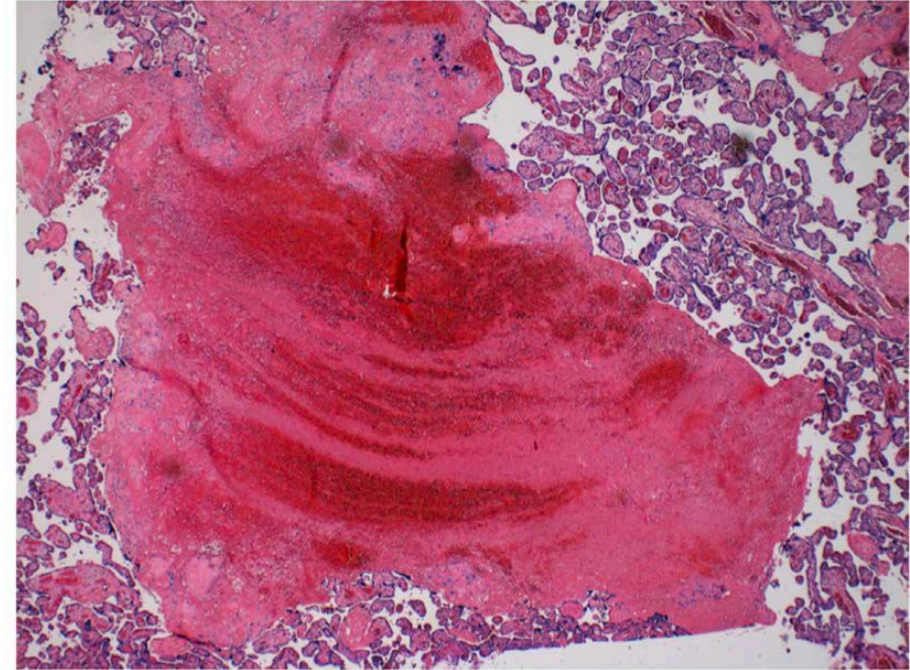
Ravishankar et al. Pathol Res Pract 2017

Examen fœtopathologique

Placenta

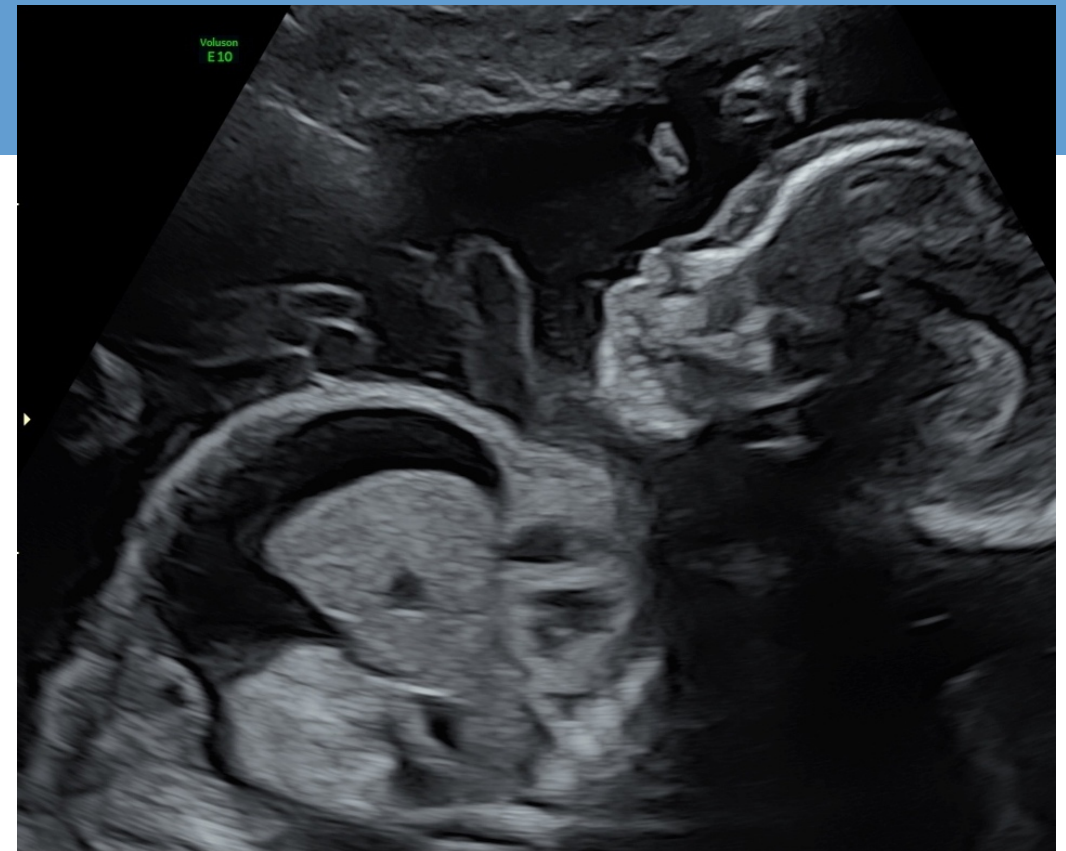


Vaisseaux fœtaux avec GR nucléés



Thrombus intervilllositaire

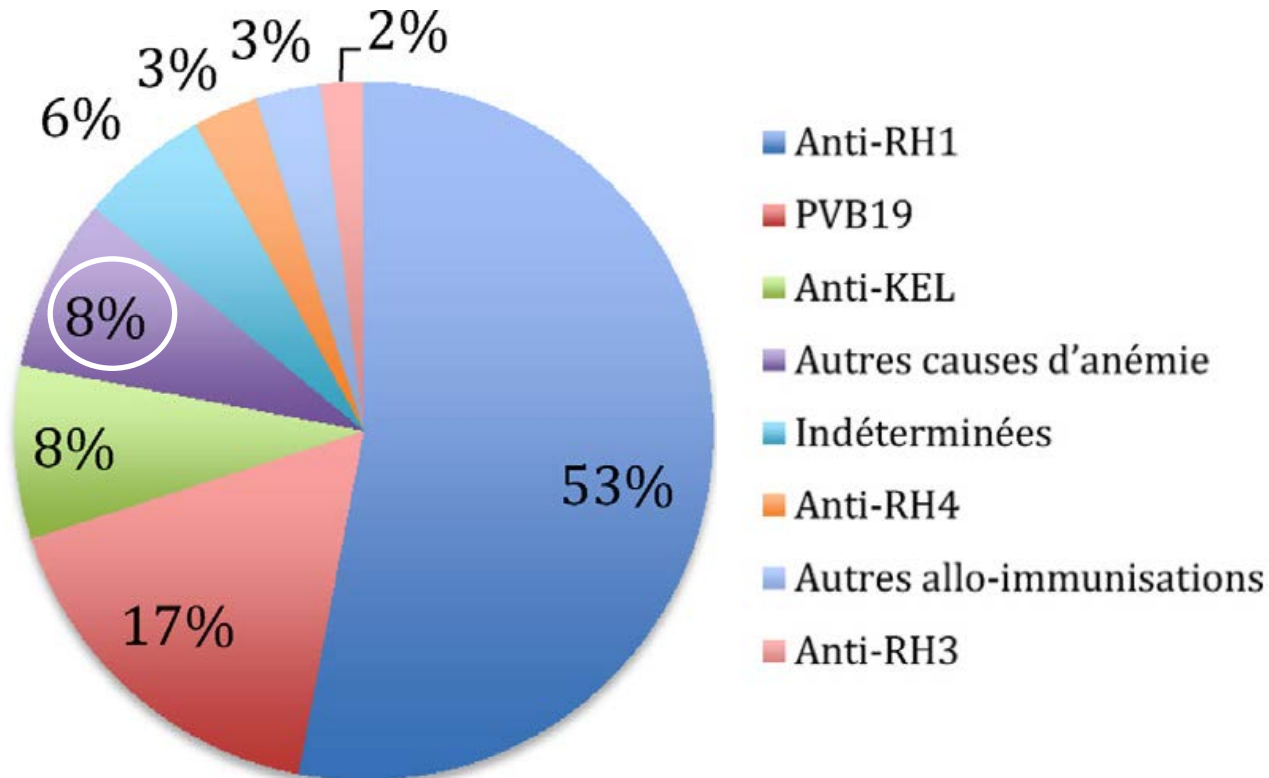
ANÉMIE FŒTALE



Transfusions fœtales érythrocytaires : état des lieux sur 4 ans en France (2011–2014)

Intrauterine blood transfusion: Status report of 4 years of practice in France (2011–2014)

A. Girault, S. Friszer, E. Maisonneuve, L. Guilbaud, A. Cortey, J.-M. Jouannic *



24 ans
634 grossesses avec transfusion in utero
HFM pour 8 grossesses
1.3%

Lindenburg et al. Prenatal Diagnosis 2013

The Recurrence Risk of Fetomaternal Hemorrhage

Libera Troia^a Huda B. Al-Kouatly^b Rebekah McCurdy^b Peter S. Konchak^c
Stuart Weiner^b Vincenzo Berghella^b

Fetal Diagnosis
and **Therapy**

Table 3. Features at admission

First author [Ref.], year	GA onset of signs/ symptoms	Presenting signs/symptoms	GA at admission, weeks + days	Ultrasound			MCA-PSV, cm/s (MoM)	Indication for cordocentesis	KB test	Estimated volume of FMH, mL	NST
				AF	FH	other features					
Cardwell [25], 1988	21	Asymptomatic	21	Polyhydramnios	Yes	Placentomegaly	NR	KB test	Pos	20	NR
Tannirandorn [26], 1990	27+4	DFM	28	Polyhydramnios	Yes	Placentomegaly	NR	KB test	Pos	113	Normal
Fischer [27], 1990	29	DFM for 2 weeks and AFM for 3 days	31	Normal	No	Enlarged fetal liver, normal placenta	NR	KB test	Pos	180	Sinusoidal FHR
Thorp [28], 1992	26	Asymptomatic	26	NR	Yes	Placentomegaly	NR	KB test	Pos	100	Poor variability and intermittent prolonged decelerations
Kohlenberg [29], 1994	26	DFM	26+2	Normal	No	AFM, large placen- tal venous lake	NR	KB test	Pos	50	130 FHR with reduced variability
Montgomery [30], 1995	27	Uterine size greater than GA	27	Polyhydramnios	Yes	NR	NR	KB test	Pos	300	NR
Lipitz [31], 1997	27	Abdominal trauma	27	Normal	No	Normal BPP, normal placenta	NR	KB test	Pos	250	Normal
Hartung [32], 2000	28	Asymptomatic	28	NR	Yes	Thickened placenta	NR	FH	Pos	250	NR
Rubod [16], 2006	28+2	DFM	28+5	NR	Yes	Placental edema	77 (2.10)	FH and sinusoidal FHR	Pos	240	140 FHR with isolated decelerations
Votino [33], 2008	25+5	DFM	26+5	NR	Yes	Placental edema	73 (2.16)	KB test	Pos	90	Very low short-term variability and no accelerations
Sifakis [34], 2010	24	Asymptomatic	24	Polyhydramnios	Yes	Placental edema	84 (2.73)	KB test	Pos	32	NR
Friszer [35], 2010	28	Asymptomatic, proteinuria	29+2	NR	Yes	NFM	71 (1.83)	KB test	Pos	75	Normal
Stefanovic [36], 2013	26+5	DFM	27+1	Reduced	No	AFM	55 (1.55)	LCM pos	Pos	>80	Sinusoidal FHR with variable decelerations
Our case, 2017	29+6	DFM	31+5	Normal	No	Fetal ascites and hepatomegaly	63.4 (1.48)	KB test, increased MCA-PSV	Pos	35	Nonreactive
Mean ± SD	26.6±2.1	27.1±2.4					70.6±10.7 (1.95±0.45)			129.6±94.9	



Table 4. Intrauterine transfusions

First author [Ref.], year	Intrauterine transfusion											Monitoring
	IUT, n	GA, weeks + days	MCA-PSV before IUT, cm/s (MoM)	MCA-PSV after IUT, cm/s (MoM)	indication	Hb pre, g/dL	Hct pre, %	Hb post, g/dL	Hct post, %	transfused volume, mL	total volume transfused in all IUTs, mL	
Cardwell [25], 1988	1	21	NR	NR	FH with KB test pos.	NR	NR	NR	NR	50 ^a	50	Serial KB testing and US
Tannirandorn [26], 1990	1	28 ^b 29	NR	NR	DFM with KB test pos. Scheduled, no fetal anemia, no IUT ^d	5.8 12.6	17.2 37	NR	36.7	65 ^c 0	65	NR
Fischer [27], 1990	2	31 31+5	NR	NR	DFM with KB test pos. DFM and sinusoidal FHR	2.2 4.2	7.6 13.5	12.4 12.2	39.2 37.9	96 100	196	NR
Thorp [28], 1992	2	26 27 29	NR	NR	Massive FH with KB test pos. DFM and sinusoidal FHR Scheduled, no fetal anemia, no IUT ^d	2.7 9.8 14.1	7 28 41	14.2 13.8	42 42	75 35 0	110	Twice weekly US, twice weekly NST, weekly KB testing
Kohlenberg [29], 1994	2	26+2 26+6 30 33	NR	NR	DFM with KB test pos. Scheduled, fetal anemia, no IUT ^d DFM with KB test pos. Scheduled, no fetal anemia, no IUT ^d	2.7 8.4 3.7 10.6	NR NR NR NR	8.3 NR 11.3	NR NR	35 0 50 0	85	Daily fetal movement count and NST, serial KB testing
Montgomery [30], 1995	5	27 27+5 29 29+5 30+2	NR	NR	Fetal anasarca with KB test pos. KB test pos. Scheduled, fetal anemia, IUT ^d Scheduled, fetal anemia, IUT ^d Scheduled, no fetal anemia, IUT ^d	5.5 6.1 6.1 8 11.1	16.4 18 18 23.7 32.7	NR NR NR NR	28.5 28 31.5 34.8 40.3	26 40 46+80† 35+20† 22	269	Biweekly BPP
Lipitz [31], 1997	1	27+5	NR	NR	KB test pos. for a week	8.8	26	NR	40.6	30	30	Weekly KB testing
Hartung [32], 2000	5	28 28+2 29 to 31	NR	NR	FH FH 3 scheduled, anemia NR, IUT ^d	4 NR NR	NR NR NR	7.6 10.4 NR	NR NR NR	40 50 NR	Not possible to estimate	Daily US and NST, weekly cordocentesis
Rubod [16], 2006	2	28+6 30 31+3	77 (2.10) 60 (1.48) 48 (1.13)	NR NR	FH, sinusoidal FHR, AFM DFM and sinusoidal FHR Scheduled, no fetal anemia, no IUT ^d	2.2 4.4 11.7	NR NR NR	9.9 11.8	NR NR	140 162 0	302	Fetal movement count, twice daily NST, twice a week MCA-PSV
Votino [33], 2008	4	26+5 27+3 29+3 29+6 33+1	73 (2.16) NR 80 (2.06) NR 52 (1.10)	NR NR 51 (1.31) NR	FH with KB test pos. Scheduled, anemia NR, IUT ^d DFM and sinusoidal FHR Scheduled, fetal anemia, IUT ^d DFM	2.9 NR 3.7 7.7 NR	7 NR 10 23 NR	NR 12.4 9.4 NR	41 37 27 50	83 40 86 62 0	271	Fetal movement count, twice daily NST and daily MCA-PSV
Sifakis [34], 2010	8	24+5 24+6 25 25+3 25+3 26 26+5 27+2	84 (2.73) NR 52 (1.61) 42 (1.30) 64 (1.99) 59 (1.75) 53 (1.57) 41 (1.16)	41.2 (1.34) 49.2 (1.60) NR NR 49 (1.52) 43.9 (1.30) 37.8 (1.12) NR	Severe FH with KB test pos. Scheduled, fetal anemia, IUT ^d Scheduled, fetal anemia, IUT ^d Scheduled, fetal anemia, IUT ^d Scheduled, fetal anemia, IUT ^d Scheduled, fetal anemia, IUT ^d Scheduled, fetal anemia, IUT ^d Scheduled, fetal anemia, IUT ^d	2.5 2.5 5.7 1.3 8.3 5 6.4 8.5	NR NR NR NR NR NR NR NR	5.6 6.2 6.9 8.3 10.8 8.8 9.2 9.8	NR NR NR NR NR NR NR NR	NR NR NR NR NR NR NR NR	350	NR
Friszer [35], 2010	3	29+3 30+4 31+4	71 (1.83) 80 (1.88) 66 (1.50)	55 (1.42) 35 (0.82) 35 (0.82)	Severe FH with KB test pos. ↑MCA-PSV ↑MCA-PSV	4.5 4.2 6.3	NR NR NR	12.5 16.2 15.5	NR NR NR	NR NR NR	NR	Twice daily NST and daily MCA-PSV
Stefanovic [36], 2013	2	27+2 28	55 (1.55) 77 (2.08)	NR NR	DFM with LCM pos. DFM and sinusoidal FHR	1.8 3.2	NR	11.9 10.5	NR	35 40	75	NR
Our case, 2017	1	32+1	63.4 (1.48)	42.8 (0.95)	DFM, KB test pos., fetal ascites and ↑MCA-PSV	6.1	21.6	13.1	44.6	35	35	Twice weekly NST, MCA-PSV and hydrops checks



Table 6. Neonatal characteristics





First author [Ref.], year	GA at delivery, weeks + days	Days since first IUT and delivery	Gen- der	Mode of delivery	Indication	Out- come	Apgar score ^a	Weight, g	Hb, g/dL	Hct, %	Assisted venti- lation	Neonatal trans- fusion	NICU course	Postnatal follow-up
Cardwell [25], 1988	38+4	193	F	PCS	Previous CS	Alive	NR	2,750	17.2	51.3	NR	No	NR	NR
Fischer [27], 1990	31+6	6	NR	UCS	Sinusoidal FHR and breech	Alive	9/10	1,750	6.6	20.6	No	Yes, twice	Phototherapy for hyperbilirubinemia	Normal
Thorp [28], 1992	39	91	F	VD	Spontaneous onset of labor	Alive	9/9	3,263	17.1	52	No	No	Uncomplicated	Normal at 8 weeks
Kohlenberg [29], 1994	38	82	F	CS	NR	Alive	NR	NR	15.5	NR	No	No	Uncomplicated	NR
Montgomery [30], 1995	30+4	25	M	CS	Maternal fever, uterine contractions and breech	Alive	4/8	1,740	18.2	56.7	Yes	No	Uncomplicated	NR
Lipitz [31], 1997	39	79	F	VD	PROM	Alive	9/10	2,800	13.9	41	No	No	Uncomplicated	NR
Hartung [32], 2000	31	21	F	CS	NR	Alive	7/9	1,850	10.2	28	Yes	Yes, once	Phototherapy for hyperbilirubinemia	Normal at 1 year
Rubod [16], 2006	38	64	M	PCS	Breech	Alive	10/10	3,400	14.2	NR	No	No	Uncomplicated	Normal at 1 month
Votino [33], 2008	33+1	45	F	CS	DFM and suspected recurrent FMH	Alive	10/10	2,075	13.6	46	No	No	Uncomplicated	Normal at 8 months
Friszer [35], 2010	31+5	16	F	UCS	Rapid increase in MCA-PSV	Alive	8/7	1,530	10.2	NR	Yes	Yes, once	Uncomplicated	Normal at 6 months
Stefanovic [36], 2013	28+2	7	F	PCS	Planned	Alive	3/NR	1,060	6.0	NR	Yes	Yes, four times	Uncomplicated	Normal at 2 years
Our case, 2017	34+1	14	F	PCS	Previous CS	Alive	7/9	2,280	17.3	52.1	No	No	Uncomplicated	Normal at 3 months
Mean ± SD	34.2± 4.2	53.6± 54.8						2,227.1± 743.7	13.3± 4.2	43.5± 12.9	4 ^b	4 ^b		

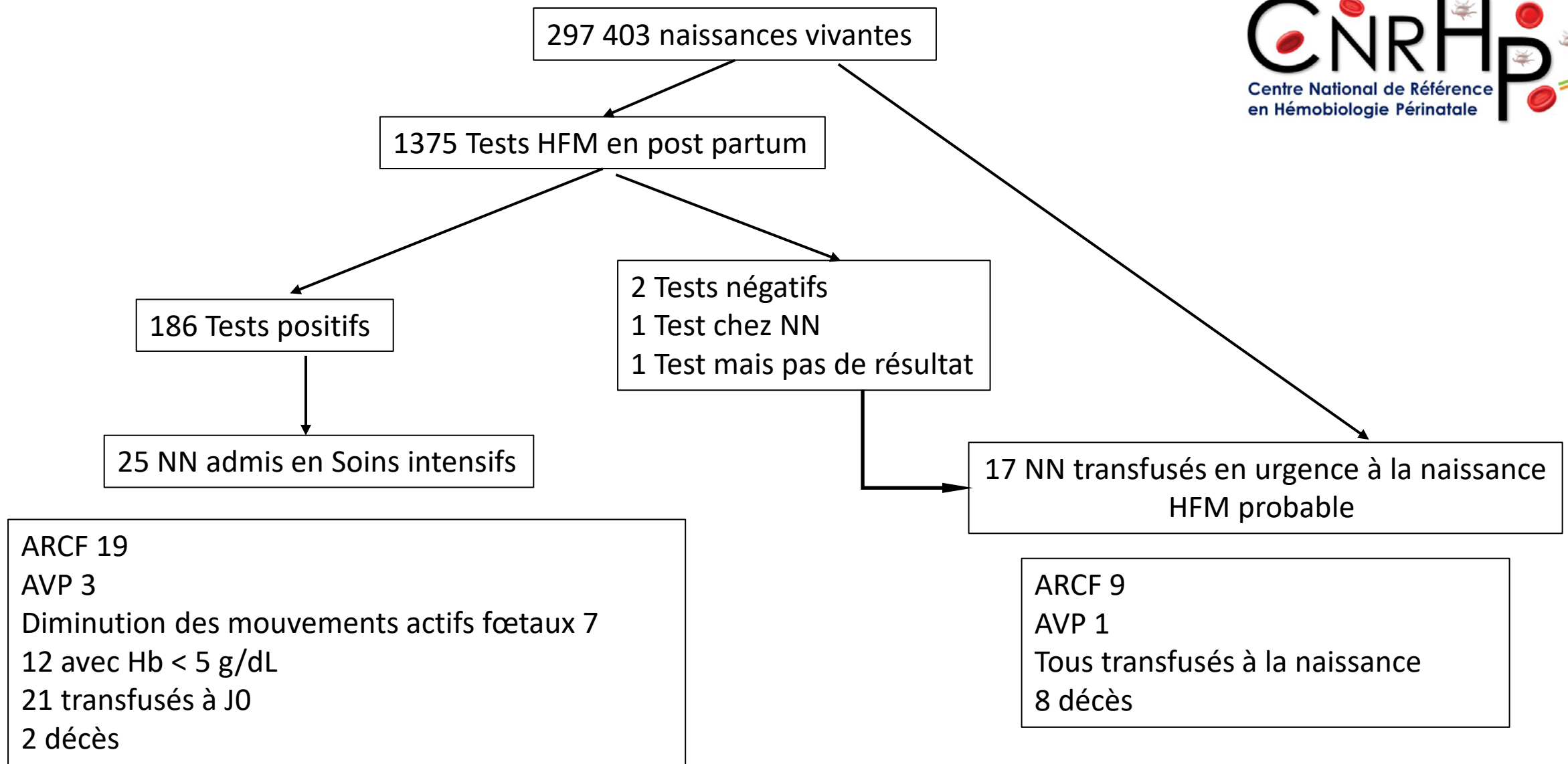
ANÉMIE NÉONATALE



Fetomaternal hemorrhage: Evidence from a multihospital healthcare system that up to 40% of severe cases are missed

Nicholas R. Carr¹  | Erick Henry² | Timothy M. Bahr^{1,3}  | Robin K. Ohls¹ |
Jessica M. Page^{2,4} | Sarah J. Ilstrup⁵ | Robert D. Christensen^{1,2,3,6}

TRANSFUSION



42 NN avec anémie sévère – 1/7081 naissances vivantes

HFM aiguë 10/42

HFM non diagnostiquée > 40%

Et après ?

Sans étiologie > 80% des situations

Wylie et al. Obstet Gynecol 2010

Choriocarcinome

Touboul et al. J Obstet Biol Reprod, 2010

Risque de récurrence 0.5%

Boller et al. AJOG 2021



cliché E Maisonneuve

HCG

Histologie placentaire

Allo-immunisation

RAI