LA SURVEILLANCE FŒTALE PER-PARTUM DU FUTUR

B Langer, N Sananès

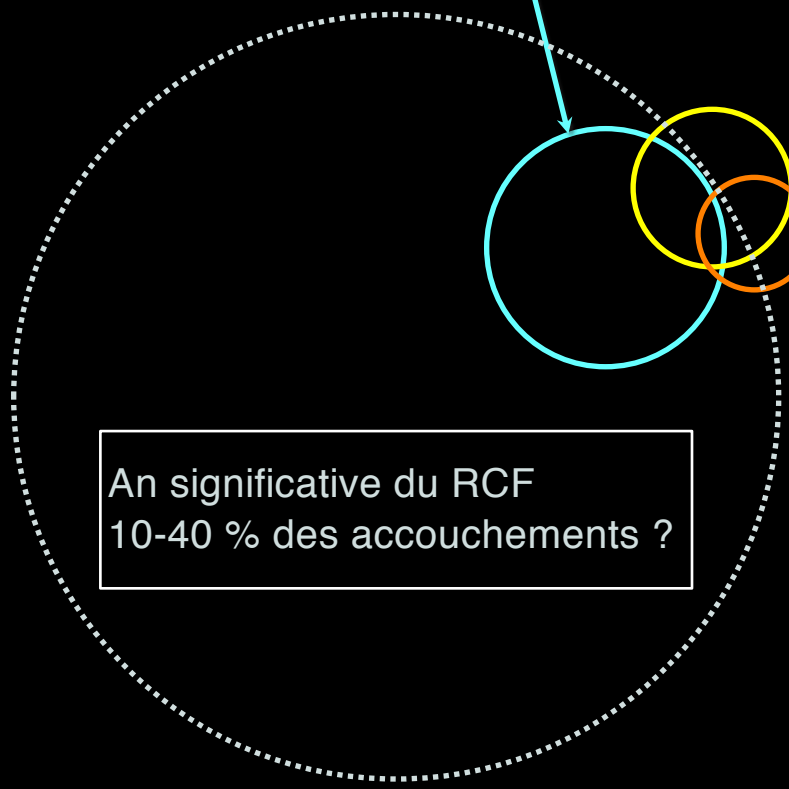
48e Journées Nationales
de la Société Française de Médecine Périnatale
16-18 Novembre 2018
Marseille

Hôpital de Hautepierre
Pôle de gynécologie-obstétrique
CHU de Strasbourg

PLAN

- La surveillance fœtale per-partum jusqu'à il y a quelques années
- La nouvelle surveillance depuis quelques années
- La surveillance du futur

ANOMALIES DU RCF



Asphyxie per-partum (BE > -12)
2 % des accouchts

Encéphalopathie néonatale : 2 ‰
50 % dues à une asphyxie per-partum

An significative du RCF
10-40 % des accouchements ?

Paralysie cérébrale du NN à terme : 1-2 ‰
5-28 % due à une asphyxie per-partum

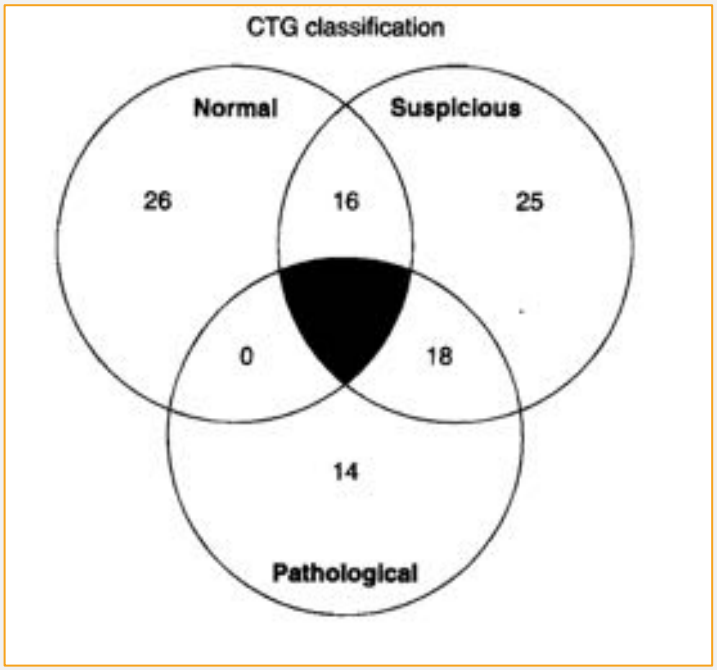
Zupan. RPC 2007
Low AJOG 2007

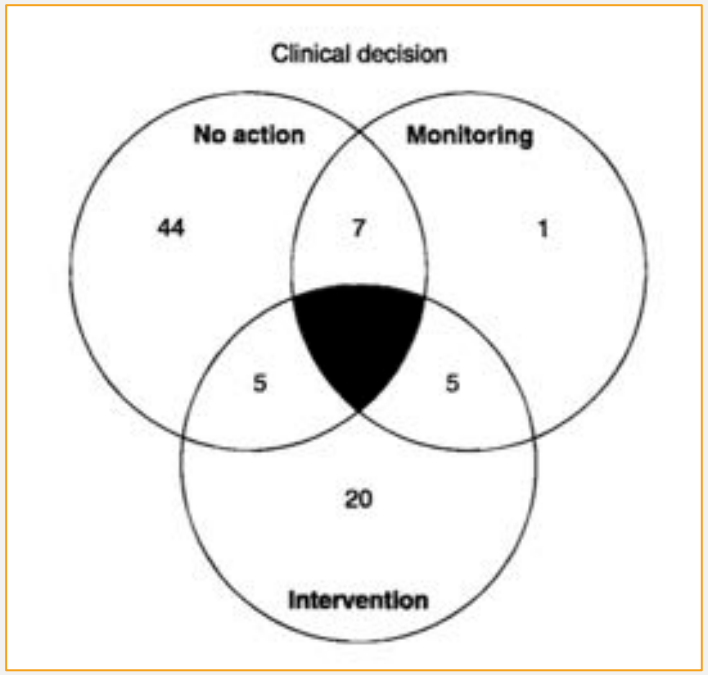
British Journal of Obstetrics and Gynaecology
December 1999, Vol 106, pp. 1307–1310

Inconsistencies in classification by experts of cardiotocograms and subsequent clinical decision

*D. Ayres-de-Campos *Specialist Registrar*, *J. Bernardes *Professor and Consultant (Obstetrics and Gynaecology)*, †A. Costa-Pereira *Professor*, *L. Pereira-Leite *Professor and Head of Department*

**Department of Obstetrics and Gynaecology, Porto Faculty of Medine, S. João Hospital; †Department of Biostatistics and Medical Information, Porto Faculty of Medicine, Porto, Portugal*





Kappa index

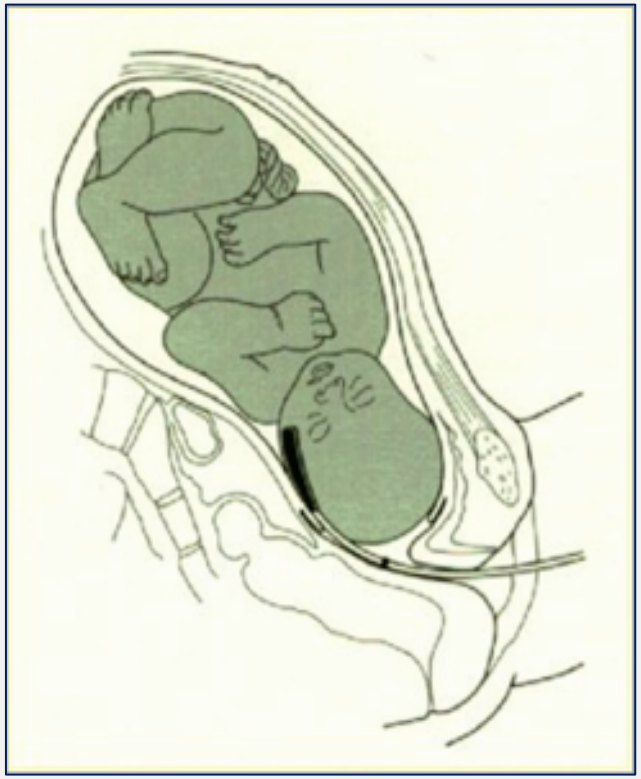
- 0,62 pour tracé N
- 0,42 pour tracé suspects
- 0,25 pour tracé pathologique

Kappa index

- 0,79 pour tracé N
- 014 pour tracé suspects
- 0,38 pour tracé pathologique

TECHNIQUES DE 2ÈME LIGNE

pH au scalp



Oxymétrie

INTÉRÊT DU PH AU SCALP

	Intermittent auscultation $n = 232$	CTG only $n = 233$	CTG with FBS for pH $n = 230$
Vaginal delivery	219 (94%)	192 (83%)	204 (87%)
Operative vaginal delivery	54 (24%)	64 (28%)	54 (23%)
Caesarean delivery (total)	13 (6%)	41 (18%)	26 (11%)
Caesarean for 'foetal distress'	1 (0.4%)	16 (7%)	8 (3%)

NS

CTG: cardiotocography; FBS: foetal blood sampling.

Haverkamp AD. Am J Obstet Gynecol 1979; 134: 399

Fetal Scalp Blood Sampling in Labor: A Review

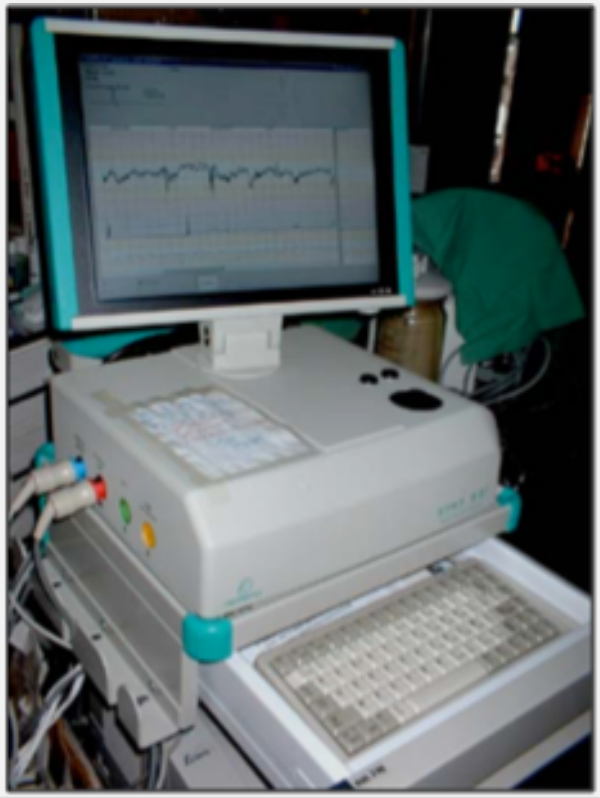
Jan S. Jørgensen, and Tom Weber

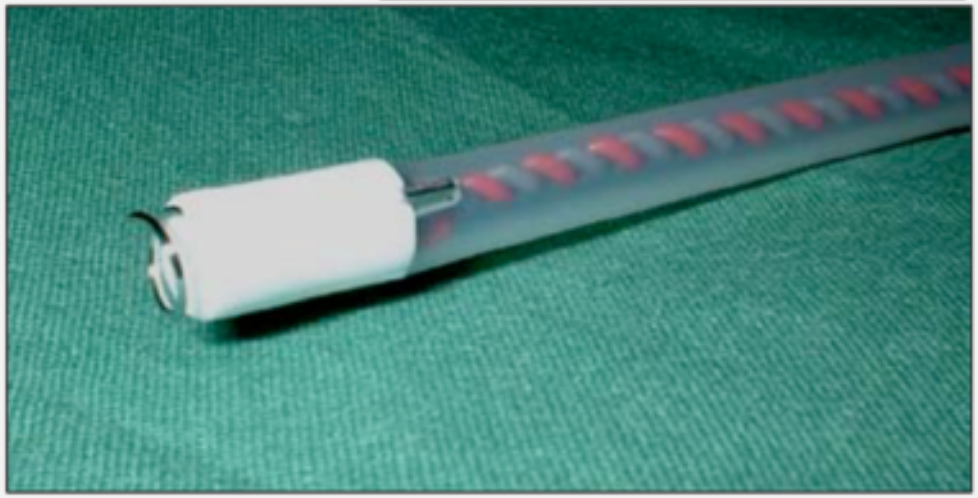
Department of Gynecology and Obstetrics, Odense University Hospital, University of Southern Denmark, Institute of Clinical Research, Perinatal Research Unit, Odense (J.S.J.); and Department of Gynecology and Obstetrics, Hvidovre Hospital, University of Copenhagen, Hvidovre, Denmark (T.W.)

Acta Obstet Gynecol Scand 2014;93:548–555

- Plan physio-pathologique : prélèvement périphérique - vasoconstriction
- Nécessite :
  - Matériel et équipe entrainée
  - 3 cm de dilatation et membranes rompues
- Indiqué si RCF suspect ou patho (pas si très grave)
- Absence d'étude randomisée démontrant son bénéfice sur le plan des interventions et sur le plan fœtal

STAN





The NEW ENGLAND JOURNAL of MEDICINE

A Randomized Trial of Intrapartum Fetal ECG ST-Segment Analysis

Michael A. Belfort, M.B., B.Ch., M.D., Ph.D., George R. Saade, M.D.,
for the Eunice Kennedy Shriver National Institute of Child Health
and Human Development Maternal–Fetal Medicine Units Network*

N Engl J Med 2015;373:632-41.
DOI: 10.1056/NEJMoa1500600

ETUDE STAN AMÉRICAINE

Le. Critère de jugement principal était un critère composite :

- Mort intra-partum ou néonatale,
- Score d'Apgar score à 5 mn ≤ 3, convulsions,
- pH art ≤ 7,05 et BE ≥ 12 mmol/L
- intubation pour ventilation à l'accouchement,
- Ou encephalopathie néonatale

Outcome	Open Group (N=5532)	Masked Group (N=5576)	Relative Risk (95% CI)	P Value
	no. (%)			
Primary composite outcome†	52 (0.94)	40 (0.72)	1.31 (0.87–1.98)	0.20
Intrapartum fetal death	0	0		
Neonatal death	3 (0.05)	1 (0.02)	3.02 (0.31–29.1)	0.37
Apgar score ≤3 at 5 min	17 (0.31)	6 (0.11)	2.86 (1.13–7.24)	0.02
Neonatal seizure	3 (0.05)	4 (0.07)	0.76 (0.17–3.38)	1.0
Umbilical-artery blood pH ≤7.05 and base deficit in extracellular fluid ≥12 mmol/liter‡	3 (0.06)	8 (0.15)	0.37 (0.10–1.41)	0.13
Intubation for ventilation at delivery	42 (0.76)	27 (0.48)	1.57 (0.97–2.54)	0.07
Neonatal encephalopathy	4 (0.07)	5 (0.09)	0.81 (0.22–3.00)	1.0

ETUDE STAN AMÉRICAINE

Outcome	Open Group (N=5532)	Masked Group (N=5576)	P Value
Maternal			
Delivery method — no. (%)			0.17
Spontaneous	4269 (77.2)	4348 (78.0)	
Forceps	128 (2.3)	103 (1.8)	
Vacuum-assisted	201 (3.6)	224 (4.0)	
Cesarean	934 (16.9)	901 (16.2)	
Indication for cesarean delivery — no./total no. (%)			0.45†
Fetal indication‡	287/934 (30.7)	298/901 (33.1)	
Dystocia	621/934 (66.5)	583/901 (64.7)	
Other	26/934 (2.8)	20/901 (2.2)	
Indication for forceps or vacuum-assisted delivery — no./total no. (%)			0.94†
Fetal indication‡	225/329 (68.4)	218/327 (66.7)	
Dystocia	95/329 (28.9)	101/327 (30.9)	
Other	9/329 (2.7)	8/327 (2.4)	
Duration of labor after randomization — hr			
Median	3.8	3.9	0.32
Interquartile range	2.1–6.4	2.2–6.7	

AOGS
Acta Obstetricia et Gynecologica Scandinavica

AOGS REVIEW ARTICLE

ST waveform analysis versus cardiotocography alone for intrapartum fetal monitoring: a systematic review and meta-analysis of randomized trials

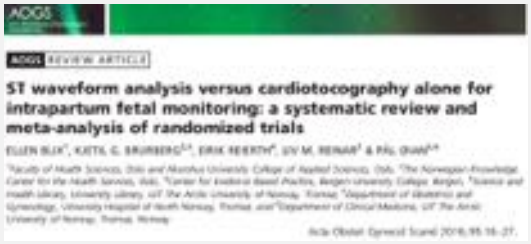
ELLEN BLIX[1], KJETIL G. BRURBERG[2,3], EIRIK REIERTH[4], LIV M. REINAR[2] & PÅL ØIAN[5,6]

[1]Faculty of Health Sciences, Oslo and Akershus University College of Applied Sciences, Oslo, [2]The Norwegian Knowledge Center for the Health Services, Oslo, [3]Center for Evidence Based Practice, Bergen University College, Bergen, [4]Science and Health Library, University Library, UiT The Arctic University of Norway, Tromsø, [5]Department of Obstetrics and Gynecology, University Hospital of North Norway, Tromsø, and [6]Department of Clinical Medicine, UiT The Arctic University of Norway, Tromsø, Norway

Acta Obstet Gynecol Scand 2016; 95:16–27.

Outcomes	Anticipated absolute effects[a] (95% CI) Risk with CTG alone	Risk with STAN	Relative effect (95% CI)	No. of participants (studies)	Quality of the evidence (Grade)
Metabolic acidosis Cord pH < 7.05 + $BD_{(ecf)}$>12 mmol/L	7 per 1000	4 per 1000 (3–6)	OR 0.64 (0.46–0.88)	26 493 (6 RCTs)	⊕⊕⊕◯ Moderate[b,c]
Cesarean delivery for fetal distress	44 per 1000	40 per 1000 (34–49)	RR 0.93 (0.78–1.12)	26 446 (6 RCTs)	⊕⊕⊕⊕ High[d]
Operative vaginal delivery for fetal distress	55 per 1000	47 per 1000 (40–56)	RR 0.87 (0.74–1.03)	26 446 (6 RCTs)	⊕⊕⊕⊕ High[d]
Neonatal and perinatal death	0 per 1000	1 per 1000 (0–2)	OR 1.79 (0.69–4.64)	26 446 (6 RCTs)	⊕⊕⊕◯ Moderate[e]
Neonatal seizures	1 per 1000	1 per 1000 (0–2)	OR 0.58 (0.18–1.90)	13 343 (3 RCTs)	⊕⊕⊕◯ Moderate[e]
Apgar score <7 at 5 min	14 per 1000	13 per 1000 (10–18)	RR 0.95 (0.73–1.25)	15 303 (5 RCTs)	⊕⊕⊕◯ Moderate[f]

[a]Calculations based on mean incidence in study populations
[b]A surrogate estimate with questionable clinical importance. Choose not to downgrade
[c]Both estimate and the conclusion of TSA unstable with regard to choice of analytic methods (e.g. fixed vs. random model)
[d]Optimal information size (OIS) achieved. RRR probably less than 20%
[e]Current information size much lower than OIS for detecting a 50% reduction with 80% certainty
[f]Wide confidence intervals – imprecise data.


AOGS REVIEW ARTICLE

ST waveform analysis versus cardiotocography alone for intrapartum fetal monitoring: a systematic review and meta-analysis of randomized trials

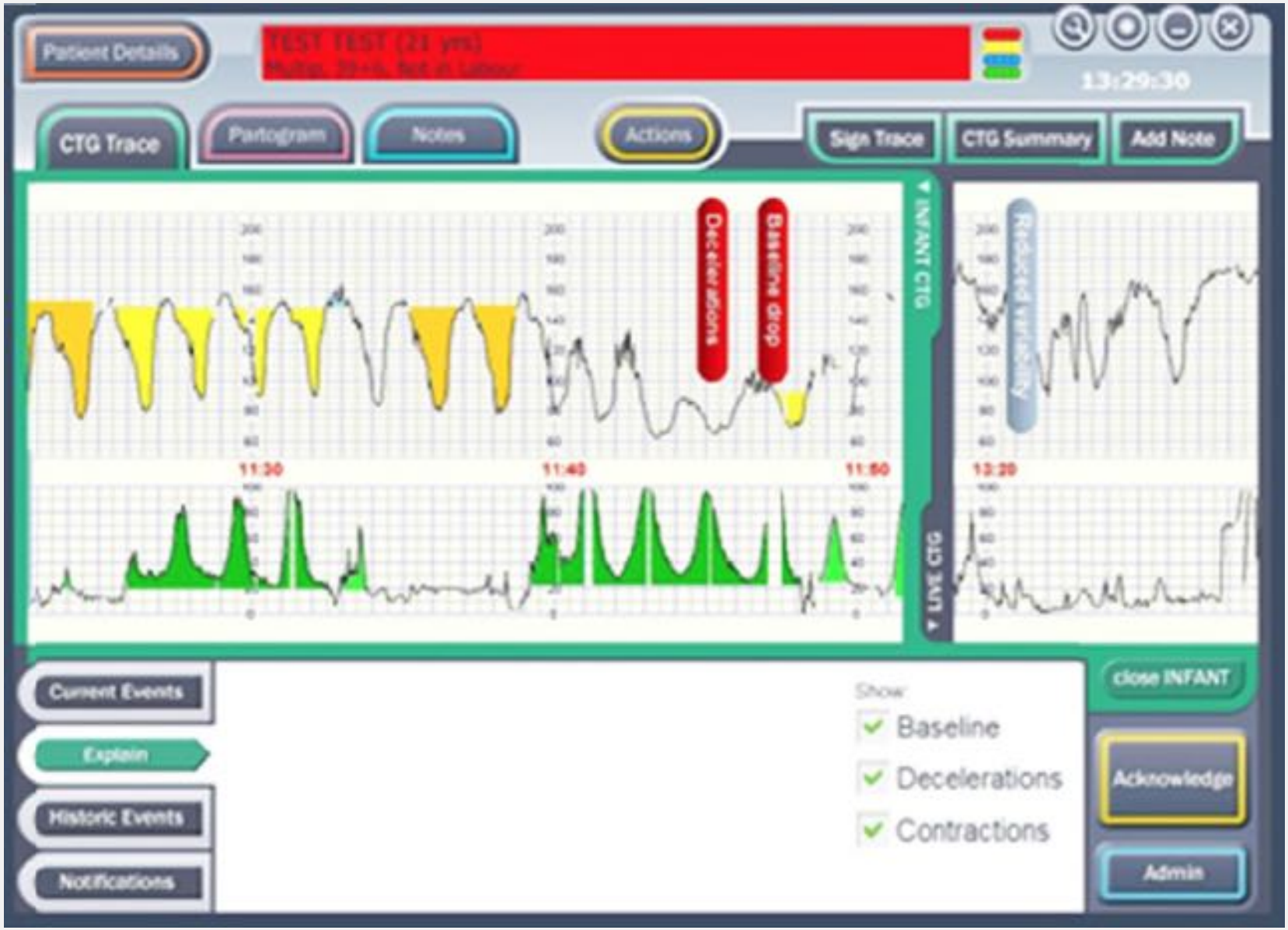
PLAN

- La surveillance fœtale per-partum jusqu'à il y a quelques années
- La nouvelle surveillance depuis quelques années
- La surveillance du futur

Systèmes d'analyse informatisée étudiés

System	Display of other Data	Real-time alerts	FHR guidelines
IntelliSpace Perinatal® (Philips Healthcare®, Eindhoven, the Netherlands)	Maternal vital signs, electronic partogram, ST events	Fetal tachycardia, bradycardia, signal loss, abnormal variability, decelerations	NICHHD
Omniview-SisPorto® (Speculum®, Lisbon, Portugal)	Maternal vital signs, electronic partogram, foetal oxymetry, ST events	Combined CTG + ST colour-coded alerts: blue, yellow, orange and red	FIGO and STAN
PeriCALM™ (LMS Medical systems, Montreal, Canada and PeriGen, Princeton, USA)	Maternal vital signs, electronic partogram	Colour-coded FHR alerts: blue, yellow, orange and red	NICHHD
INFANT® (K2 Medical Systems™, Plymouth, UK)	Maternal vital signs, electronic partogram, FBS	Colour-coded FHR alerts: blue, yellow and red	–
Trium CTG Online® (Trium Analysis Online GmbH, Munich, Germany)		Baseline changes, reduced variability, decelerations and signal loss	FIGO

Système Infant



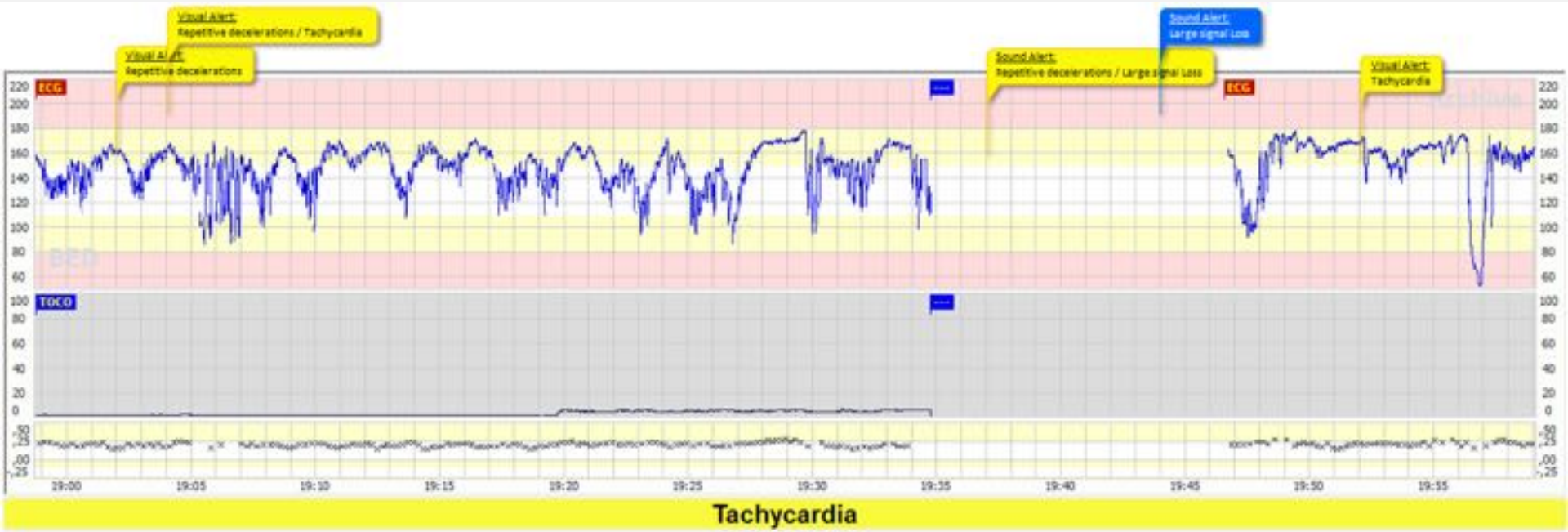
Système SisPorto

Système SisPorto

Cas 1

Système SisPorto

Cas 1



Tachycardia

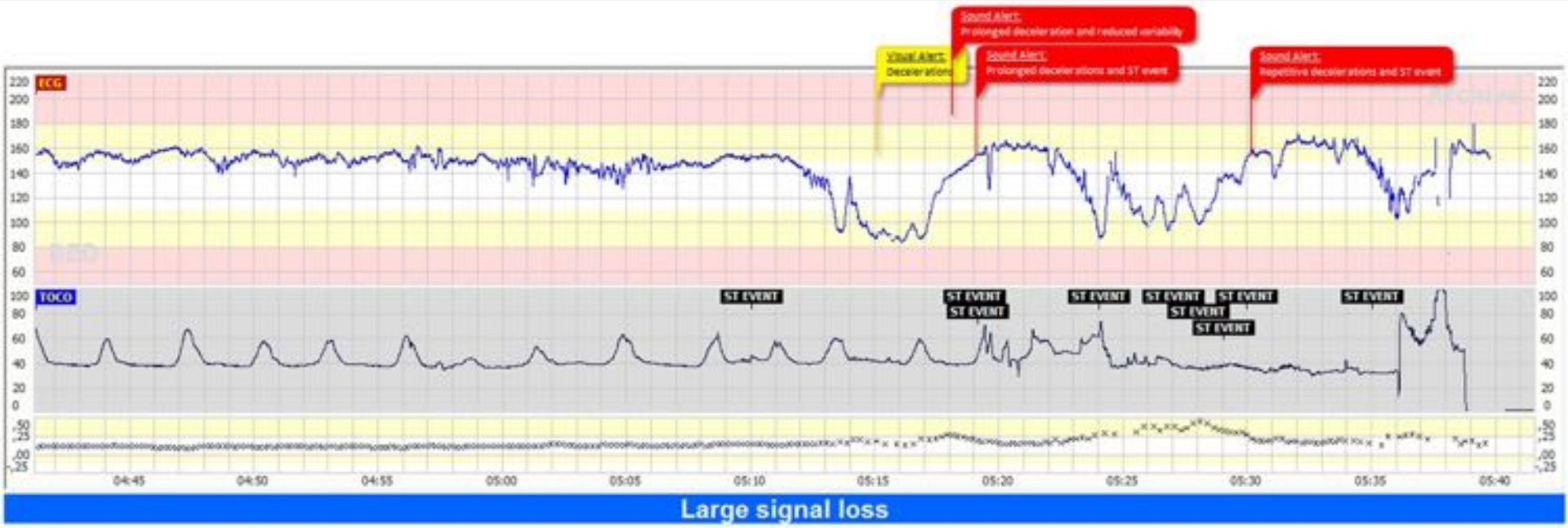
Gestational weeks:	41	Minutes to birth:	13	Apgar 1 min:	9	Artery pH:	7,25
Parity:	Primiparous	Delivery:	CS epidural/spinal	Apgar 5 min:	10	Vein pH:	7,36
Induced:	No	Weight:	3530	Apgar 10 min:	10	Cord art BDecf, mmol/l:	-0,7
Conditions:		Sex:	Female			Neonatal surveillance:	No

Système SisPorto

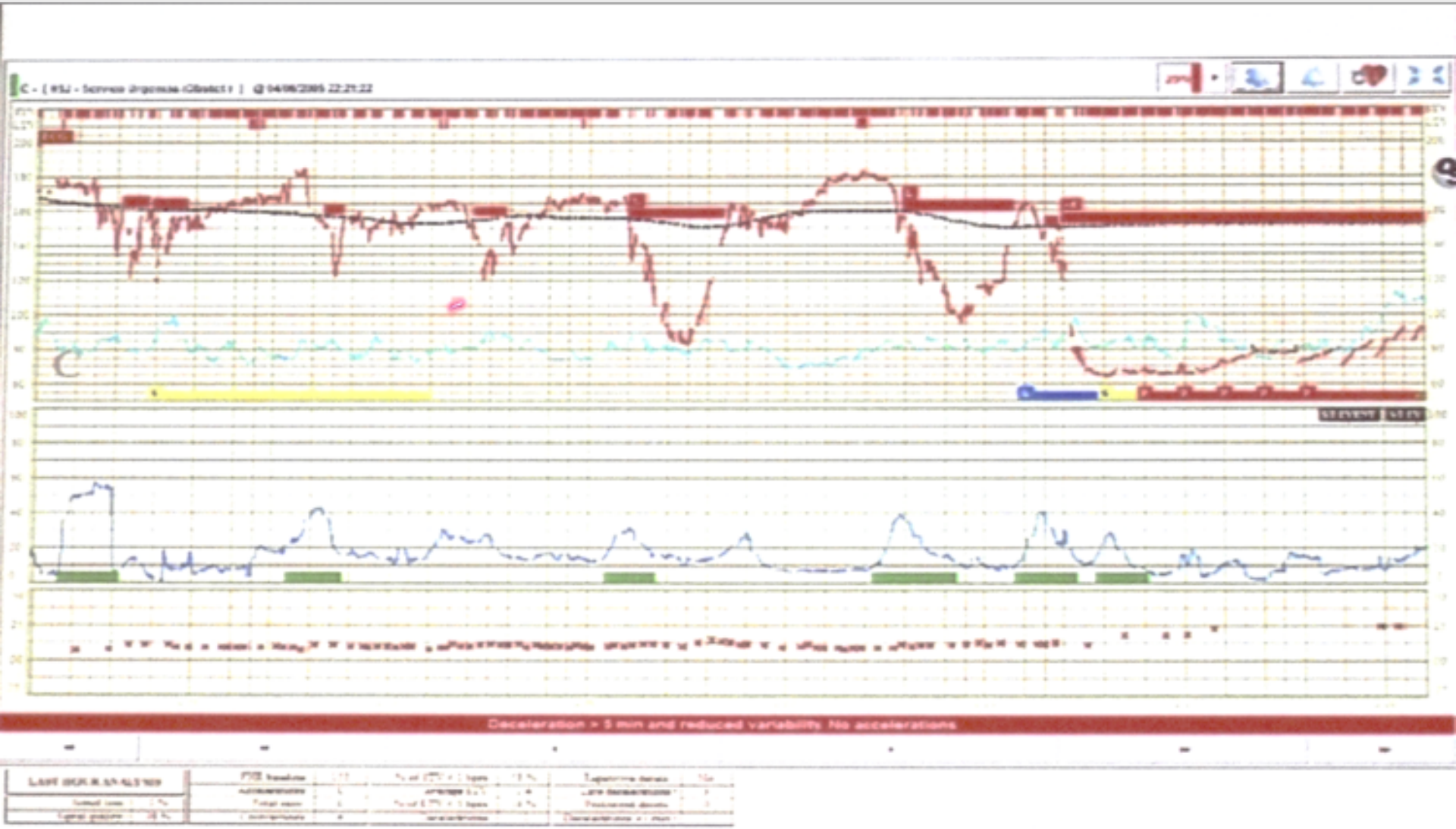
Cas 2

Système SisPorto

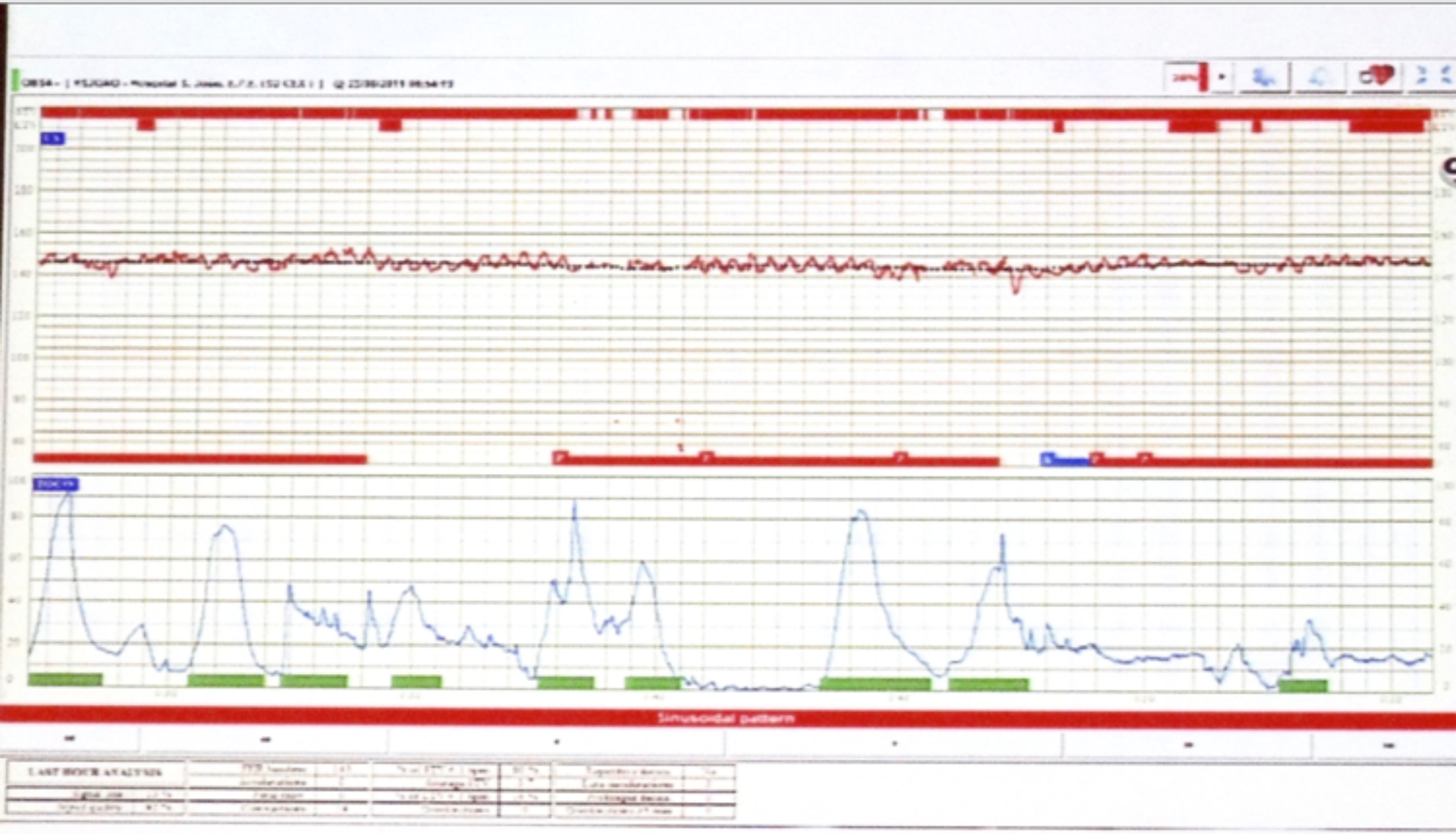
Cas 2



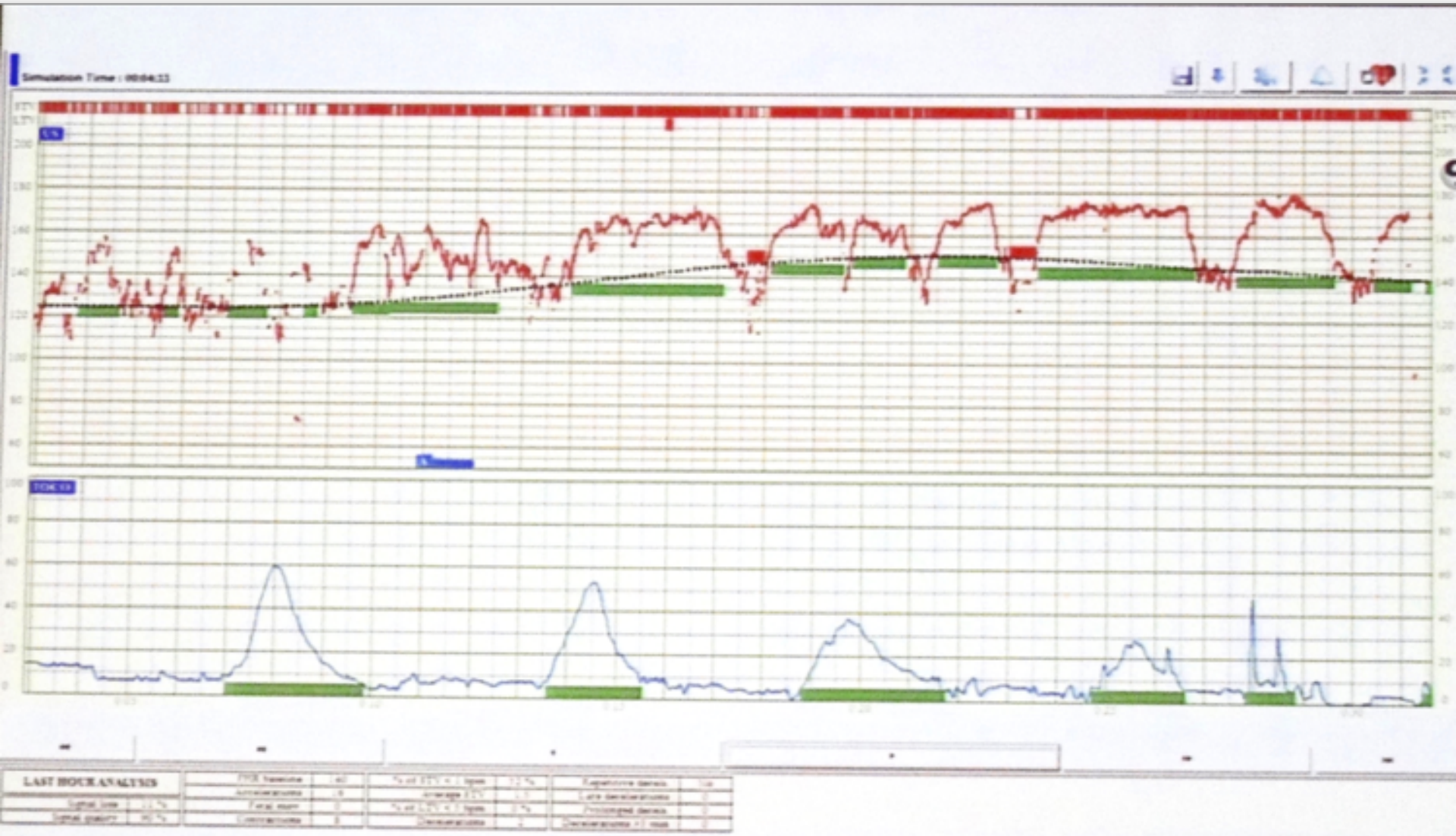
Gestational weeks:	39	Minutes to birth:	10	Apgar 1 min:	1	Artery pH:	6,93
Parity:	Nulliparous	Delivery:	CS gen anaest	Apgar 5 min:	4	Vein pH:	7,12
Induced:	No	Weight:	3800	Apgar 10 min:	0	Cord art BDecf, mmol/l:	12,4
Conditions:		Sex:	Male			Neonatal surveillance:	Yes

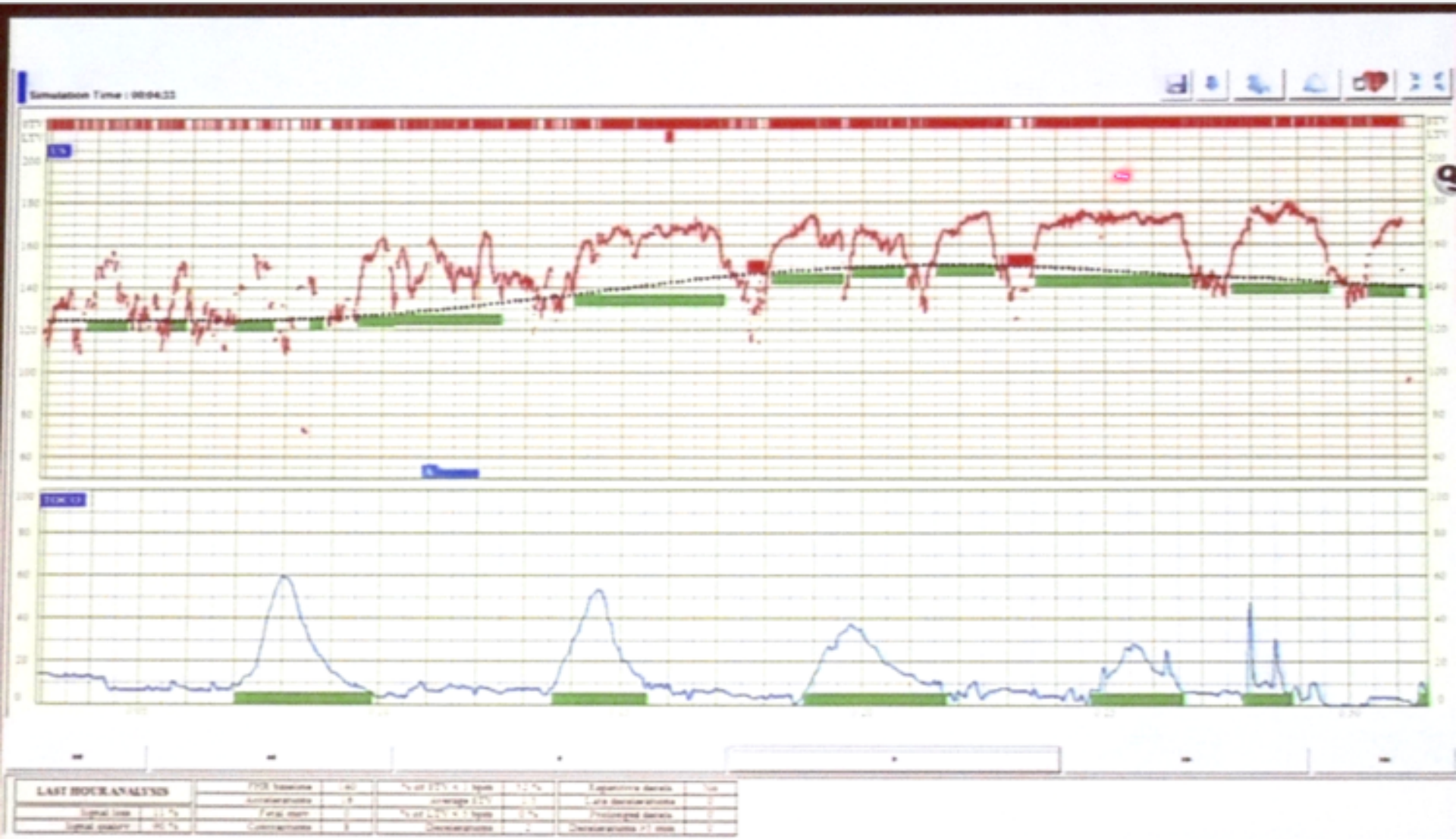


Deceleration > 5 min and reduced variability



Sinusoidal pattern


Simulation Time : 00:04:33
LAST HOUR ANALYSIS



Normal

ECG
Archive

	Comparison with experts	Validity study	RCT
OB TraceVue®	Yes	-	-
SisPorto®	Yes	Yes	Finished
PeriCALM™	Yes	Yes	-
INFANT®	Yes	-	Finished
Trium CTG online®	-	Yes	-

Central Fetal Monitoring With and Without Computer Analysis

A Randomized Controlled Trial

*Inês Nunes, MD, Diogo Ayres-de-Campos, MD, PhD, Austin Ugwumadu, MD, PhD, Pina Amin, MD, Philip Banfield, MD, Antony Nicoll, MD, Simon Cunningham, MD, Paulo Sousa, B Eng, Cristina Costa-Santos, MSc, PhD, and João Bernardes, MD, PhD, for the Fetal Monitoring and Alert (FM-ALERT) Study Group**

OBSTETRICS & GYNECOLOGY 83 VOL. 129, NO. 1, JANUARY 2017

Etude multicentrique randomisée ayant inclus 7730 grossesses uniques, céphalique, > 36 SA, bas et haut risque

Groupe étude : Système Omniview – SisPorto comprend des alertes couleur (jaune, orange, rouge selon gravité) + analyse du RCF + analyse segment ST + pH au scalp si nécessaire

Groupe témoin : RCF + analyse segment ST + pH au scalp si nécessaire

	Experimental Arm (n=3,957)	Control Arm (n=3,759)	Total (N=7,716)
Baseline characteristics			
Maternal age (y)	28±6	29±6	28±6
Maternal height (cm)	164±9	163±11	163±10
Last maternal weight (kg)	75±19	75±19	75±19
No. of previous pregnancies			
0	1,864 (47)	1,784 (48)	3,648 (47)
1	1,053 (27)	995 (26)	2,048 (27)
2	517 (13)	500 (13)	1,017 (13)
3 or more	523 (13)	480 (13)	1,002 (13)
3rd-trimester GBS carrier status			
Negative	267 (7)	234 (6)	501 (7)
Positive	120 (3)	109 (3)	229 (3)
Undetermined	3,570 (90)	3,416 (91)	6,986 (90)
Labor characteristics			
Gestational age (wk)	40±2	40±2	40±2
Beginning of labor			
Induced	2,036 (51)	1,924 (51)	3,960 (51)
Spontaneous	1,921 (49)	1,835 (49)	3,756 (49)
Augmented labor	2,225 (56)	2,129 (57)	4,354 (56)
Meconium staining during labor			
Heavy or with particles	315 (8)	303 (8)	618 (8)
Light	394 (10)	366 (10)	760 (10)
None	3,248 (82)	3,090 (82)	6,338 (82)
Intrapartum bleeding	137 (3)	115 (3)	252 (3)

Central Fetal Monitoring With and Without Computer Analysis

A Randomized Controlled Trial

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Primary and Secondary Outcomes	Experimental Arm (n=3,961)	Control Arm (n=3,769)	RR (95% CI)	Homogeneity Test* (*P*)
Metabolic acidosis	16 (0.404)	22 (0.583)	0.69 (0.36–1.31)	.424
Umbilical blood pH less than 7.10†	152 (3.8)	158 (4.2)	0.91 (0.74–1.14)	.793
Umbilical blood pH less than 7.15†	367 (9.3)	372 (9.9)	0.94 (0.82–1.08)	.905
Umbilical blood gas data	3,464 (87.5)	3,248 (86.2)	0.91 (0.81–1.02)	.372
5-min Apgar less than 7‡	47 (1.2)	52 (1.4)	0.86 (0.58–1.28)	.434
Perinatal death	1 (0.025)	0 (0.000)	2.85 (0.12–70.06)	—
HIE of any grade	7 (0.177)	8 (0.212)	0.83 (0.30–2.29)	—
Grade 2 or 3 HIE	5 (0.126)	1 (0.027)	4.76 (0.56–40.70)	.219
Cesarean delivery	809 (20.4)	772 (20.5)	1.00 (0.91–1.09)	.525
Cesarean delivery for NRFS	258 (6.3)	239 (6.3)	1.03 (0.87–1.22)	.476
FBS during labor	240 (6.1)	210 (5.6)	1.09 (0.91–1.30)	.205
ST analysis during labor§	2,763 (70)	2,584 (69)	1.02 (0.99–1.05)	.364
Signal quality§	95.54 (0–99.95)	95.38 (0–99.98)	0.104‖	—

Central Fetal Monitoring With and Without Computer Analysis

A Randomized Controlled Trial

*Inês Nunes, MD, Diogo Ayres-de-Campos, MD, PhD, Austin Ugwumadu, MB, BSc, Pina Amin, MD, Philip Banfield, MD, Antony Nicoll, MD, Simon Cunningham, MD, Paulo Souza, BEng, Cristina Costa-Santos, MSc, PhD, and João Bernardes, MD, PhD, for the Fetal Monitoring and Alert (FM-ALERT) Study Group**

Computerised interpretation of fetal heart rate during labour (INFANT): a randomised controlled trial

*The INFANT Collaborative Group**

Lancet 2017 ; 389 : 1719-29

Etude multicentrique (GB et Irlande) randomisée ayant inclus 46042 grossesses uniques ou gémellaires, céphalique, > 35 SA, bas et haut risque et enregistrement continu du RCF

Groupe étude : RCF + alertes couleur (jaune, orange, rouge selon gravité) + analyse du RCF (rythme de base, haute variabilité, accélération, type et timing décélérations, qualité du signal, contractions utérines)

Groupe témoin : RCF

Computerised interpretation of fetal heart rate during labour (INFANT): a randomised controlled trial

The INFANT Collaborative Group*

Lancet 2017 ; 389 : 1719-29

	Decision support (n=23 263)	No decision support (n=23 351)	Adjusted risk ratio (CI)
Composite neonatal primary outcome			
Composite primary outcome*	172 (0·7%)	171 (0·7%)	1·01 (95% CI 0·82–1·25)
Intrapartum stillbirths†	1 (0)	2 (0)	0·50 (95% CI 0·05–5·53)
Neonatal deaths up to 28 days after birth‡	6 (0)	4 (0)	1·51 (95% CI 0·42–5·33)
Moderate or severe neonatal encephalopathy (requiring cooling)	18 (0·1%)	21 (0·1%)	0·86 (95% CI 0·46–1·61)
Admission to neonatal unit within 48 h of birth for ≥48 h because of feeding difficulties, respiratory illness or symptoms, or encephalopathy and evidence of compromise at birth	147 (0·6%)	144 (0·6%)	1·02 (95% CI 0·81–1·29)
Other neonatal outcomes			
Admission to a higher level of care	1389 (6·0%)	1429 (6·1%)	0·98 (99% CI 0·89–1·08)
Apgar score <4 at 5 min	43 (0·2%)	65 (0·3%)	0·67 (99% CI 0·40–1·11)
Cord artery pH			
<7·15	1625 (11·3%)	1695 (11·8%)	0·96 (99% CI 0·88–1·04)
<7·05	268 (1·9%)	278 (1·9%)	0·95 (99% CI 0·77–1·19)
Mean (SD)	7·24 (0·08)	7·24 (0·08)	--
Unknown	8829	8981	--
Metabolic acidosis§			
Yes	148 (1·1%)	131 (1·0%)	1·12 (99% CI 0·82–1·52)
No	13 538 (98·9%)	13 533 (99·0%)	--
Unknown	9577	9687	--

Computerised interpretation of fetal heart rate during labour (INFANT): a randomised controlled trial

The INFANT Collaborative Group*

Lancet 2017 ; 389 : 1719-29

Delivery outcomes			
Mode of delivery			
Spontaneous cephalic vaginal	11 823 (50·8%)	11 959 (51·2%)	0·99 (99% CI 0·97–1·01)
Caesarean section	5669 (24·4%)	5555 (23·8%)	..
Instrumental	5698 (24·5%)	5765 (24·7%)	..
Vaginal breech	73 (0·3%)	72 (0·3%)	..
Indications for any operative intervention (caesarean section and instrumental delivery)			
Fetal distress	4278 (18·4%)	4262 (18·3%)	1·04†† (99% CI 1·00–1·08)
Failure to progress	5059 (21·8%)	5175 (22·2%)	1·01†† (99% CI 0·97–1·05)
Fetal distress and failure to progress	1774 (7·6%)	1599 (6·9%)	..
Other reason	229 (1·0%)	247 (1·1%)	..

(Table 2 continues on next page)

Caesarean section			
Grade 1 (immediate threat to life)	1138 (4·9%)	1121 (4·8%)	1·02‡‡ (99% CI 0·92–1·13)
Grade 2 (some threat of compromise)	3754 (16·2%)	3605 (15·5%)	1·04‡‡ (99% CI 0·99–1·09)
Grade 3 (no threat of compromise)	645 (2·8%)	689 (3·0%)	1·02‡‡ (99% CI 0·98–1·07)
Grade 4 (elective)	12 (0·1%)	12 (0·1%)	..

Computerised interpretation of fetal heart rate during labour (INFANT): a randomised controlled trial

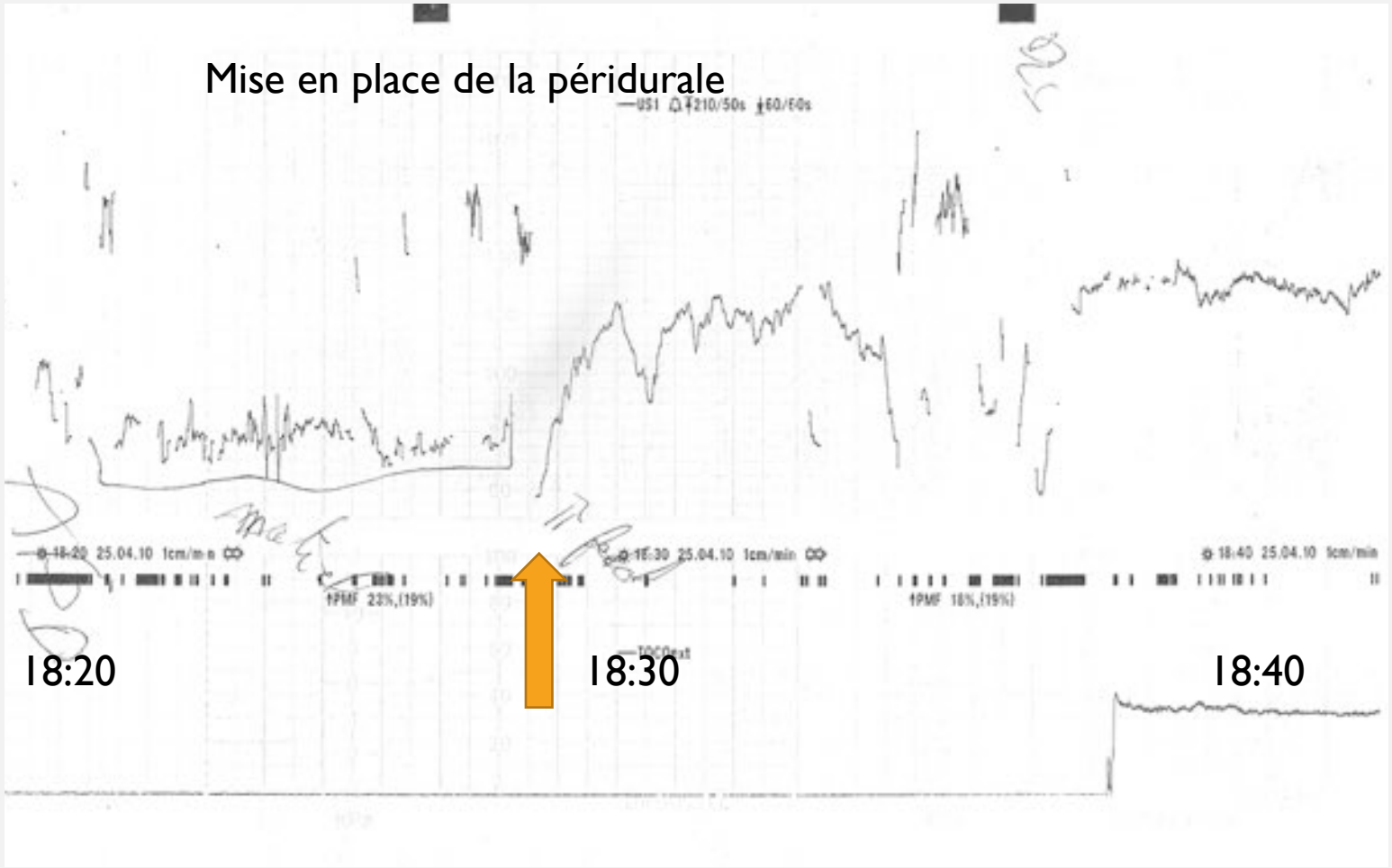
The INFANT Collaborative Group*

Lancet 2017 ; 389 : 1719-29

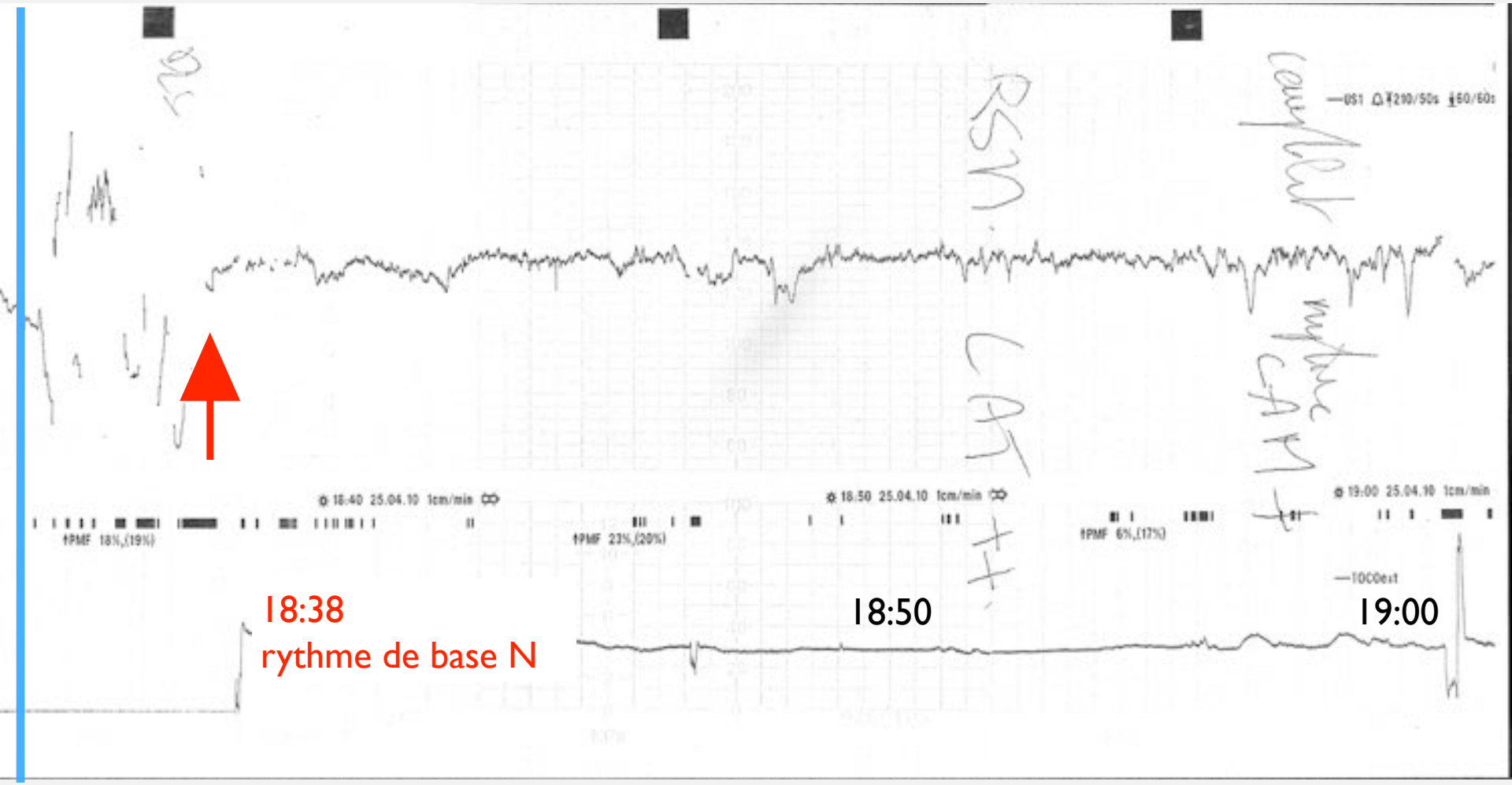
	Decision support (n=22 517)	No decision support* (n=22 564)	Adjusted effect measure (99% CI)
Time from last red level of concern to delivery (mins)			
Median	58 (13–279)	58 (13–264)	HR 0·99 (99% CI 0·92–1·06)
Unknown‡	822	823	..

ET DANS LES CAS SUIVANTS…, AURAIT-ON PU ÉVITER LE DÉCÈS ?

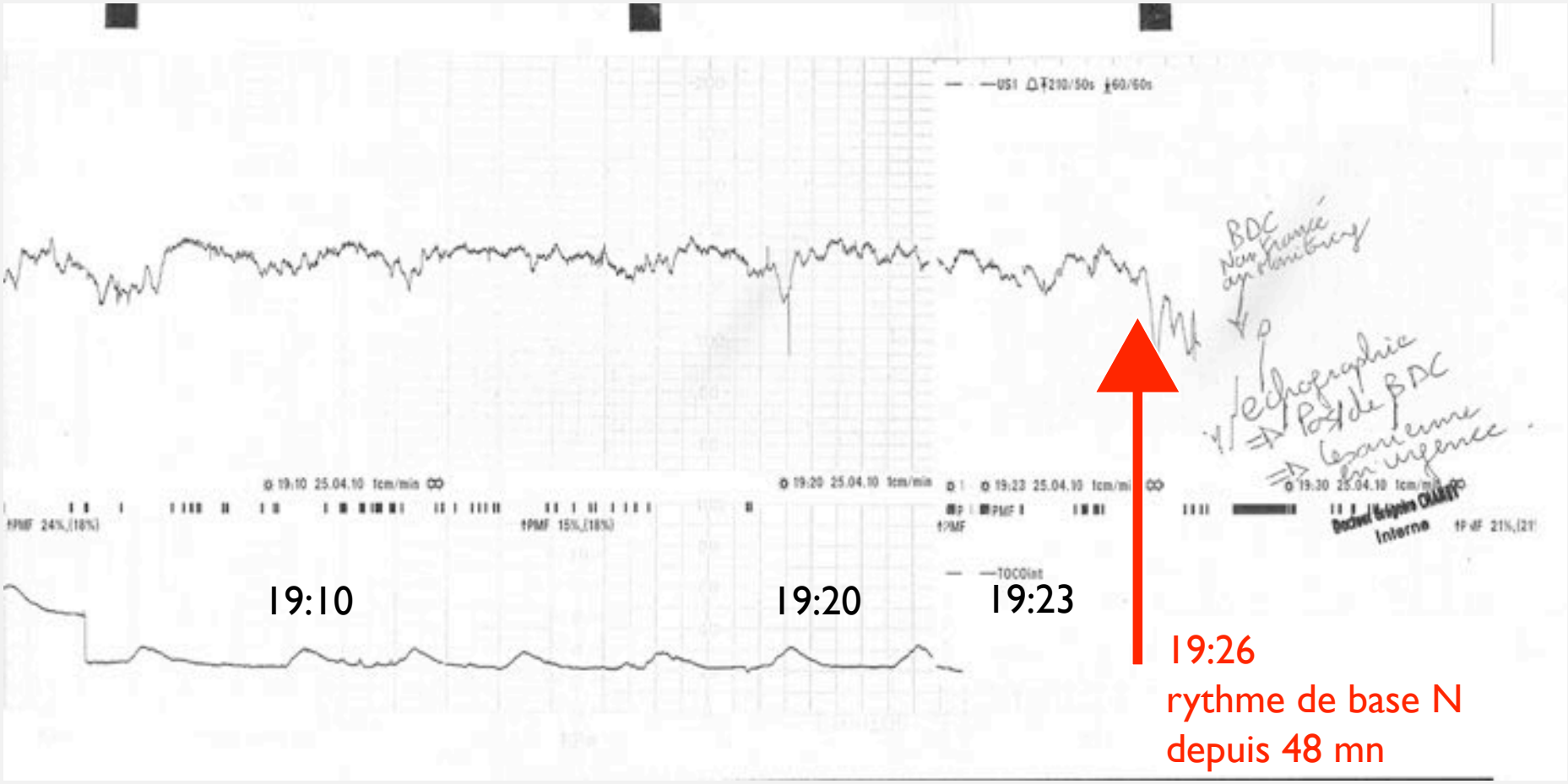
CAS 1



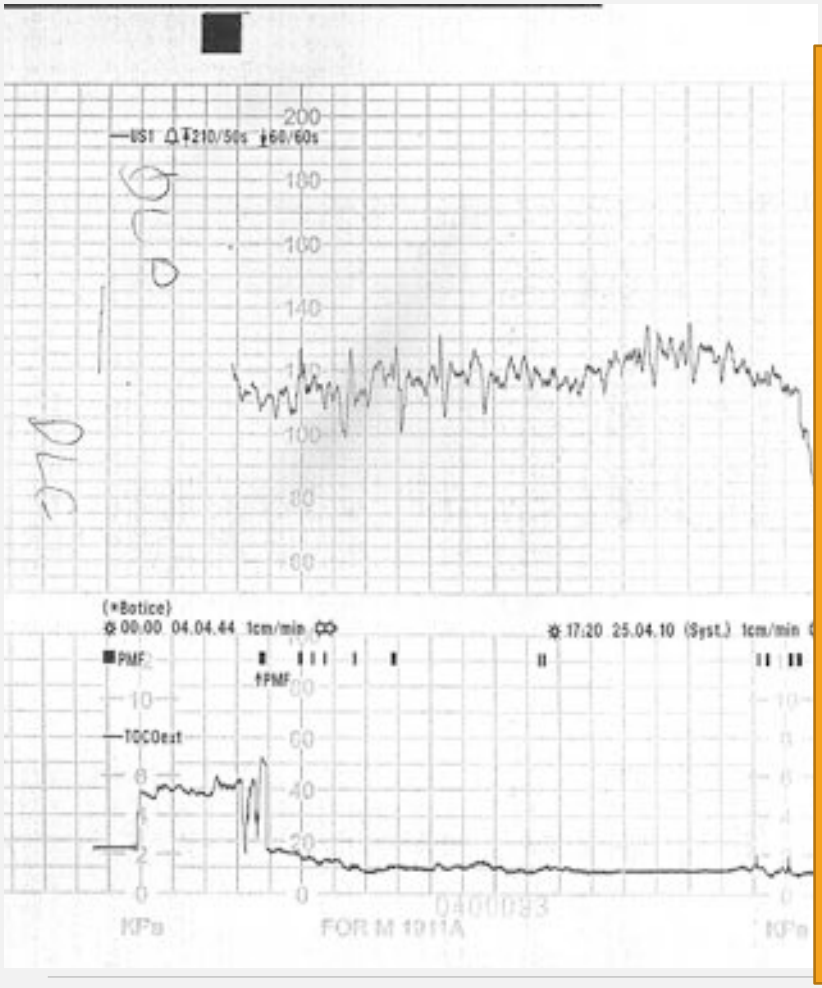
CAS 1

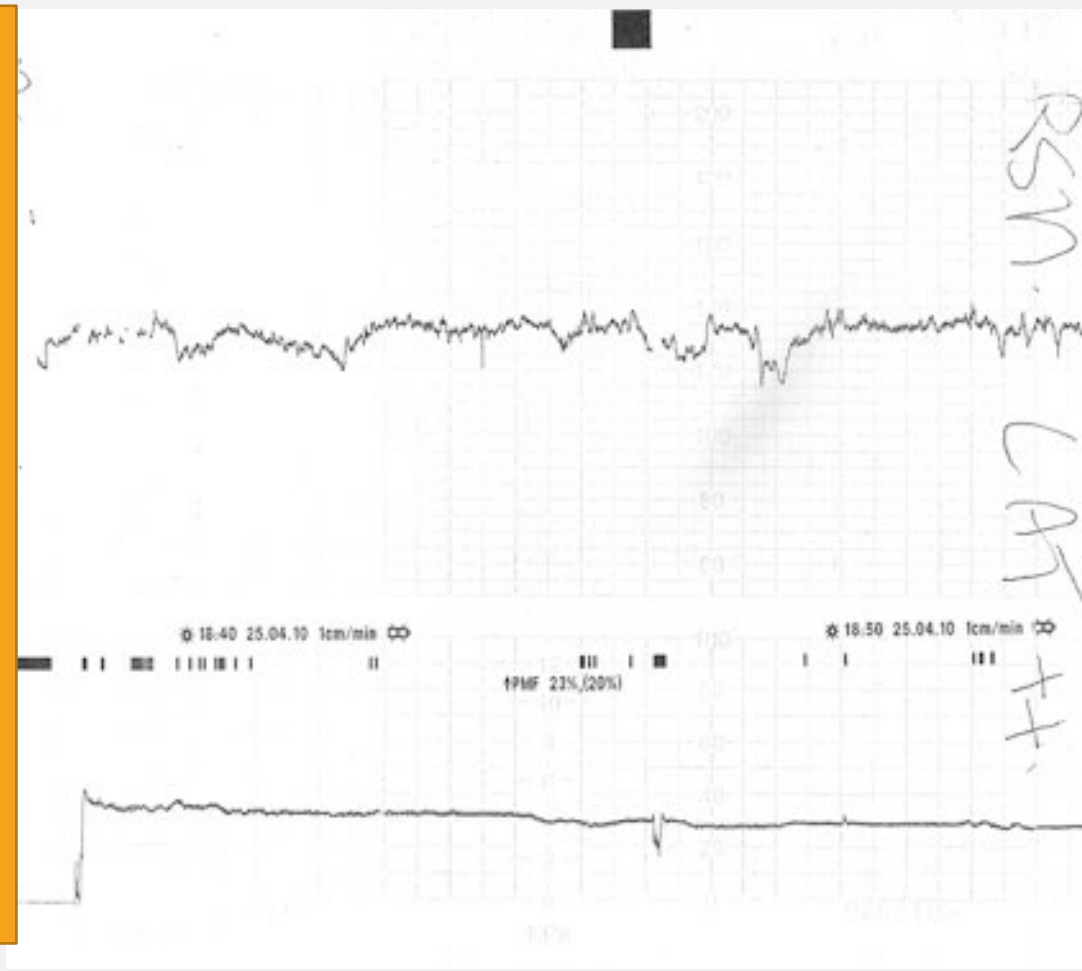


CAS 1

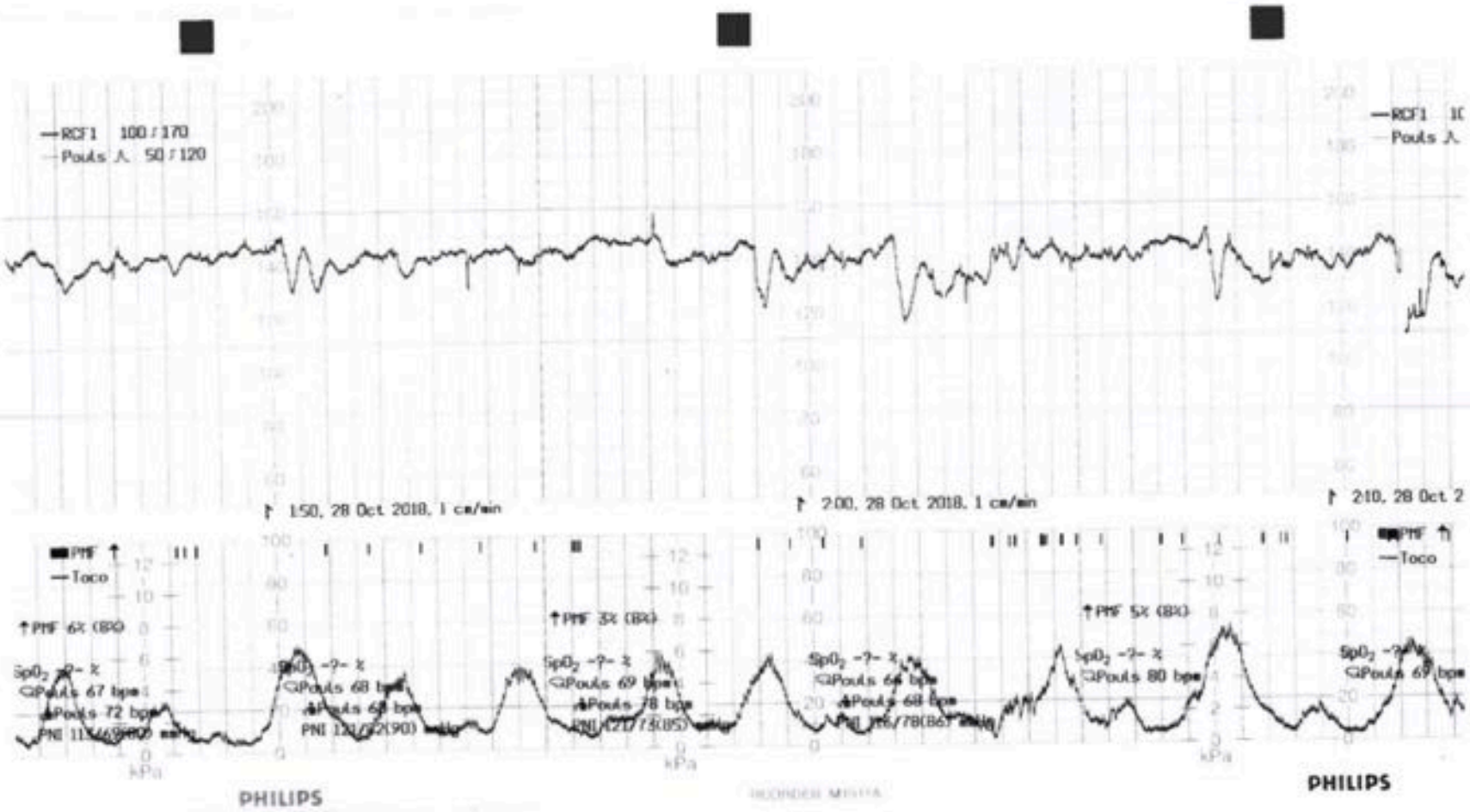


CAS 1
AVANT APRES LA POSE DE PÉRIDURALE

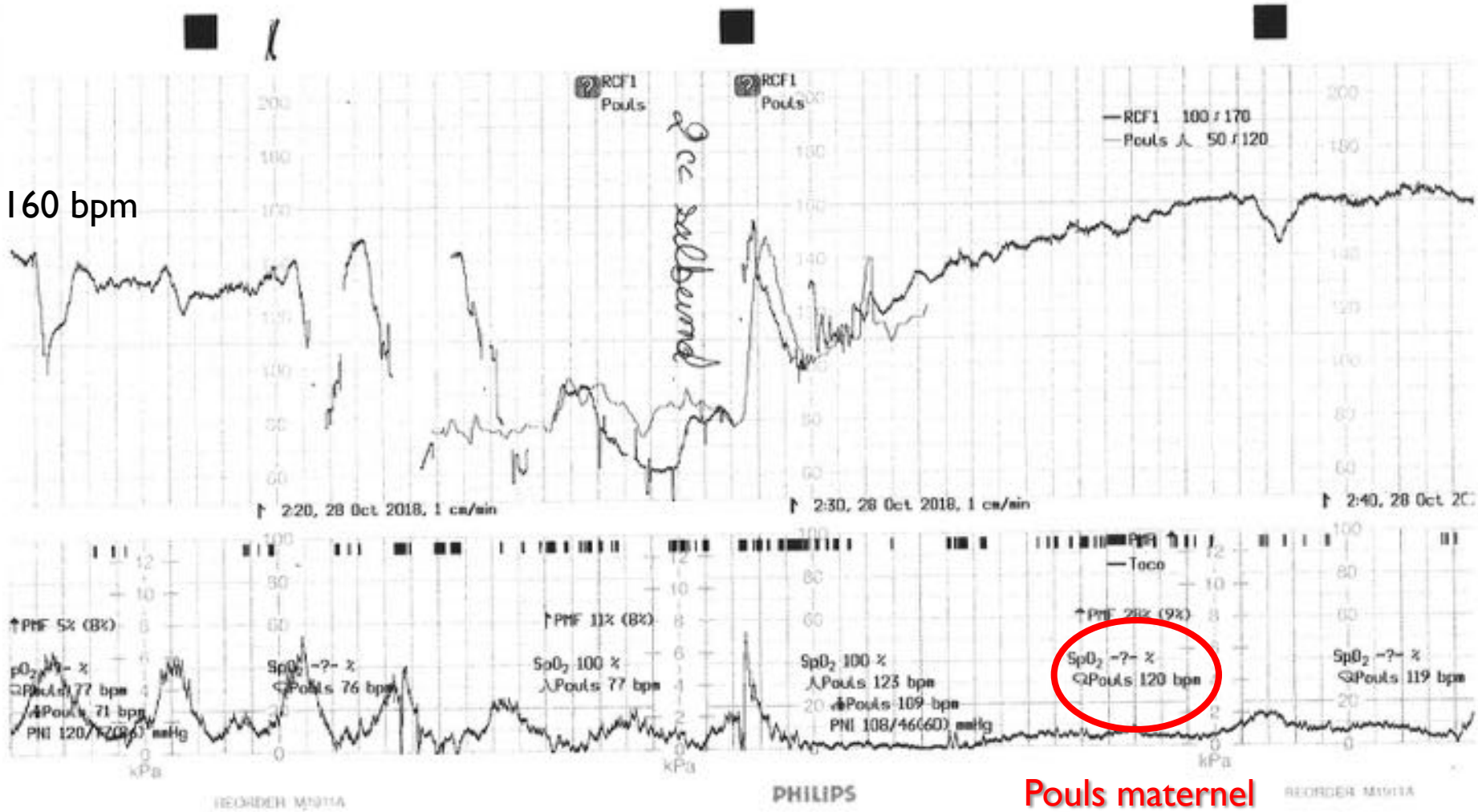




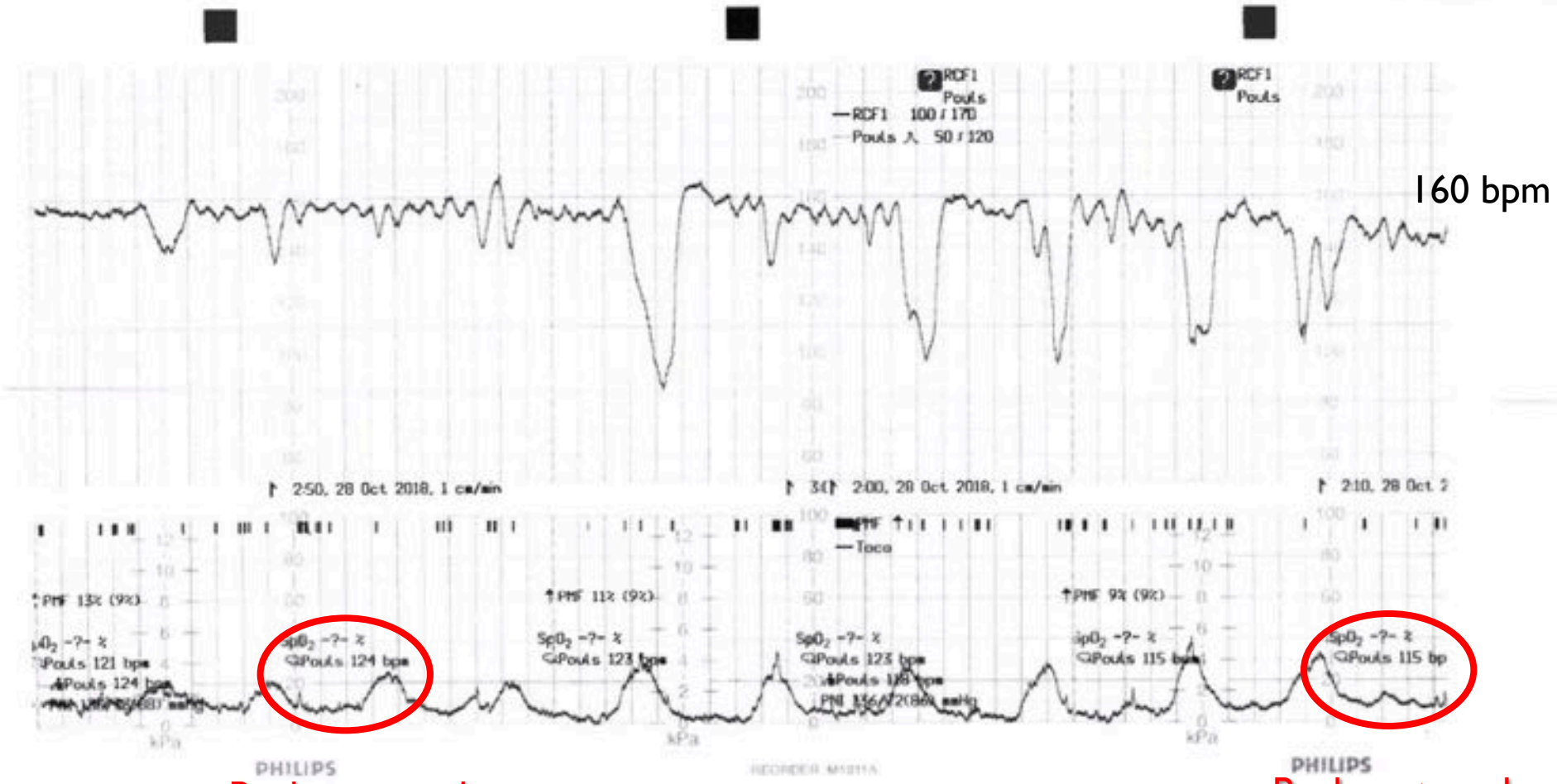
CAS 2


RCF1 100 / 170
Pouls 50 / 120
150, 28 Oct 2018, 1 cm/min
200, 28 Oct 2018, 1 cm/min
210, 28 Oct 2
PHIL
Toco
PHF 6% (BX)
PHF 3% (BX)
PHF 5% (BX)
Pouls 67 bpm
Pouls 72 bpm
Pouls 68 bpm
Pouls 69 bpm
Pouls 78 bpm
Pouls 80 bpm
Pouls 69 bpm
kPa
PHILIPS
PHILIPS

CAS 2


160 bpm
RCF1
Pouls
RCF1
Pouls
RCF1 100 / 170
Pouls 50 / 120
2:20, 28 Oct 2018, 1 cm/min
2:30, 28 Oct 2018, 1 cm/min
2:40, 28 Oct 20
Toco
PMF 5% (8%)
PMF 11% (8%)
SpO2 100 %
Pouls 77 bpm
Pouls 123 bpm
Pouls 109 bpm
PNI 108/46(60) mmHg
SpO2 -?- %
Pouls 120 bpm
SpO2 -?- %
Pouls 119 bpm
kPa
PHILIPS
Pouls maternel
120

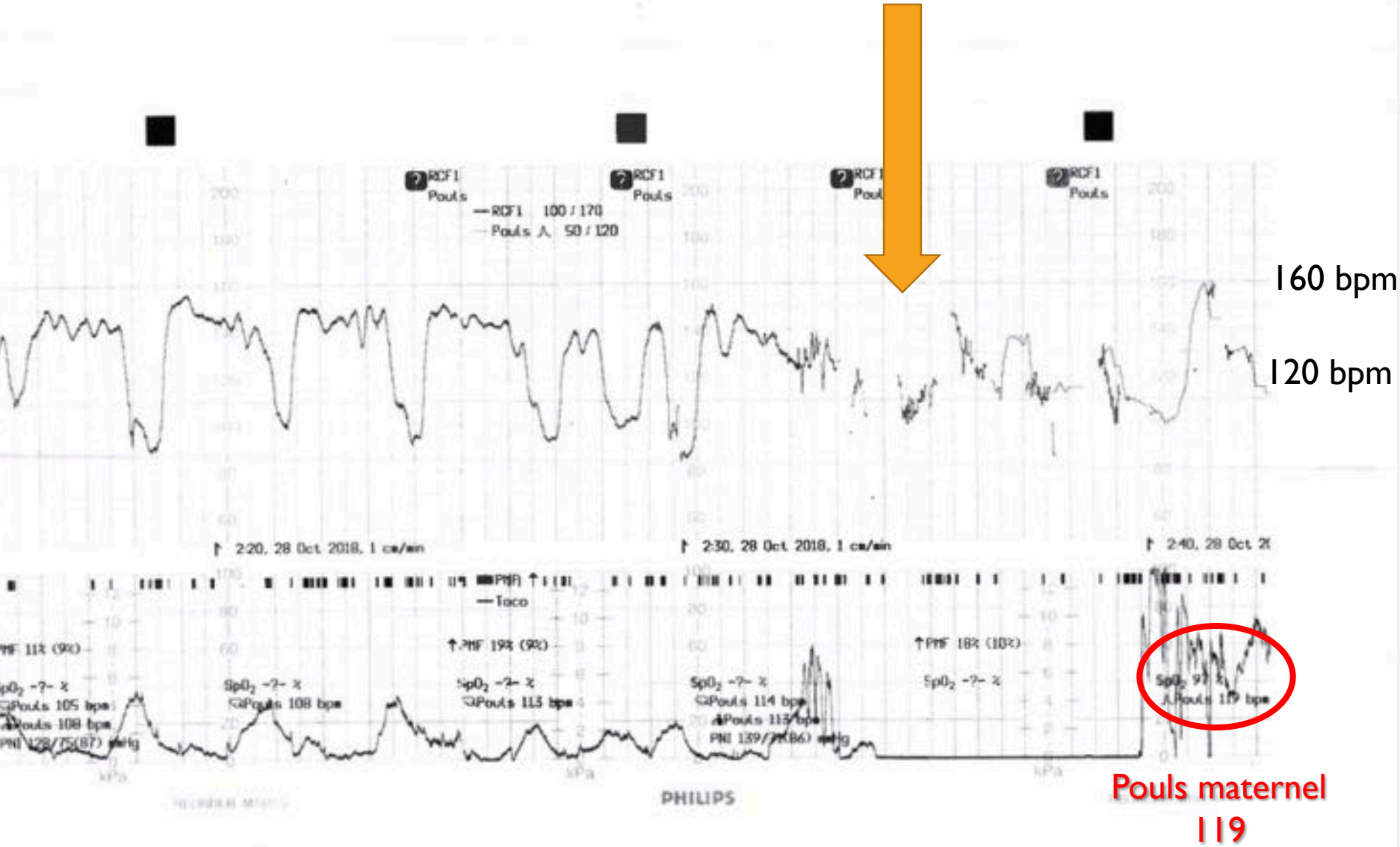
CAS 2



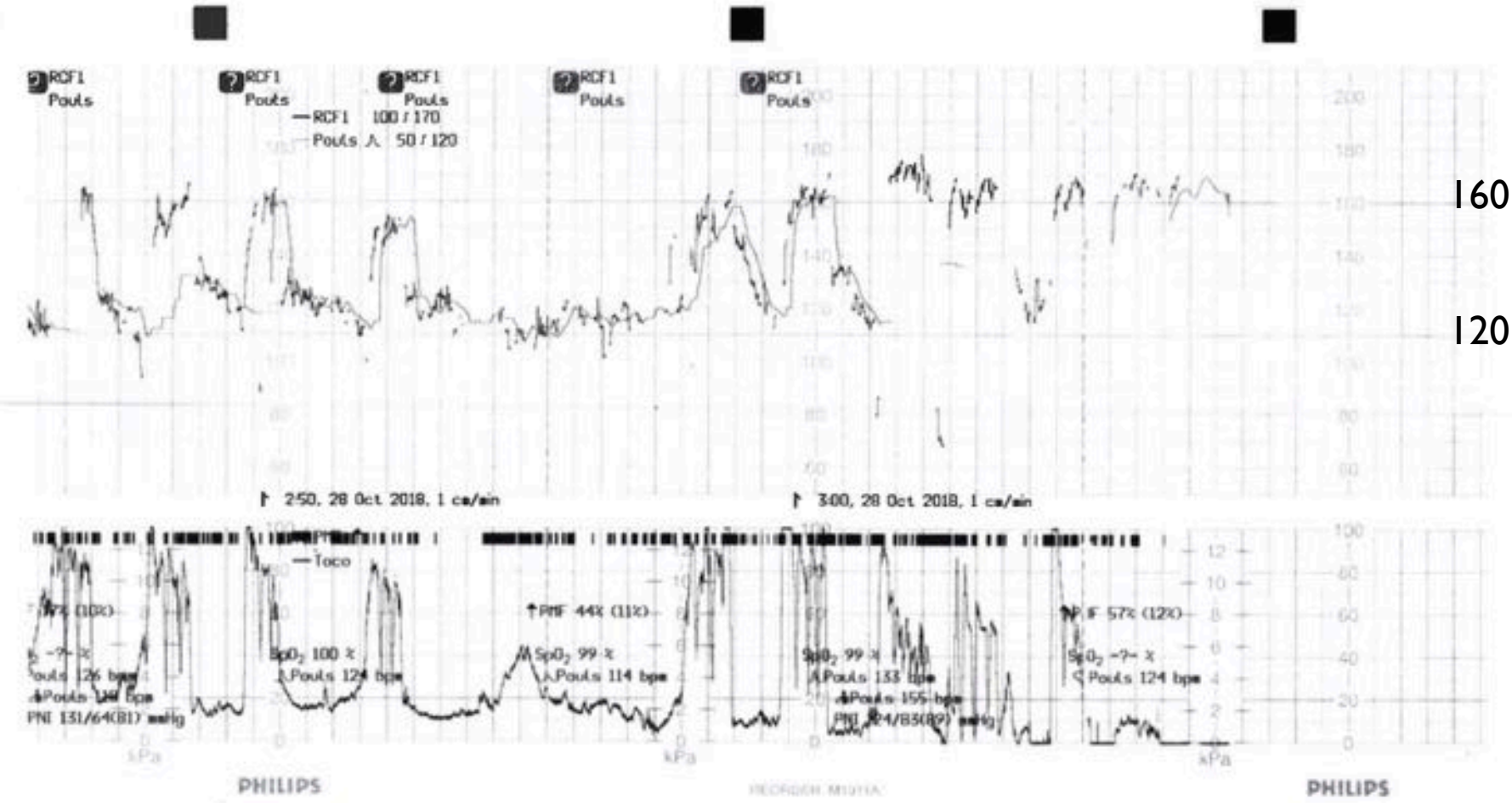
Pouls maternel
124

Pouls maternel
115

CAS 2



CAS 2



Naissance d'un garçon de 2390, Apgar 0 à 5 mn, pH art 6,95 lactates à 9
Arrêt des soins après 2 jours

LA SURVEILLANCE DU FUTUR

LE CONCEPT

Radicalement différent !

Il ne s'agit pas de programmer la Machine pour qu'elle alerte automatiquement selon des paramètres que l'Homme a fixé.

Il s'agit de programmer la Machine pour qu'elle détermine elle-même les paramètres pertinents, puis alerte en fonction.

Ce n'est plus alors l'Homme qui détient l'intelligence, mais la Machine.

« - Comment tu le trouves le tracé ?
- Il est un peu réduit quand même, non ?
- Bon allez, je fais une césarienne ! »

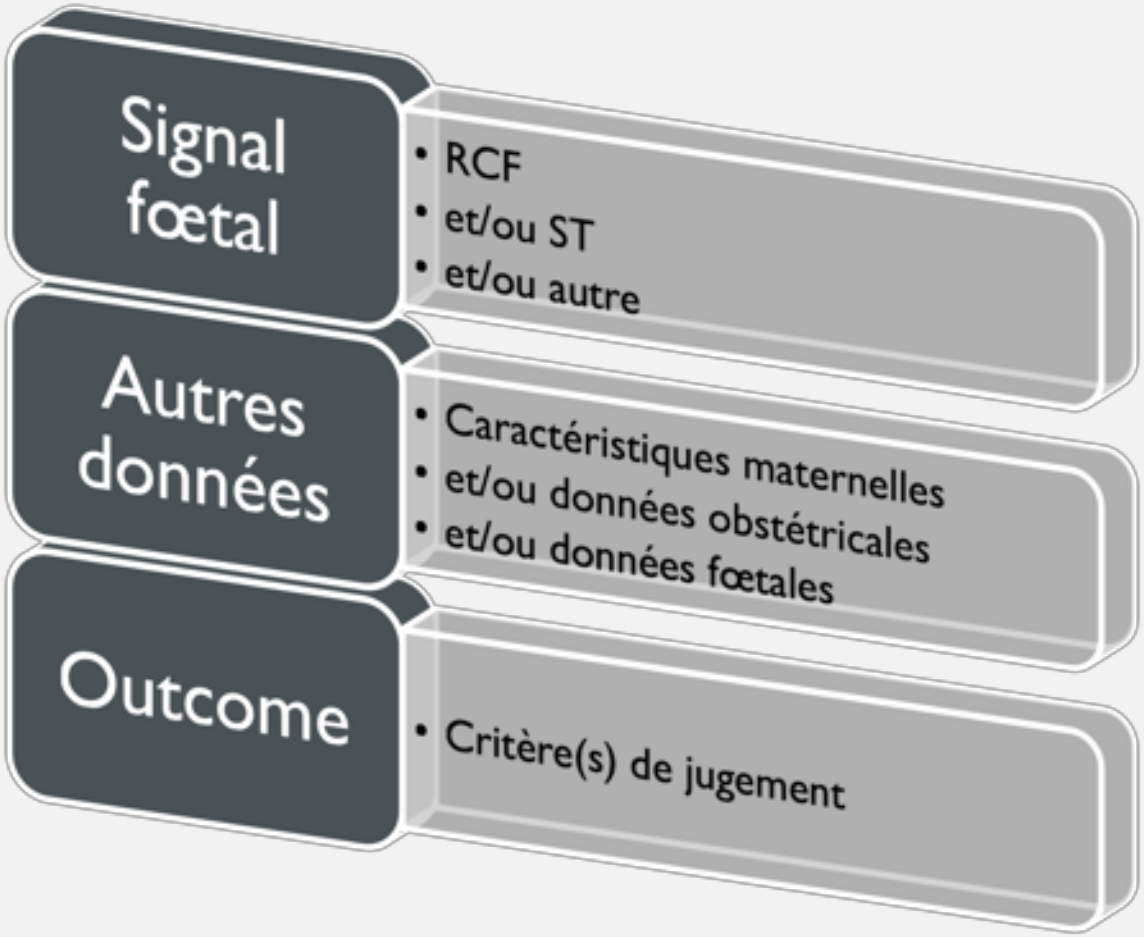
SUBJECTIF

« - La machine m'indique une VCT à 2.
- Ça veut dire que le RCF est réduit.
- Je vais faire une césarienne alors ! »

OBJECTIF

« - La machine dit qu'il faut faire une césarienne !
- Ah ouais, pourquoi ???
- Ben je ne sais pas… »
(Ce sera lié à la conjonction de nombreux paramètres)

ARTIFICIEL



L'algorithme qui prédit le critère de jugement APPREND AUTOMATIQUEMENT

↓ ↓

INTELLIGENCE ARTIFICIELLE

L'intelligence humaine, c'est interpréter un tracé…
en fonction de son expérience,
en suivant des classifications simplifiées +/- validées
et en prenant en compte certains paramètres cliniques

ART

pH 7,04 : le gynéco se couche automatiquement

ALORS que l'intelligence artificielle va interpréter un tracé…
en fonction d'une expérience basée sur plusieurs millions de tracés,
sans idée préconçue sur des patterns d'alerte
et en prenant en compte le fait que la patiente a 32,345 ans,
qu'elle a déjà accouché une fois d'un enfant de 3425g,
que l'âge gestationnel est de 40,352 SA,
que l'âge, le sexe du capitaine est de 42,534 ans, féminin
et qu'il est 2h03 du matin

SCIENCE

pH 7,04 : l'algorithme se met à jour automatiquement

CONCLUSION

- Le monitorage continu du RCF pendant le travail est un mode de surveillance très sensible, mais peu spécifique.
- Les examens de 2e ligne sont peu efficaces
- Les nouveaux appareils de surveillance avec des systèmes d'alerte n'ont pas permis d'améliorer la surveillance
- L'intelligence artificielle est un nouvel outil qui deviendra forcément incontournable
- Un des enjeux sera sans doute l'intégration de ce nouvel outil à notre pratique.

Philippe Geluck