L'EEG continu en réanimation

Gadget ou révolution ?

Présentation JARCA 2024 15/11/2024

Dr Grégoire Cane, PH Neuro – Anesthésie – Réanimation

Liens d'intérêt

- ***Laboratoires Roche :*** ***fourniture de réactifs pour une étude sur des neuro-biomarqueurs***

Introduction : à quelle onde se vouer …

Compte – Rendu EEG au chevet

底事：什么事。浑身：全身。着：穿

没有涂脂粉的养蚕妇，满脸饥色，根本不知道世上有荣华富贵。年年都说我养蚕非常辛苦，为何浑身上下没有绫罗绸缎，而只有粗布苎麻。

古人：老朋友。辞：告别。孤帆：单独的一只帆船。尽：消失。唯见：只看见。天际：天边

老朋友孟子浩然在黄鹤楼向我辞行，在这繁华以锦的三月去扬州。他乘坐的那只帆船渐渐消失在远处碧水蓝天相接的地方，只见滔滔的长江之水向天边滚滚流去

凉州：在今甘肃省西部。城：孤零零的城。万仞：形容非常高。何须：何必。度：越过。

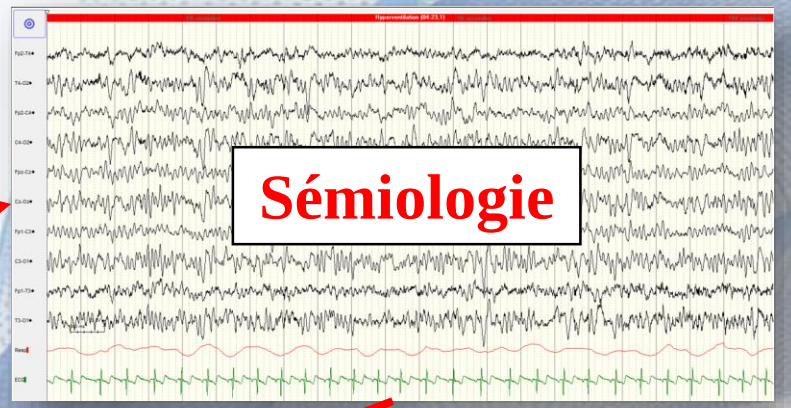
黄河奔流着，远远望去仿佛与天边的白云相接；玉门关这座塞上孤城耸立在高山峻岭之中，羌笛吹奏着感伤的《折杨柳》曲，好像在埋怨荒凉严寒的边陲春光来迟。其实这又是何必呢？因为春风是吹不到玉门关来的。

远远望去仿佛与天边的白云相接；玉门关这座塞上孤城耸立在高山峻岭之中

Conclusion :

没有涂脂粉的养蚕妇，满脸饥色，根本不知道世上有荣华富贵。 **EPILEPSIE** 年年都说我养蚕非常辛苦，为何浑身上下没有绫罗绸缎，而只有粗布苎麻。

Interprétation



Sémiologie

Accessible ou élitiste ?

Utile ou futile ?

Introduction : à quelle onde se vouer …

I. ***Accessible ou élitiste ?***

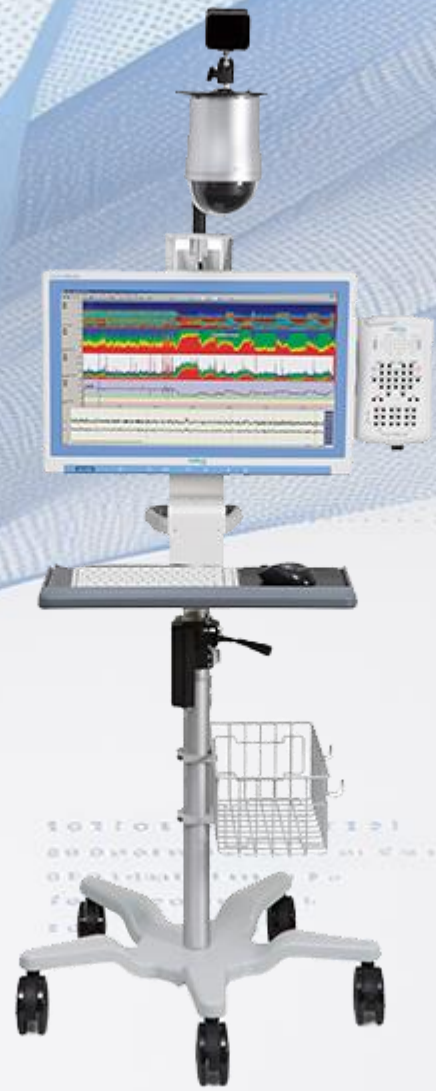
- Notions d'interprétation de l'EEG
- EEG quantifié

II. ***Utile ou futile ?***

- EEG continu et crises / états de mal non – convulsifs
- EEG continu et détection de l'ischémie cérébrale retardée

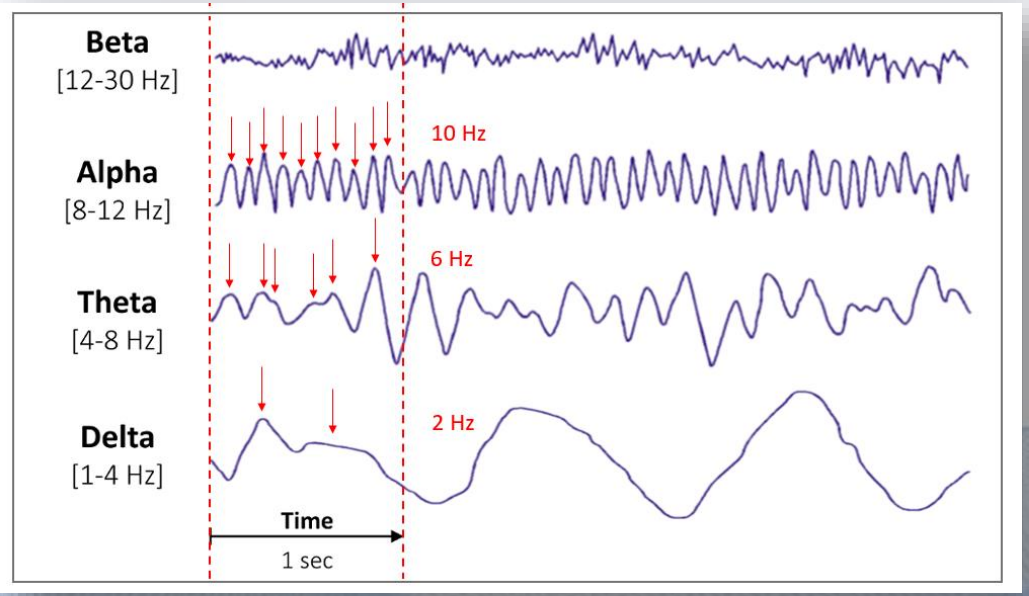
III. ***Conclusion : vers un monitorage de routine ?***

I. Accessible ou élitiste ?



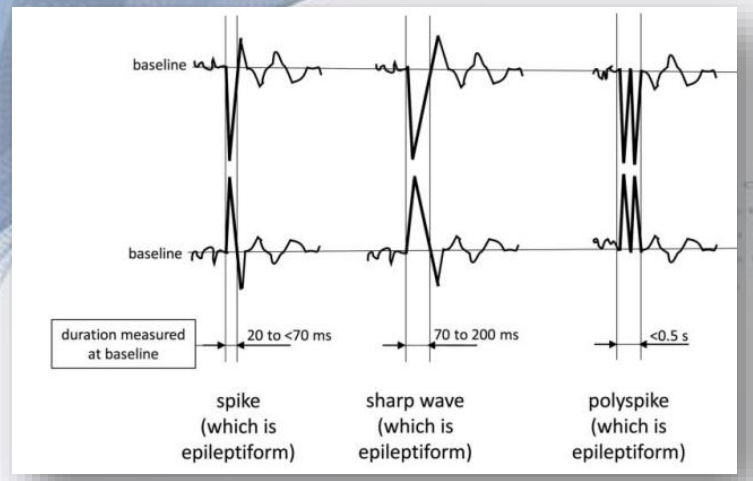
I. Accessible ou élitiste ?

Rythme de fond



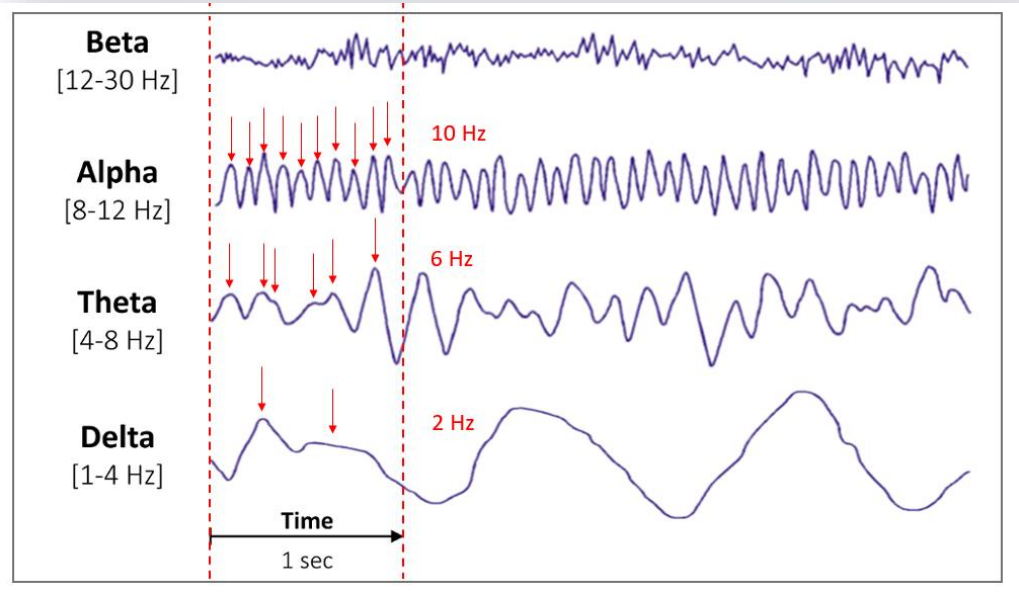
Activités paroxystiques

- **« Extrasystoles cérébrales » = anomalies structurelles ou fonctionnelles parenchymateuses**
- **« Epileptiformes » ou non**



I. Accessible ou élitiste ?

Rythme de fond



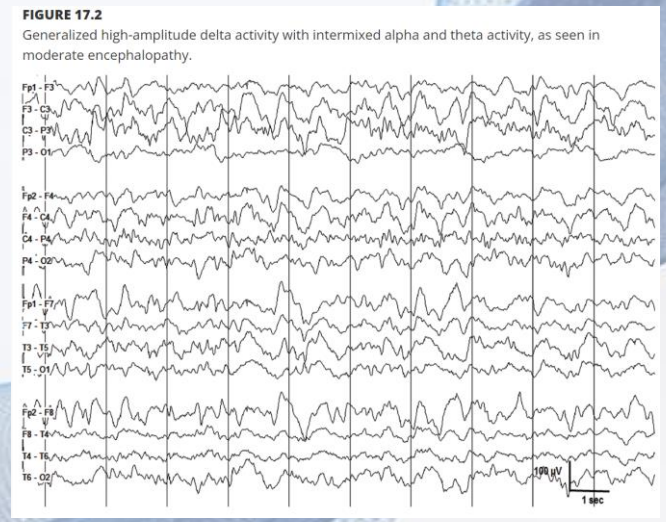


FIGURE 17.2
Generalized high-amplitude delta activity with intermixed alpha and theta activity, as seen in moderate encephalopathy.

FIGURE 17.1
Generalized desynchronized alpha and theta activity with intermixed delta activity, as seen in mild encephalopathy.

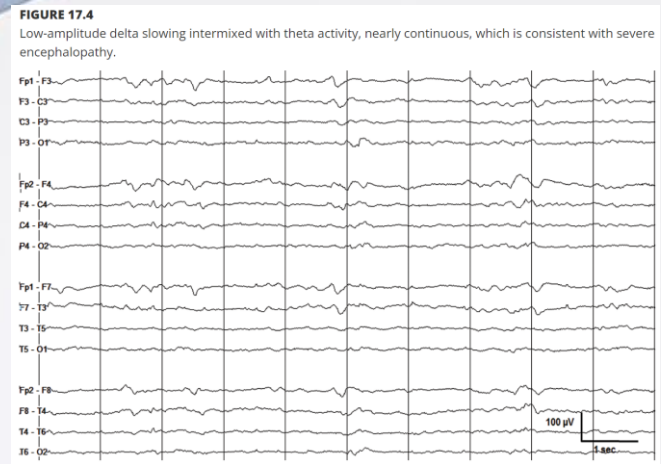
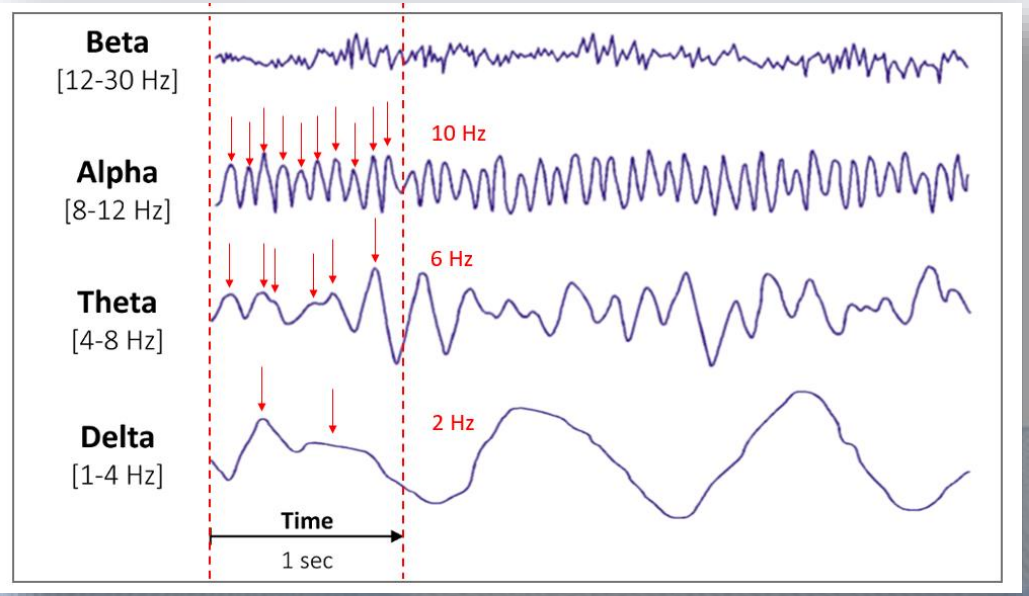


FIGURE 17.4
Low-amplitude delta slowing intermixed with theta activity, nearly continuous, which is consistent with severe encephalopathy.

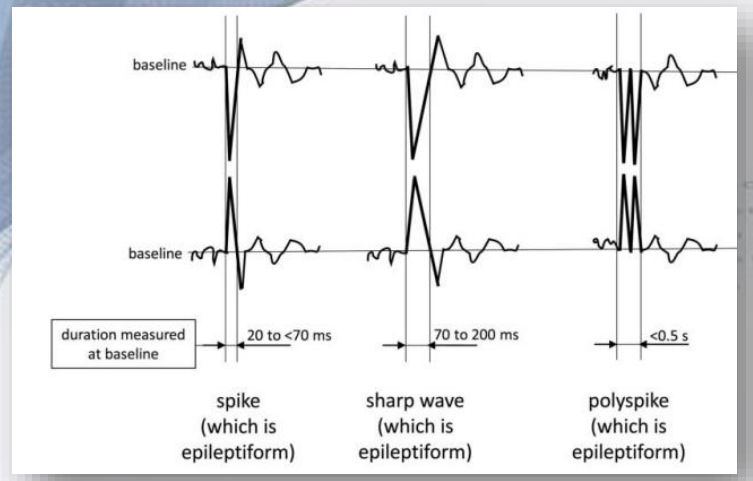
I. Accessible ou élitiste ?

Rythme de fond



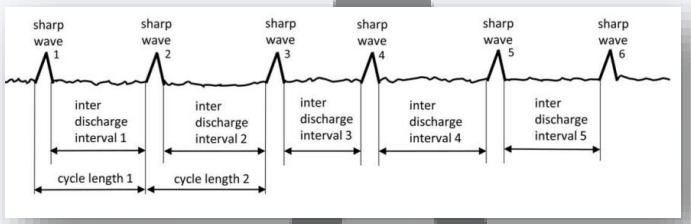
Activités paroxystiques

- **« Extrasystoles cérébrales » = anomalies structurelles ou fonctionnelles parenchymateuses**
- **« Epileptiformes » ou non**

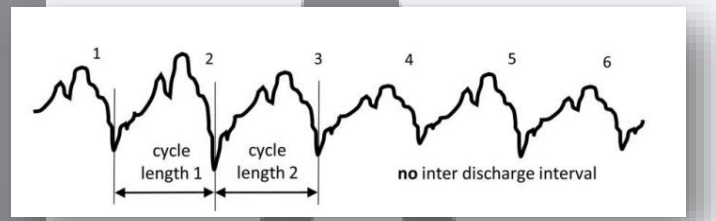


I. Accessible ou élitiste ?

Activités périodiques



Activités rythmiques

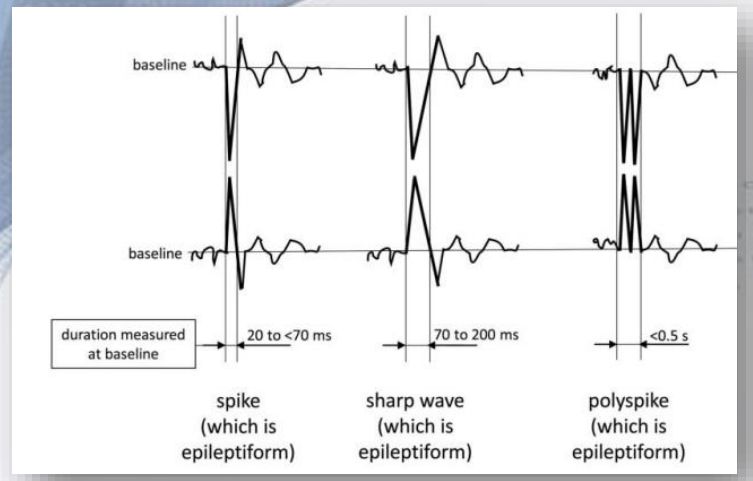


Encéphalopathie :
toxique, infectieuse, métabolique …

Epilepsie :
états de mal, crises non – convulsives …

Activités paroxystiques

- **« Extrasystoles cérébrales » = anomalies structurelles ou fonctionnelles parenchymateuses**
- **« Epileptiformes » ou non**



I. Accessible ou élitiste ?

ACNS GUIDELINE

American Clinical Neurophysiology Society's Standardized Critical Care EEG Termi

Lawrence J. Hirsch,* Michael W.K. For
Nicholas S. Abend,¶ Jong Woo Lee,#
Elizabeth E. Gerard,§§ Susan T. Herma
Carolina B. Maciel,## Emily J. Gilmore
Aatif M. Husain,§§§ Ji Yeoun Yoo,‖‖‖ Elson L. So,¶¶¶ Peter W. Kaplan,### M
Putten,†††† Raoul Sutter,‡‡‡‡ Frank W. Drislane,§§§§ Eugen Trinka,‡ and Ni

Elitiste …

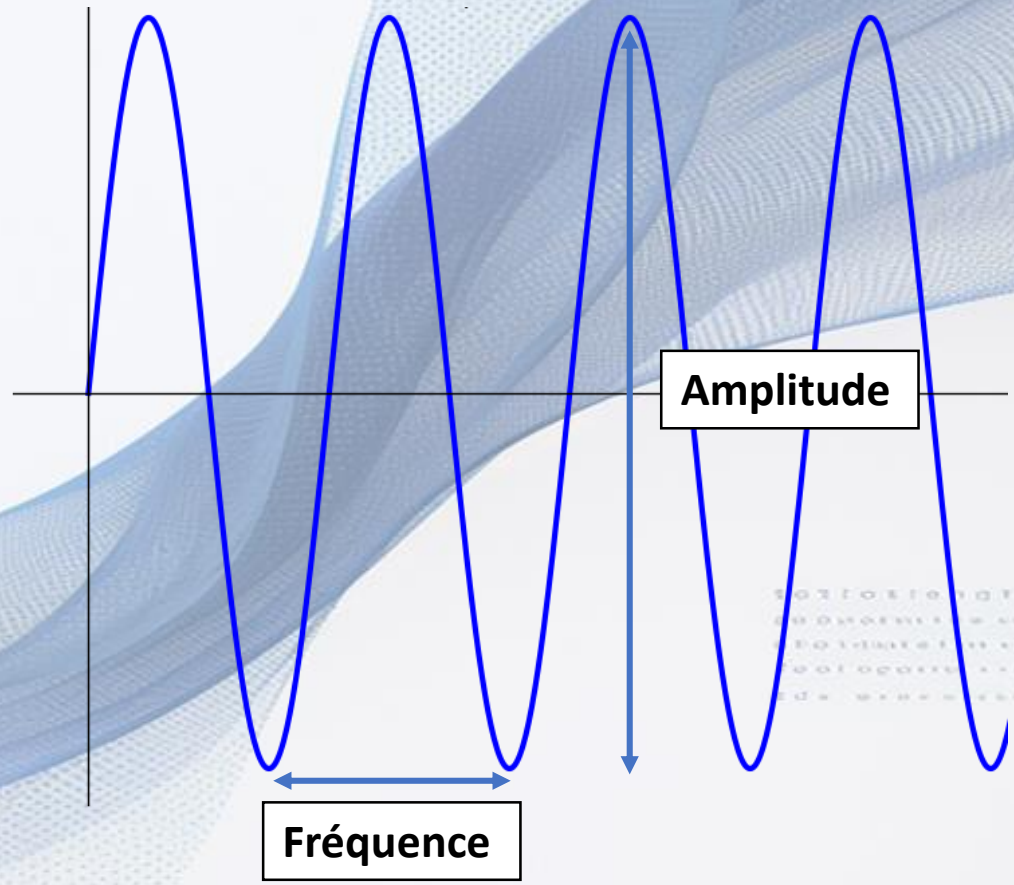
Accessible !

A. EEG BACKGROUND
B. SPORADIC EPILEPTIFORM DISCHARGES
C. RHYTHMIC AND PERIODIC PATTERNS (RPPs)
D. ELECTROGRAPHIC AND ELECTROCLINICAL SEIZURES [NEW, 2021]
E. BRIEF POTENTIALLY ICTAL RHYTHMIC DISCHARGES (BIRDs) [NEW, 2021]
F. ICTAL-INTERICTAL CONTINUUM (IIC) [NEW, 2021]
G. MINIMUM REPORTING REQUIREMENTS
H. OTHER TERMS

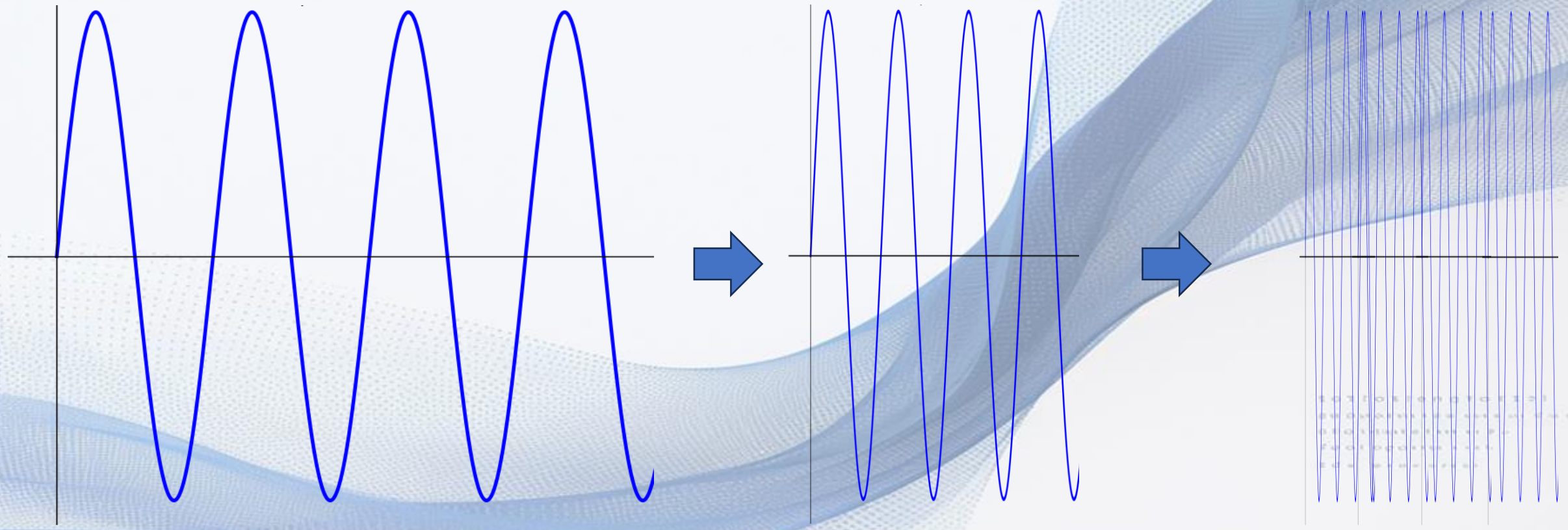
I. Accessible ou élitiste ?

Elitiste …

Accessible !



I. Accessible ou élitiste ?



I. Accessible ou élitiste ?

Notions d'interprétation | **EEG quantifié : domaine temporel** | EEG quantifié : domaine fréquentiel

EEG d'amplitude

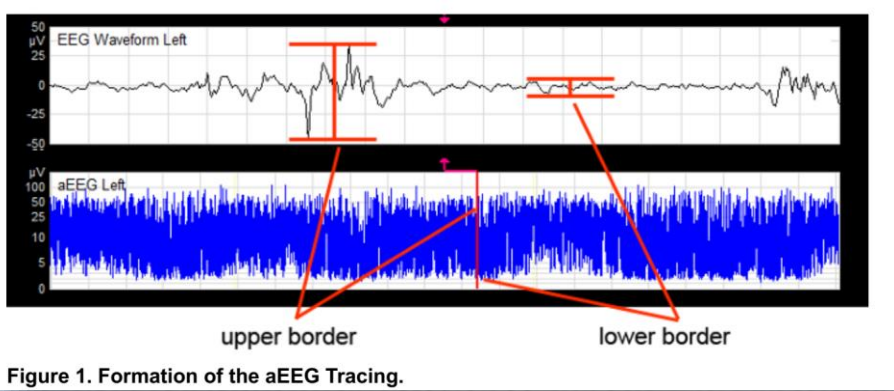
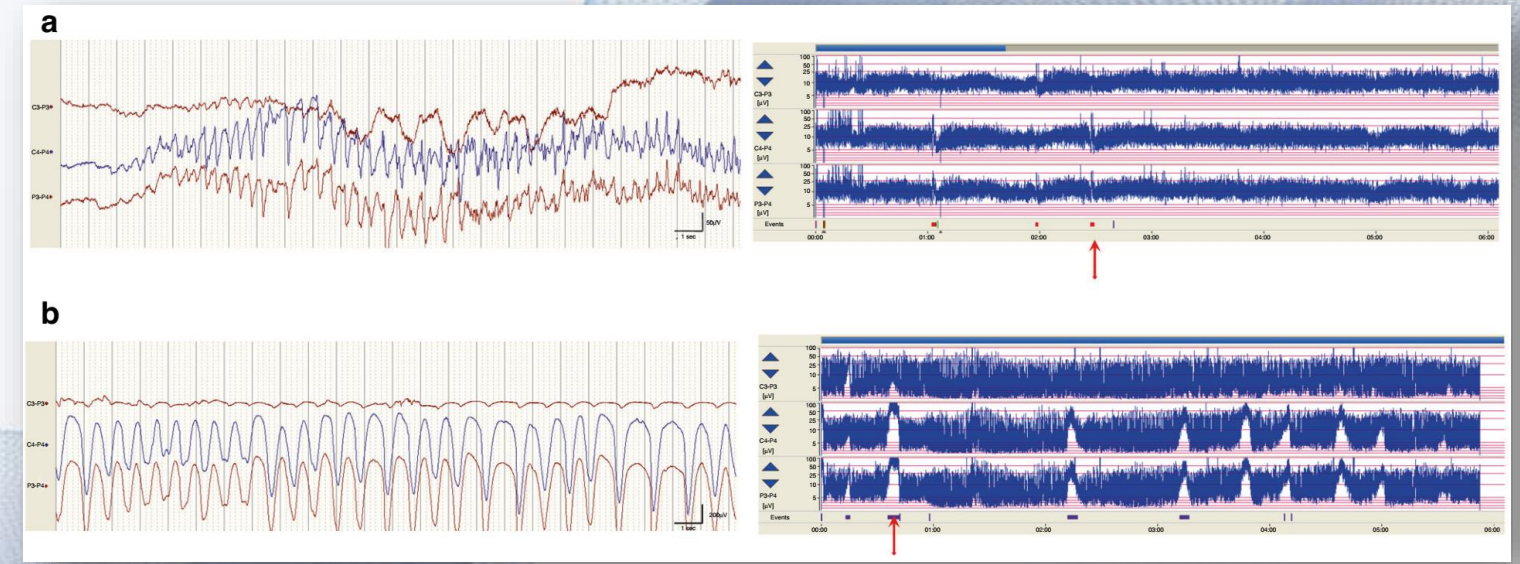


Figure 1. Formation of the aEEG Tracing.

Bruns N, Blumenthal S, Meyer I, Klose-Verschuur S, Felderhoff-Müser U, Müller H. Application of an Amplitude-integrated EEG Monitor (Cerebral Function Monitor) to Neonates. *J Vis Exp*. 2017;(127):55985. Published 2017 Sep 6. doi:10.3791/55985

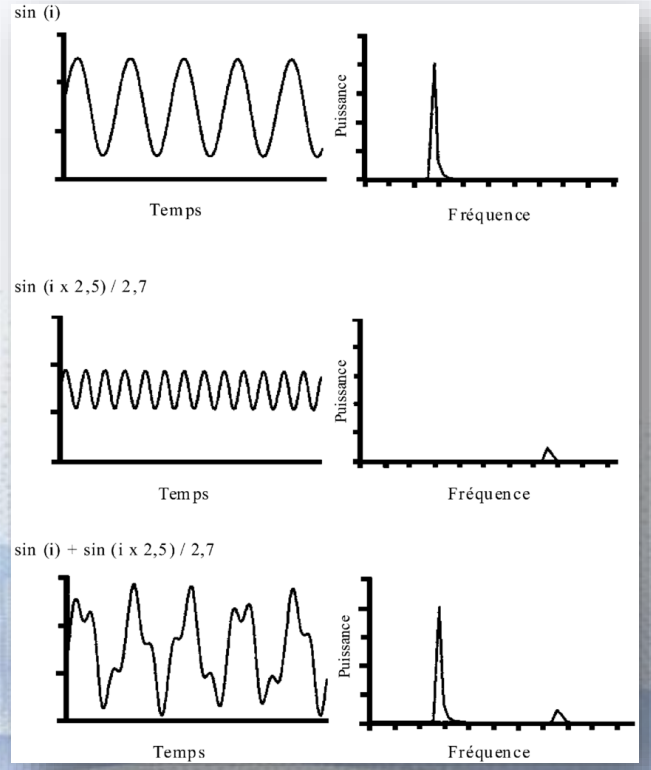


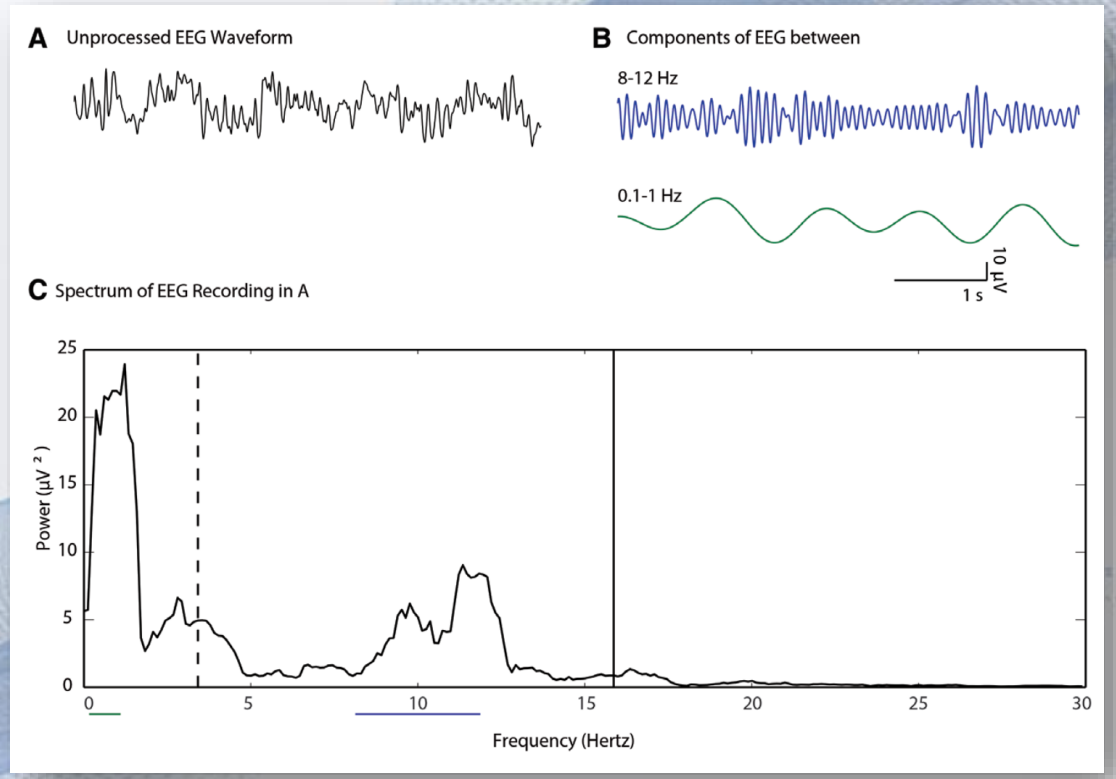
El-Dib M, Abend NS, Austin T, et al. Neuromonitoring in neonatal critical care part I: neonatal encephalopathy and neonates with possible seizures. *Pediatr Res*. 2023;94(1):64-73. doi:10.1038/s41390-022-02393-1

I. Accessible ou élitiste ?

Notions d'interprétation | EEG quantifié : domaine temporel | **EEG quantifié : domaine fréquentiel**

Densité de puissance spectrale



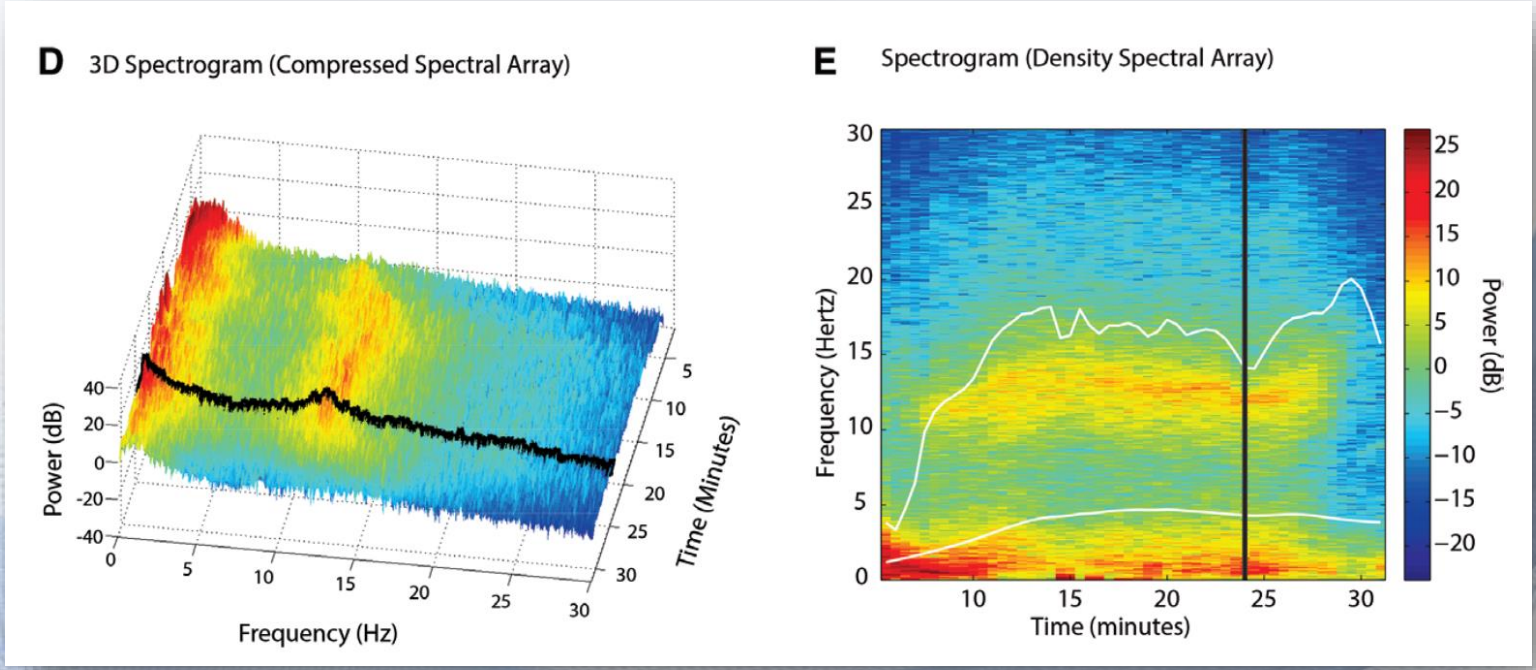


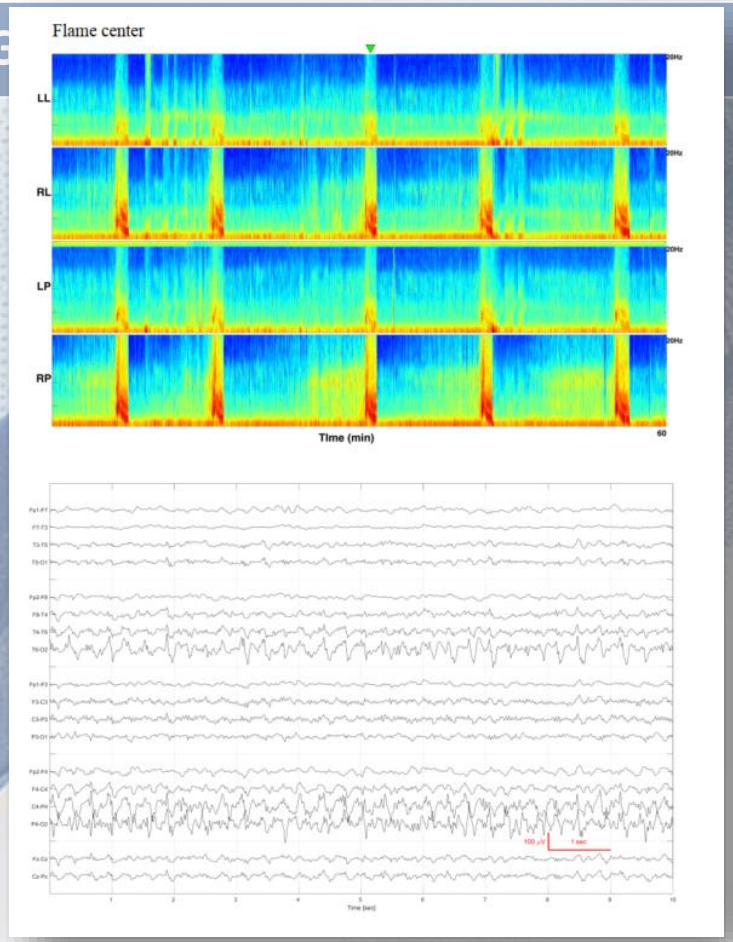
Purdon PL, Sampson A, Pavone KJ, Brown EN. Clinical Electroencephalography for Anesthesiologists: Part I: Background and Basic Signatures. *Anesthesiology*. 2015;123(4):937-960. doi:10.1097/ALN.0000000000000841

I. Accessible ou élitiste ?

Notions d'interprétation | EEG quantifié : domaine temporel | EEG

Densité de puissance spectrale

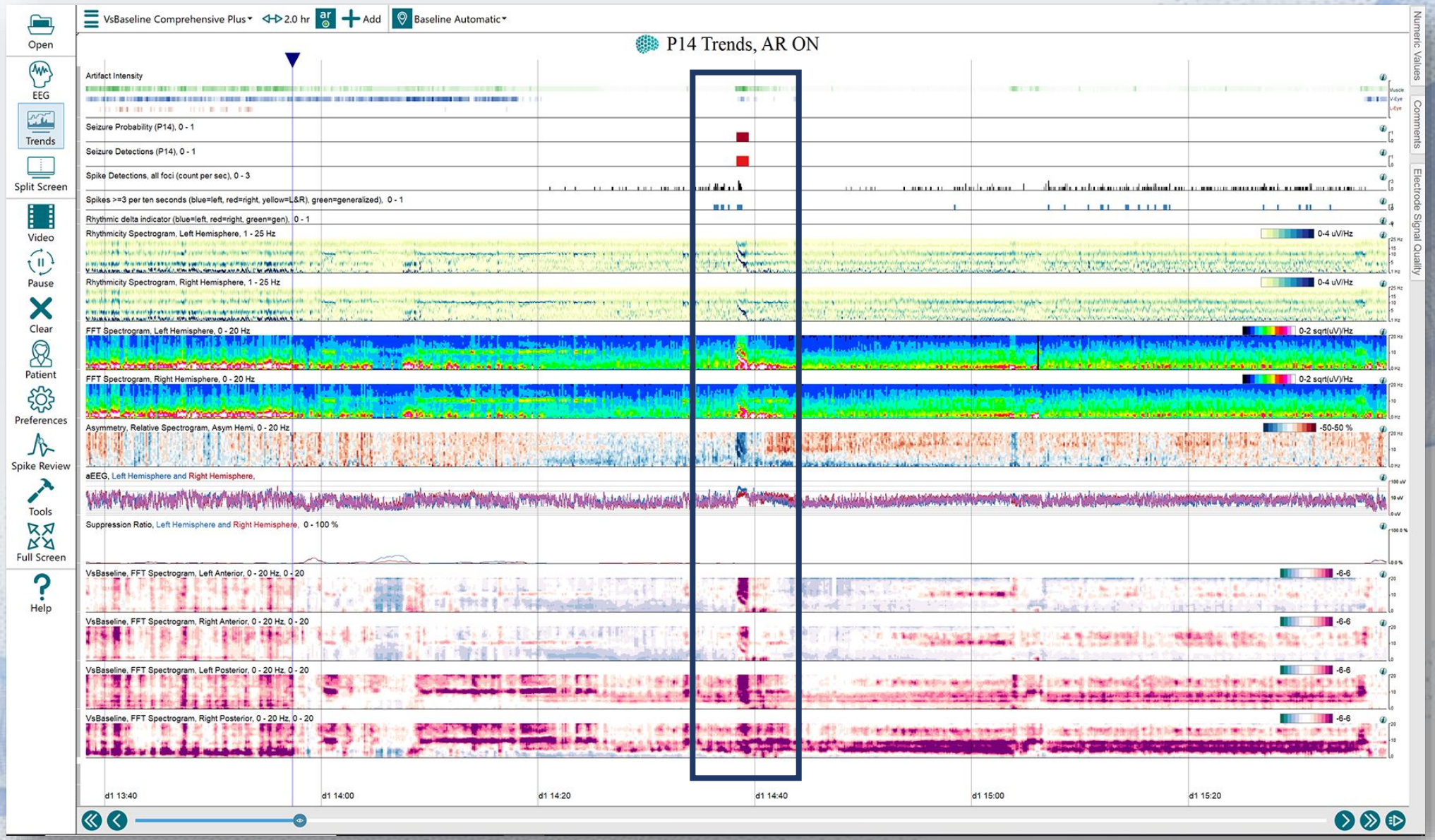




Purdon PL, Sampson A, Pavone KJ, Brown EN. Clinical Electroencephalography for Anesthesiologists: Part I: Background and Basic Signatures. *Anesthesiology*. 2015;123(4):937-960. doi:10.1097/ALN.0000000000000841

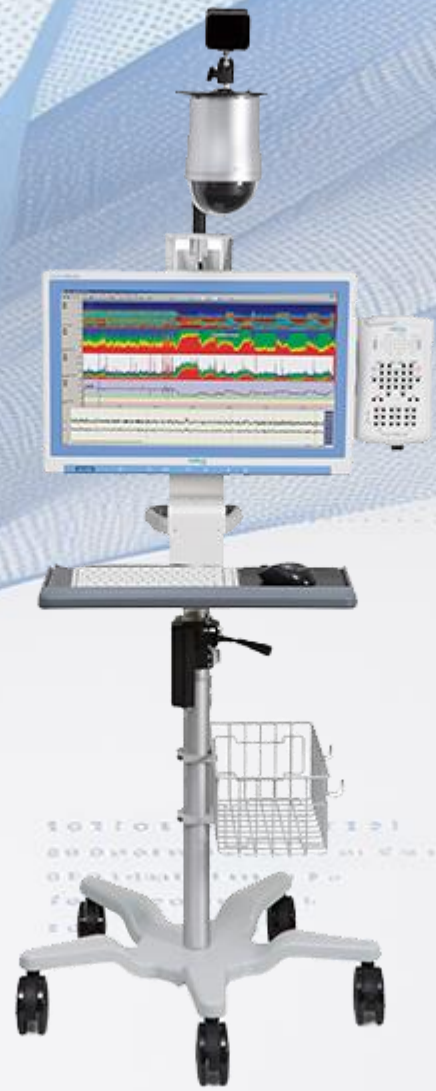
Zafar SF, Amorim E, Williamsom CA, et al. A standardized nomenclature for spectrogram EEG patterns: Inter-rater agreement and correspondence with common intensive care unit EEG patterns. *Clin Neurophysiol*. 2020;131(9):2298-2306. doi:10.1016/j.clinph.2020.05.032

I. Accessible ou élitiste ?



https://www.persyst.com/technology/trending/

II. Utile ou futile ?



II. Utile ou futile ?

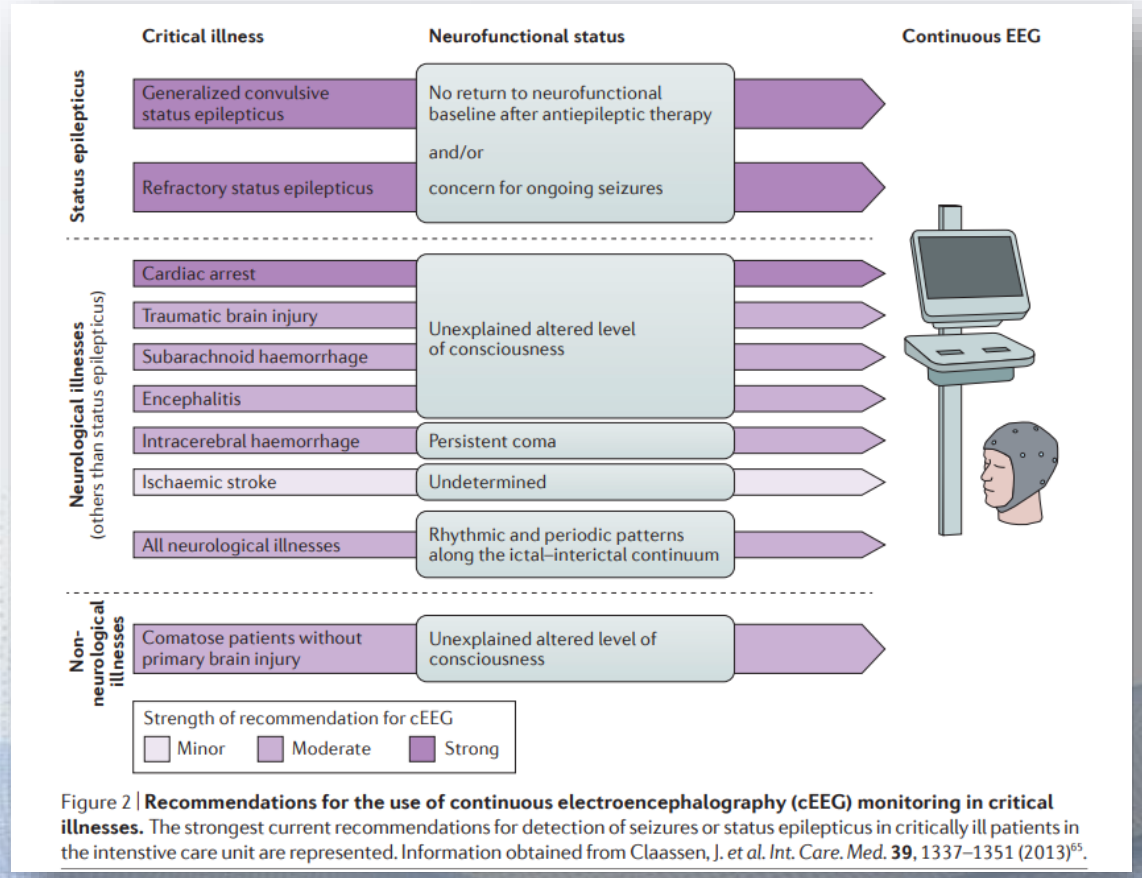


Figure 2 | **Recommendations for the use of continuous electroencephalography (cEEG) monitoring in critical illnesses.** The strongest current recommendations for detection of seizures or status epilepticus in critically ill patients in the intenstive care unit are represented. Information obtained from Claassen, J. *et al. Int. Care. Med.* **39**, 1337–1351 (2013)[65].

Sutter R, Semmlack S, Kaplan PW. Nonconvulsive status epilepticus in adults - insights into the invisible. *Nat Rev Neurol*. 2016;12(5):281-293. doi:10.1038/nrneurol.2016.45

Published in final edited form as:
J Clin Neurophysiol. 2015 April ; 32(2): 87–95. doi:10.1097/WNP.0000000000000166.

Consensus Statement on Continuous EEG in Critically Ill Adults and Children, Part I: Indications

Susan T. Herman, M.D.[1], Nicholas S. Abend, M.D.[2], Thomas P. Bleck, M.D., M.C.C.M., F.N.C.S., F.C.N.S.[3], Kevin E. Chapman, M.D.[4], Frank W. Drislane, M.D.[1], Ronald G. Emerson, M.D.[5], Elizabeth E. Gerard, M.D.[6], Cecil D. Hahn, M.D., M.P.H.[7], Aatif M. Husain, M.D.[8], Peter W. Kaplan, M.B. B.S., F.R.C.P.[9], Suzette M. LaRoche, M.D.[10], Marc R. Nuwer, M.D., Ph.D.[11], Mark Quigg, M.D.[12], James J. Riviello, M.D.[13], Sarah E. Schmitt, M.D.[14], Liberty A. Simmons, R. EEG T., CLTM, CNIM, R. NCS T. CNCT[15], Tammy N. Tsuchida, M.D., Ph.D.[16], and Lawrence J. Hirsch, M.D.[17]

A. Diagnosis of Nonconvulsive Seizures (NCS), Nonconvulsive Status Epilepticus (NCSE), and Other Paroxysmal Events

B. Assessment of Efficacy of Therapy for Seizures and Status Epilepticus

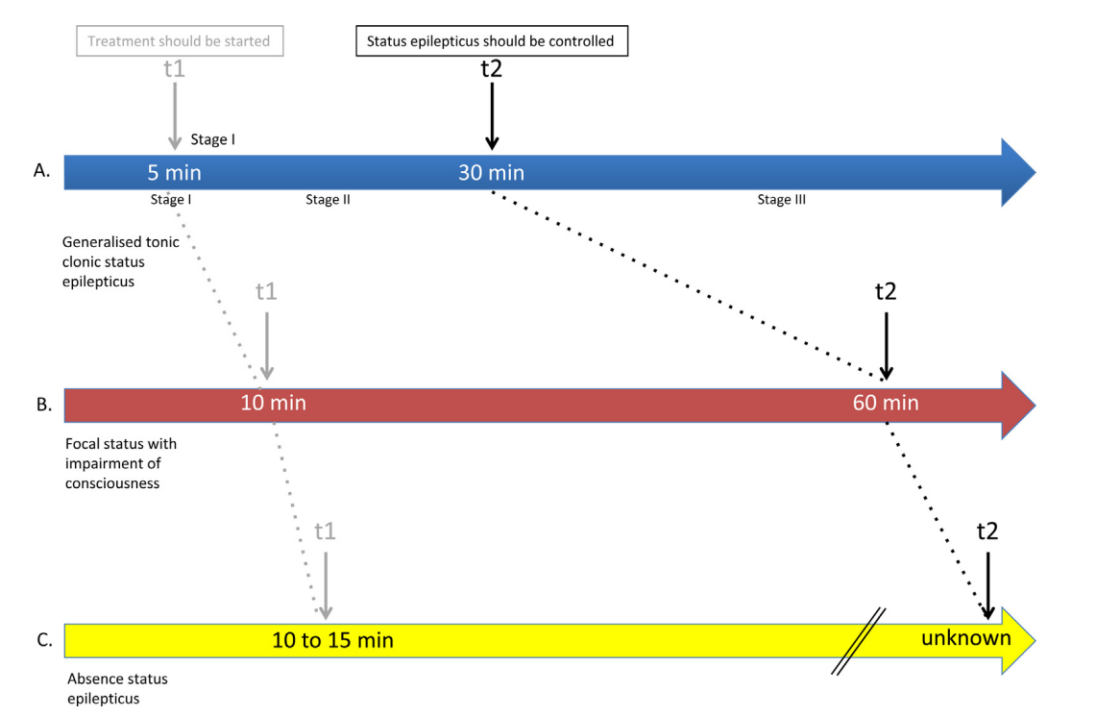
C. Identification of Cerebral Ischemia

D. Monitoring of Sedation and High-Dose Suppressive Therapy

E. Assessment of Severity of Encephalopathy and Prognostication

II. Utile ou futile ?

EEGc et état de mal non – convulsif | EEGc et crises non – convulsives | EEGc et détection de l'ischémie



Trinka E, Kälviäinen R. 25 years of advances in the definition, classification and treatment of status epilepticus. *Seizure*. 2017;44:65-73. doi:10.1016/j.seizure.2016.11.001

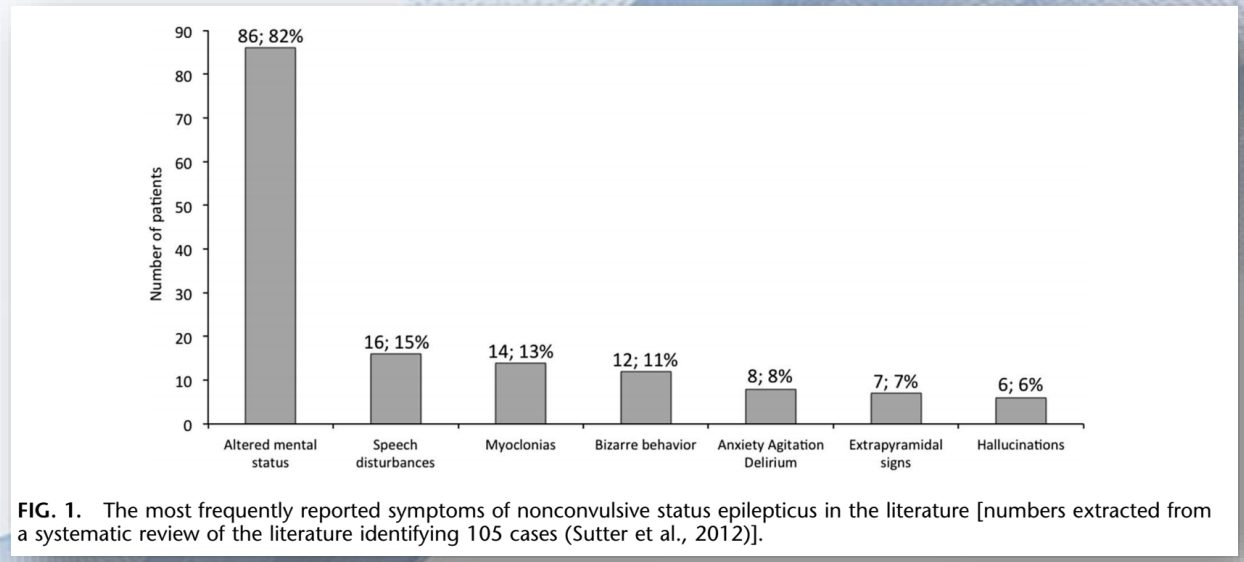


FIG. 1. The most frequently reported symptoms of nonconvulsive status epilepticus in the literature [numbers extracted from a systematic review of the literature identifying 105 cases (Sutter et al., 2012)].

Sutter R. Are We Prepared to Detect Subtle and Nonconvulsive Status Epilepticus in Critically Ill Patients?. *J Clin Neurophysiol*. 2016;33(1):25-31. doi:10.1097/WNP.0000000000000216

NCSE : Grave et difficile à diagnostiquer

II. Utile ou futile ?

EEGc et état de mal non – convulsif > EEGc et crises non – convulsives > EEGc et détection de l'ischémie

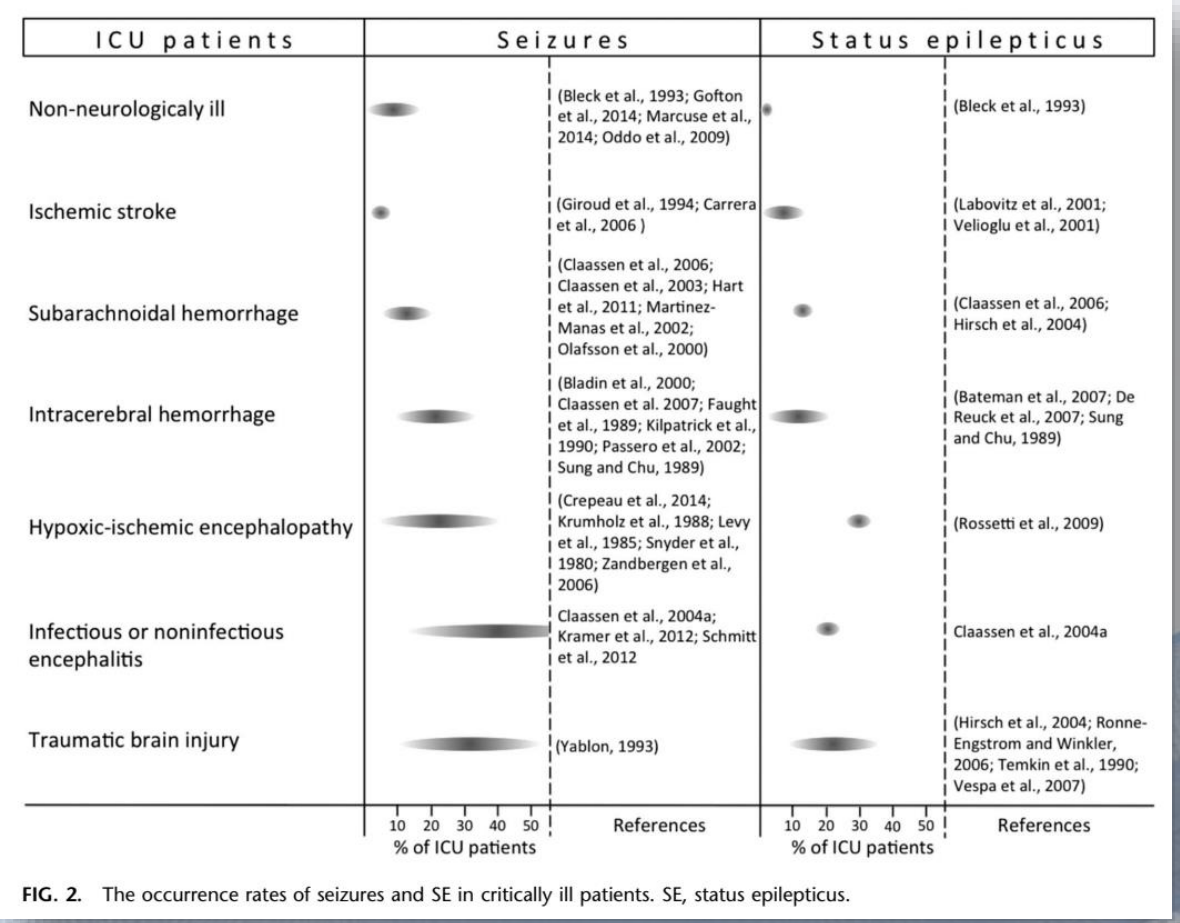


FIG. 2. The occurrence rates of seizures and SE in critically ill patients. SE, status epilepticus.

Sutter R. Are We Prepared to Detect Subtle and Nonconvulsive Status Epilepticus in Critically Ill Patients?. *J Clin Neurophysiol*. 2016;33(1):25-31. doi:10.1097/WNP.0000000000000216

NCSE : fréquent ++

Diagnostic EEG : intermittent suffisant ou continu nécessaire ?

II. Utile ou futile ?

EEGc et état de mal non – convulsif | EEGc et crises non – convulsives | EEGc et détection de l'ischémie

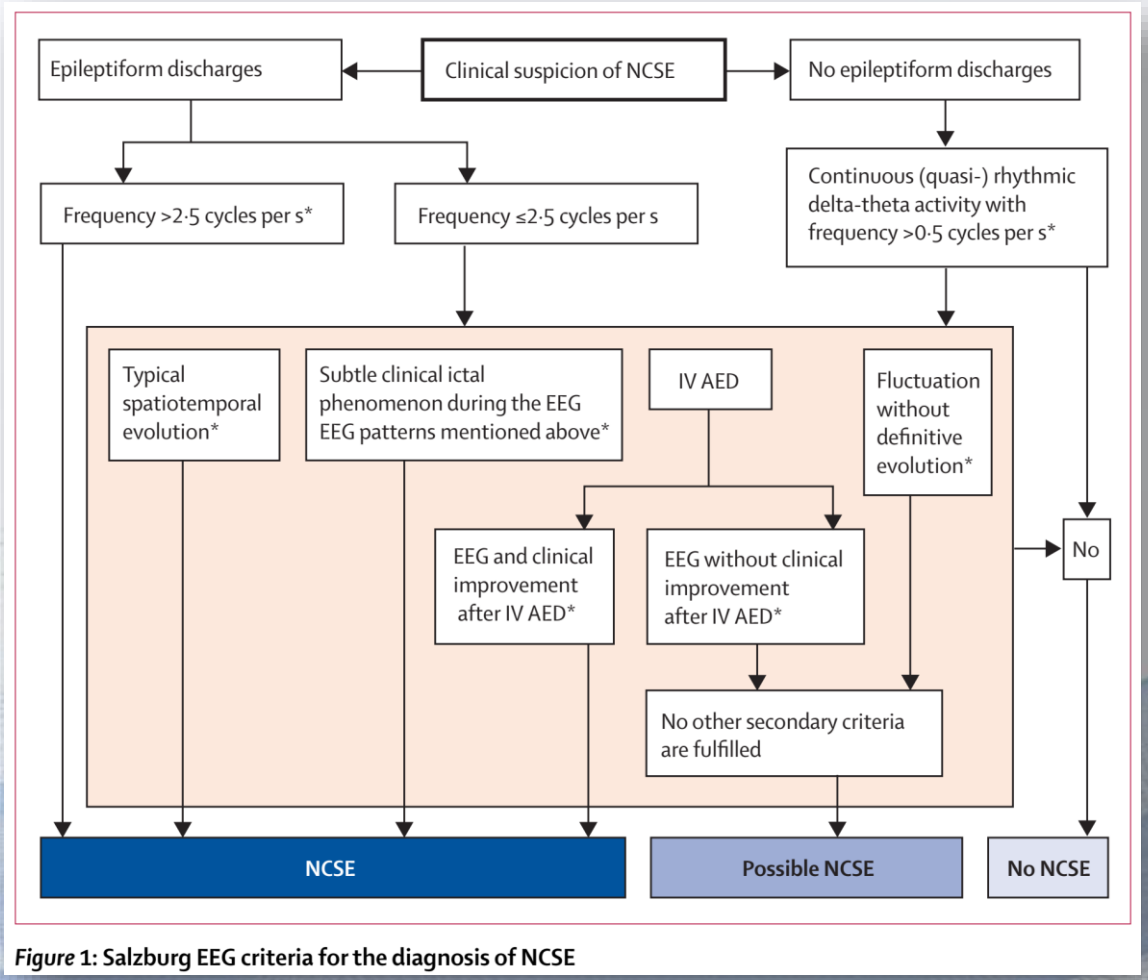
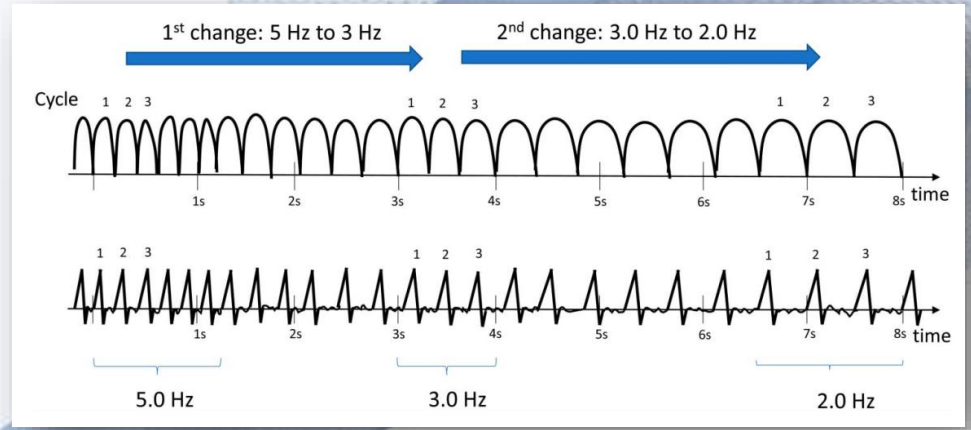
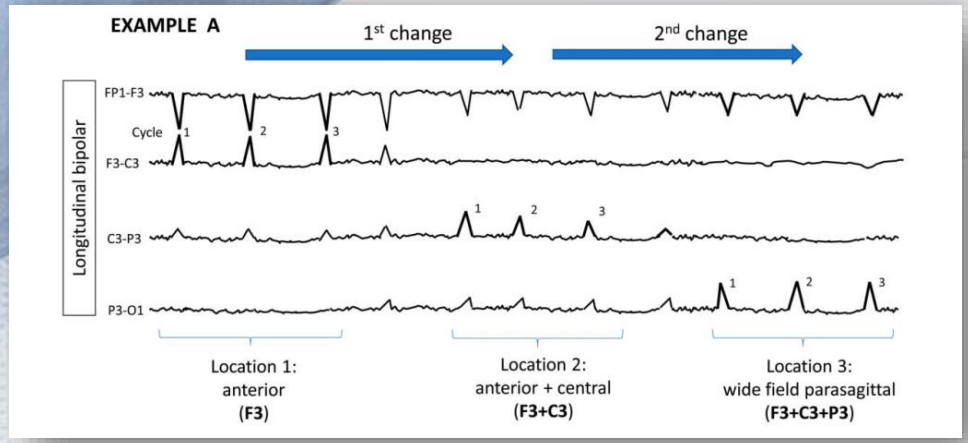


***Figure* 1: Salzburg EEG criteria for the diagnosis of NCSE**

Leitinger M, Trinka E, Gardella E, et al. Diagnostic accuracy of the Salzburg EEG criteria for non-convulsive status epilepticus: a retrospective study. *Lancet Neurol*. 2016;15(10):1054-1062. doi:10.1016/S1474-4422(16)30137-5

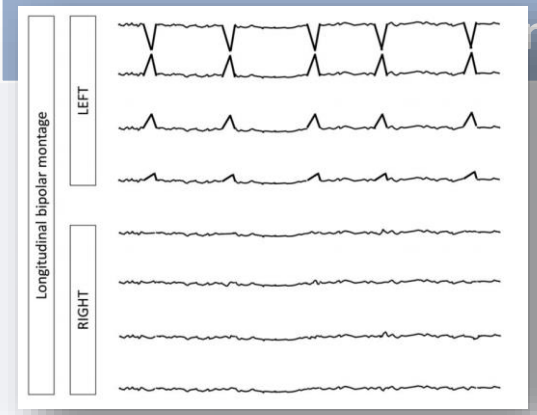
Diagnostic complexe ++



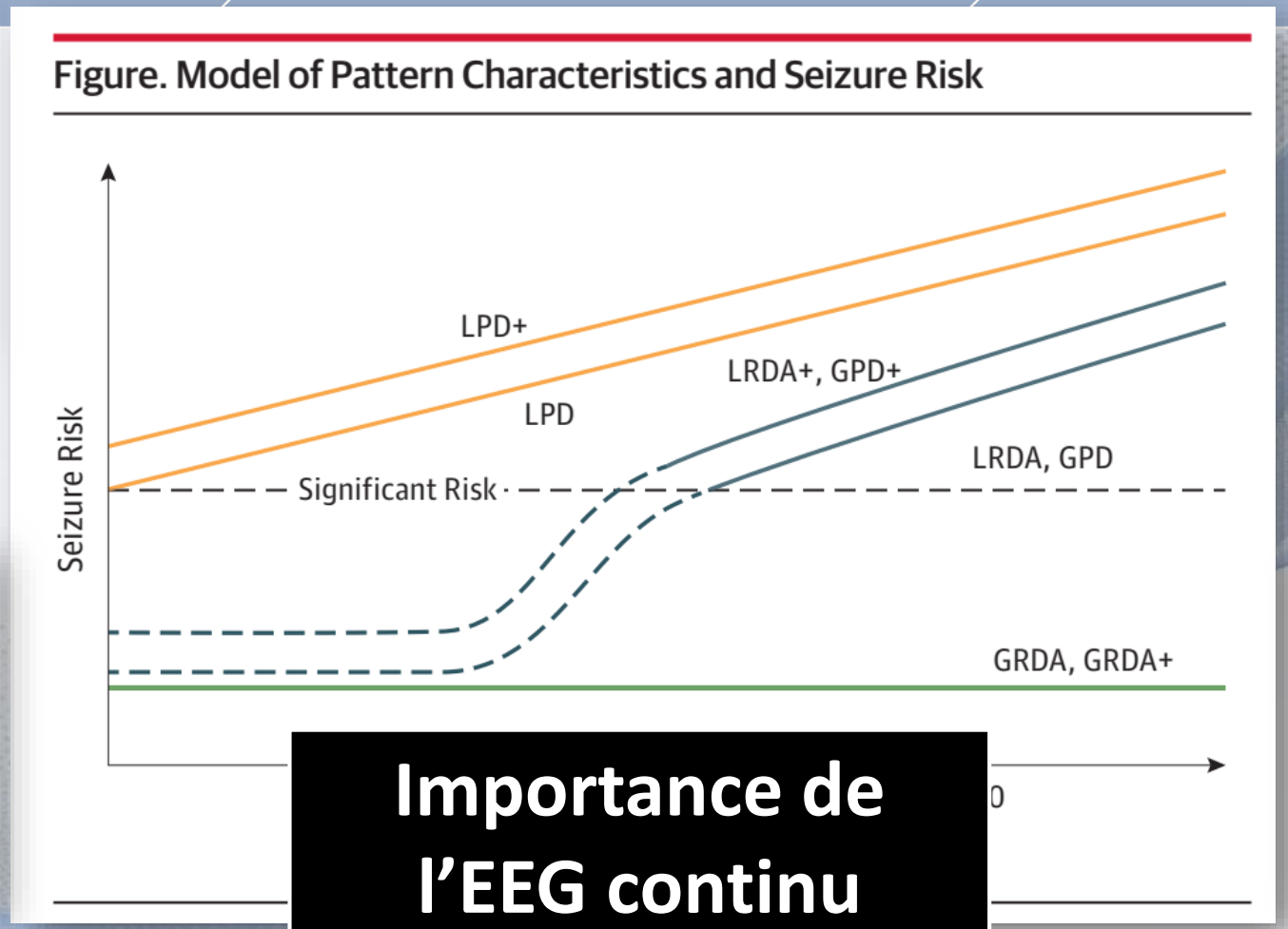


II. Utile ou futile ?

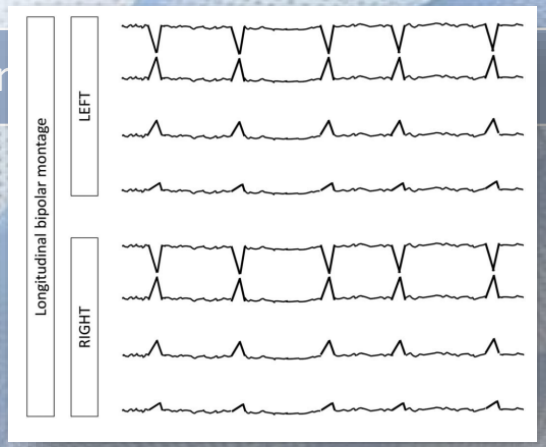
Continuum ictal – interictal



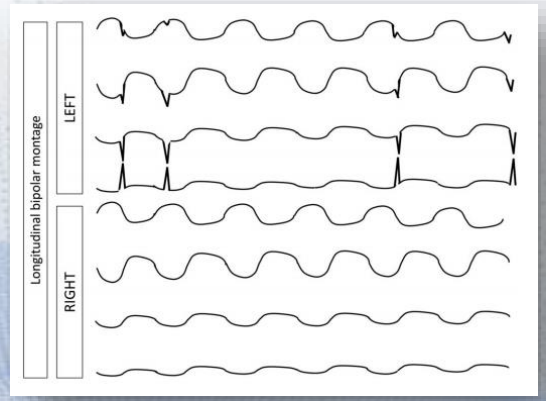
LPDs



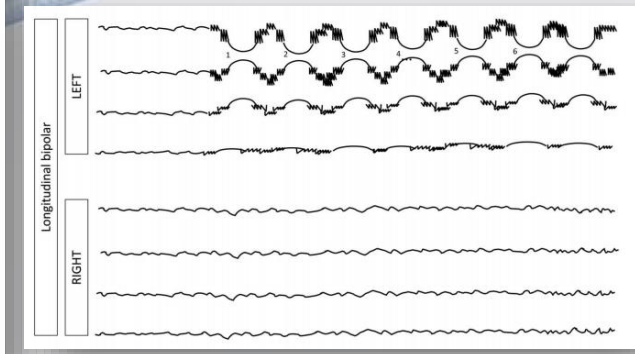
Importance de l'EEG continu +++++



GPDs



GRDA



LRDA

Rodriguez Ruiz A, Vla ic
Electroencephalograp *Neurol.*
2017;74(2):181-188. d

II. Utile ou futile ?

EEGc et état de mal non – convulsif | **EEGc et crises non – convulsives** | EEGc et détection de l'ischémie

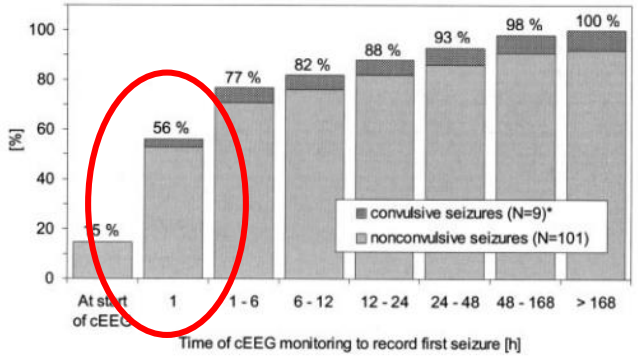


*Figure 1. Time elapsed between start of continuous EEG (cEEG) monitoring and detection of the first seizure (n = 110). *Three of these nine patients had nonconvulsive seizures as well.*

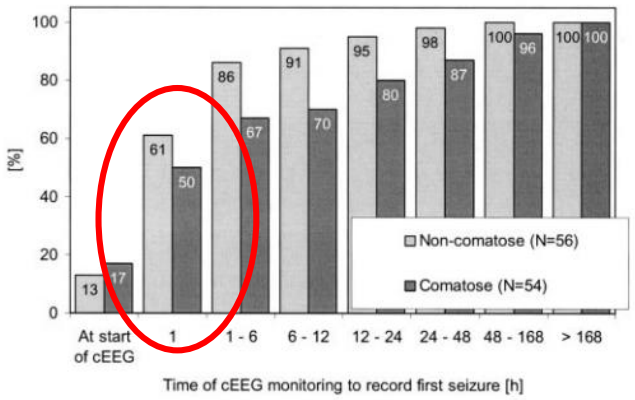
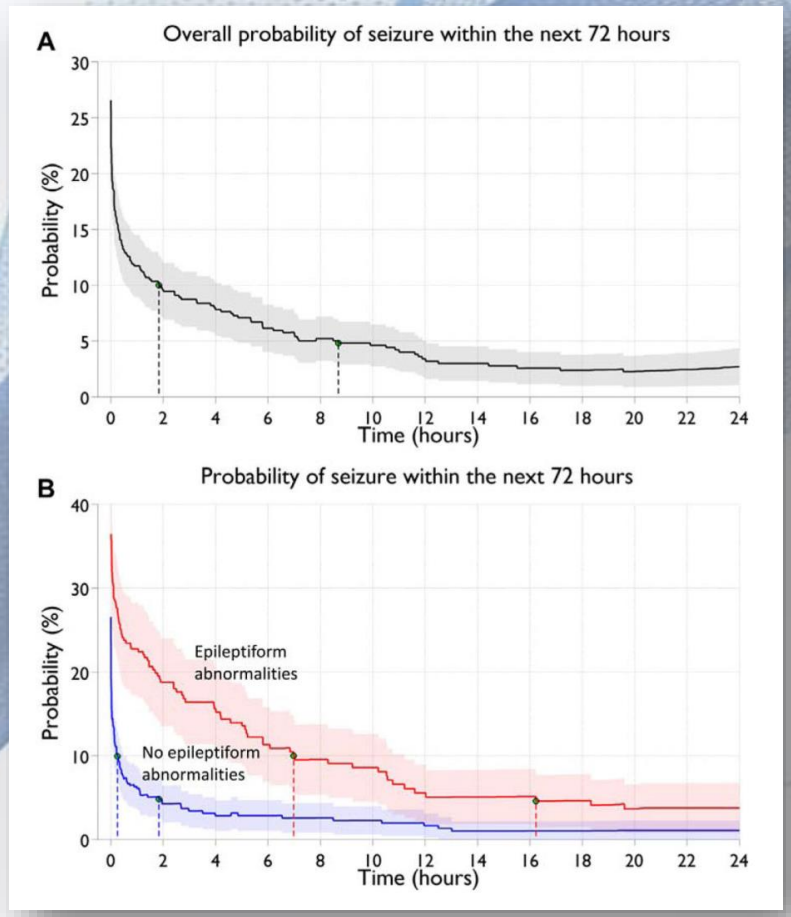


Figure 2. Time to record the first seizure, comparing noncomatose and comatose patients. cEEG = continuous EEG.

Claassen J, Mayer SA, Kowalski RG, Emerson RG, Hirsch LJ. Detection of electrographic seizures with continuous EEG monitoring in critically ill patients. *Neurology*. 2004;62(10):1743-1748. doi:10.1212/01.wnl.0000125184.88797.62



Westover MB, Shafi MM, Bianchi MT, et al. The probability of seizures during EEG monitoring in critically ill adults. *Clin Neurophysiol*. 2015;126(3):463-471. doi:10.1016/j.clinph.2014.05.037

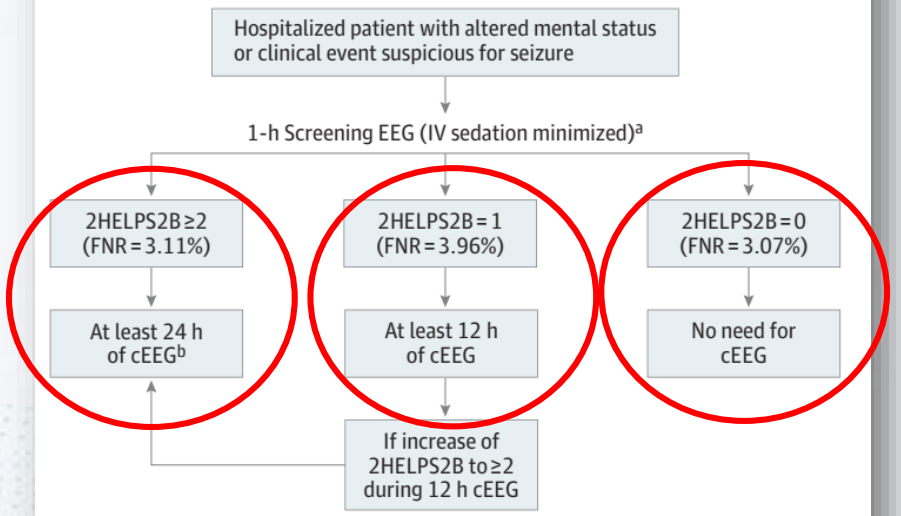
Un EEG de 20 minutes ne suffit pas

Doit – on équiper tous les patients ?

II. Utile ou futile ?

EEGc et état de mal non – convulsif | **EEGc et crises non – convulsives** | EEGc et détection de l'ischémie

Figure 4. 2HELPS2B Clinical Algorithm

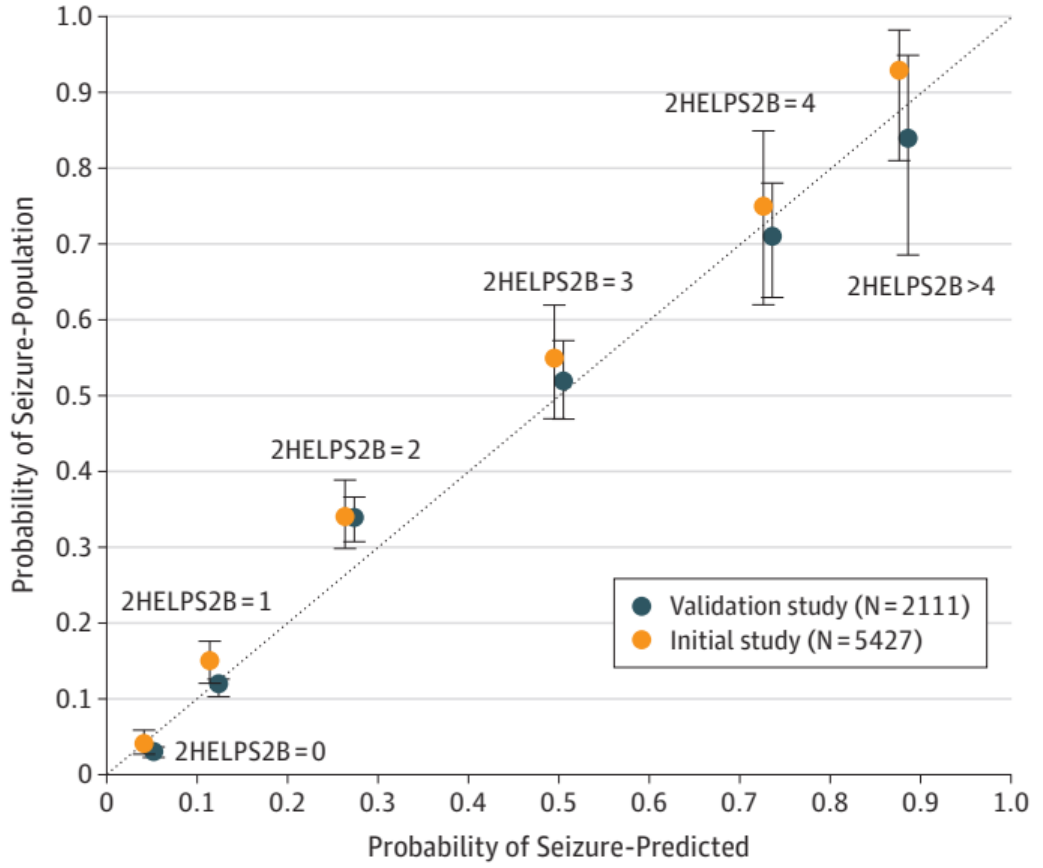


If a seizure is detected at any time (including in the 1-hour screening electroencephalogram [EEG]), there is a recommendation for at least 24 hours of EEG monitoring after the last seizure.[33] cEEG indicates continuous EEG monitoring; D/, discontinue; FNR, false negative rate.

[a] For patients with coma, a screening EEG of up to 90 minutes may be considered.

[b] In cases of ictal-interictal continuum patterns, which are common in those with a 2HELPS2B score of 2 or greater, a longer duration of monitoring may be required for empirical treatment trials.

Figure 1. Risk-Calibration Graph of the Error for the 2HELPS2B Model in the Initial Study Cohort and the Validation Cohort



II. Utile ou futile ?

EEGc et état de mal non – convulsif | **EEGc et crises non – convulsives** | EEGc et détection de l'ischémie

Table 2. Primary Outcome (Mortality at 6 Months) and Functional Outcomes Across cEEG vs rEEG (Poisson Regression Models for Categorical Variables [Mortality] and Linear Regression Models for Continuous Variables [Δ mRS and CPC])[a]

	rEEG (n = 182),	cEEG (n = 182),	Crude		Adjusted for CCI, cardiac arrest	
Outcome	No. (%)	No. (%)	Relative risk (95% CI)	*P* value	Relative risk (95% CI)	*P* value
Mortality at 6 mo, No. (%)	88 (48.4)	89 (48.9)	1.01 (0.82 to 1.25)	.92	1.02 (0.83 to 1.26)	.85
	Median (range)	Median (range)	Regression coefficient	*P* value	Regression coefficient	*P* value
Δ mRS at 6 mo, survivors	1 (−5 to 4)	1 (−3 to 5)	0.65 (0.13 to 1.16)	.01	0.63 (0.13 to 1.14)	.01
CPC at 6 mo, survivors	2 (1 to 4)	2 (1 to 4)	0.08 (−0.17 to 0.34)	.52	0.08 (−0.18 to 0.33)	.55

Table 3. Exploratory Analyses: Associations of Secondary Outcome Measures With EEG Type[a]

	No. (%)			
Outcome	rEEG (n = 183)	cEEG (n = 185)	Relative risk (95% CI)	*P* value
Features of ictal-interictal continuum detected, without seizures/SE	102 (55.7)	128 (69.2)	1.24 (1.06-1.46)	.009
Seizures/SE detected	8 (4.4)	29 (15.7)	3.59 (1.68-7.64)	.001
Changes in antiseizure drug prescription within 60 h following start of EEG intervention[b]	21 (11.5)	39 (21.1)	1.84 (1.12-3.00)	.01
Changes in sedation prescription within 60 h following start of EEG intervention[b]	8 (4.4)	13 (7.0)	1.61 (0.683-3.79)	.27
Need of additional EEG after intervention	41 (22.8)[c]	56 (31.1)	1.37 (0.97-1.93)	.08
In-hospital infection requiring antibiotics	56 (30.8)	47 (25.7)	0.82 (0.61-1.11)	.20
Length of ventilation need, median (range), h	123 (0-837)	138 (0-1214)	NA	.47
Length of hospital stay in survivors, median (range), d	25.3 (2.6-393.3)	24.5 (1.4-161.1)	NA	.84
Time to death since randomization, median (range), d	8.5 (0-157)	6 (0-176)	NA	.07

CERTA Trial

EEG continu Vs. Intermittent :

- ***Morbi – mortalité NS***
- ***Plus de diagnostic de NCSE et d'adaptation thérapeutique***

...

- ***Hétérogénéité pathologies***
- ***Exclusion patients avec indication de cEEG (SE)***

Rossetti AO, Schindler K, Sutter R, et al. Continuous vs Routine Electroencephalogram in Critically Ill Adults With Altered Consciousness and No Recent Seizure: A Multicenter Randomized Clinical Trial. *JAMA Neurol*. 2020;77(10):1225-1232. doi:10.1001/jamaneurol.2020.2264

II. Utile ou futile ?

EEGc et état de mal non – convulsif | **EEGc et crises non – convulsives** | EEGc et détection de l'ischémie

Activités paroxystiques et demande métabolique cérébrale

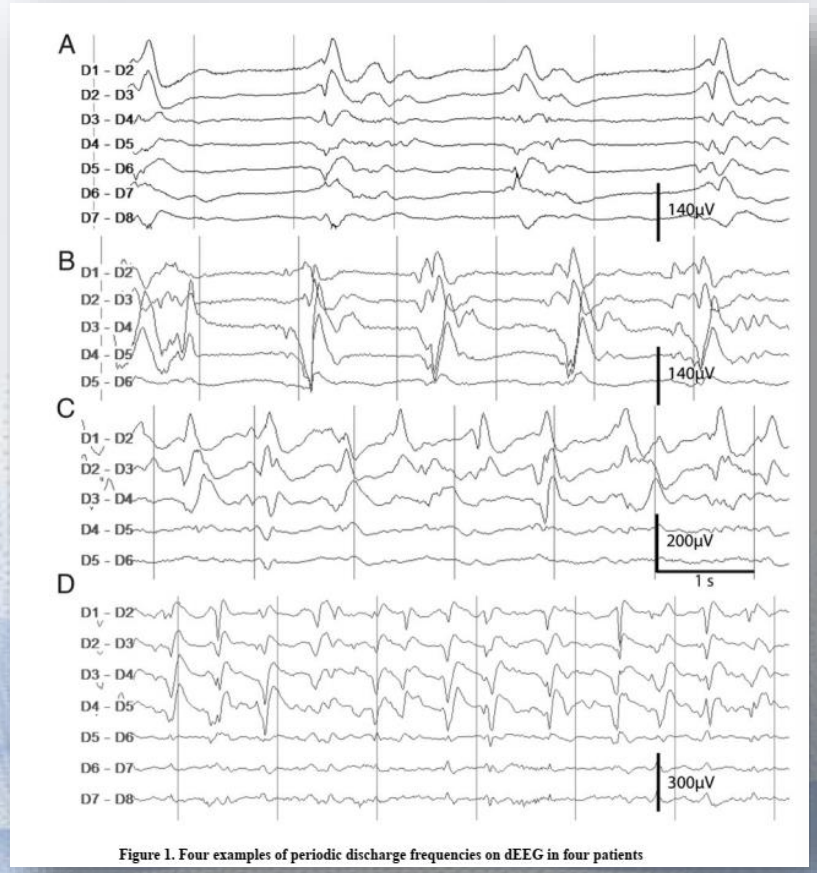


Figure 1. Four examples of periodic discharge frequencies on dEEG in four patients

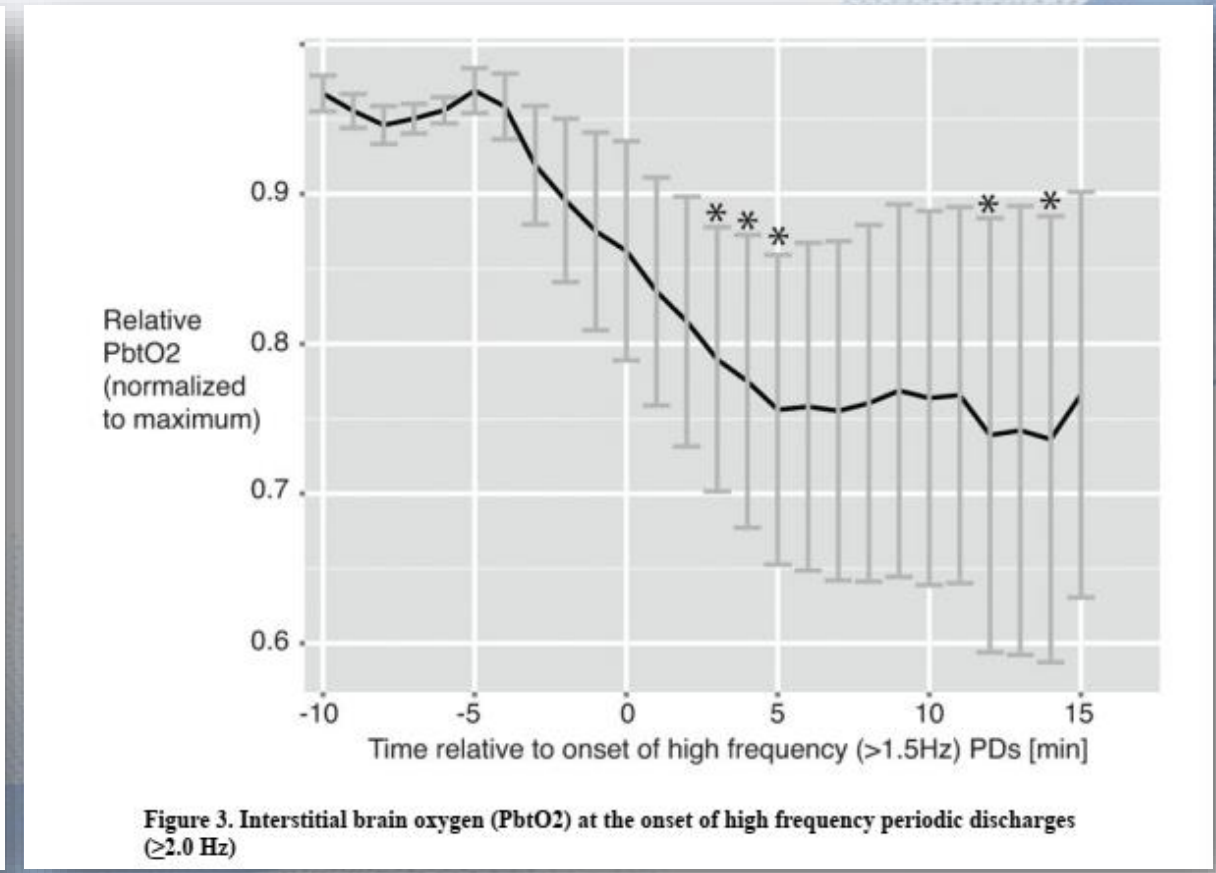
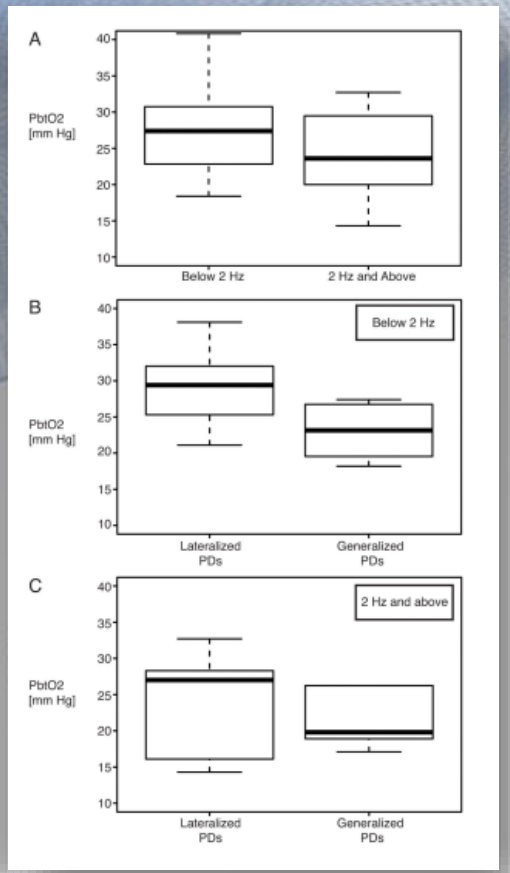


Figure 3. Interstitial brain oxygen (PbtO2) at the onset of high frequency periodic discharges (≥2.0 Hz)



Witsch J, Frey HP, Schmidt JM, et al. Electroencephalographic Periodic Discharges and Frequency-Dependent Brain Tissue Hypoxia in Acute Brain Injury. *JAMA Neurol*. 2017;74(3):301-309. doi:10.1001/jamaneurol.2016.5325

II. Utile ou futile ?

EEGc et état de mal non – convulsif | EEGc et crises non – convulsives | **EEGc et détection de l'ischémie**

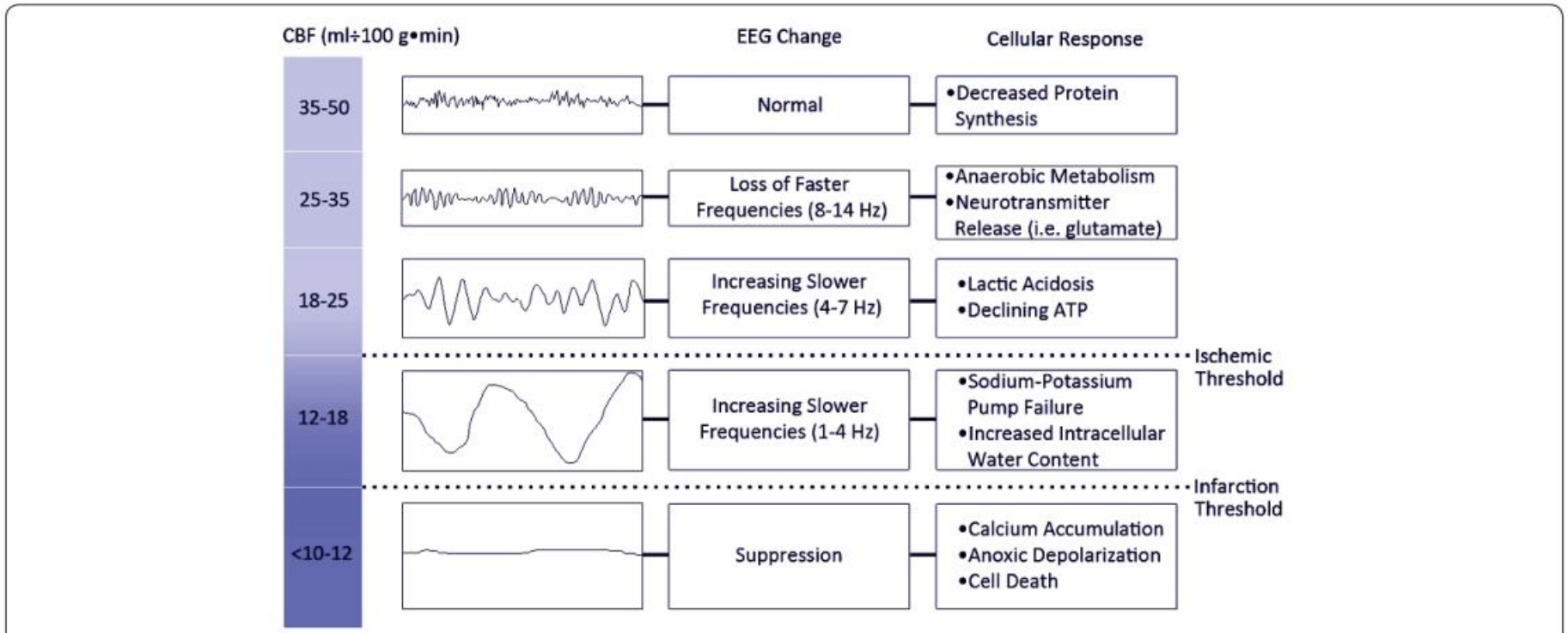


Figure 1. The relationship of cerebral blood flow to electroencephalogram (EEG) and pathophysiology. ATP, adenosine triphosphate (CBF). Data from [2,4].

Foreman B, Claassen J. Quantitative EEG for the detection of brain ischemia. *Crit Care*. 2012;16(2):216. Published 2012 Dec 12. doi:10.1186/cc11230

II. Utile ou futile ?

EEGc et état de mal non – convulsif | EEGc et crises non – convulsives | **EEGc et détection de l'ischémie**

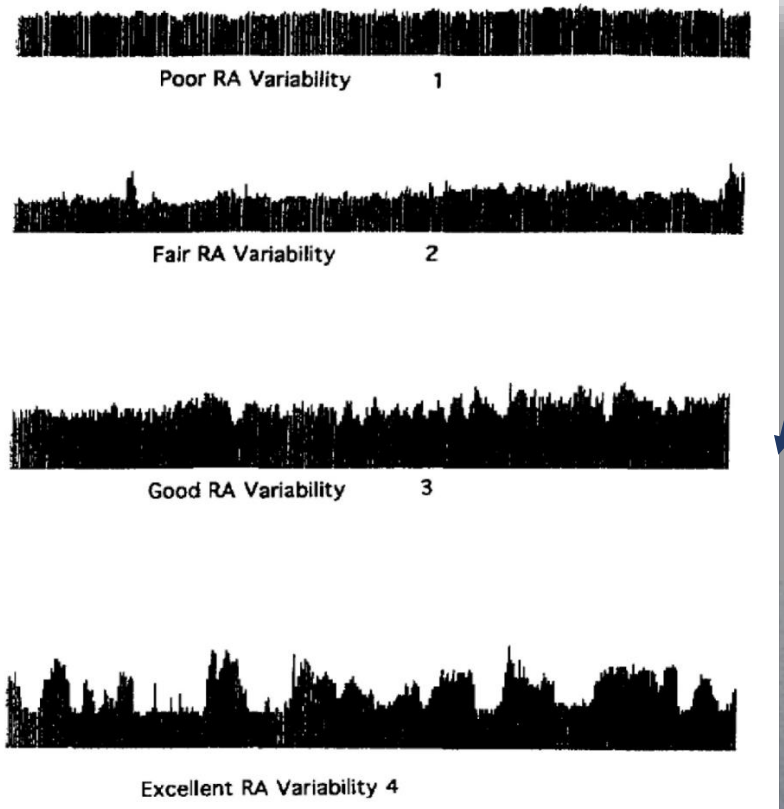


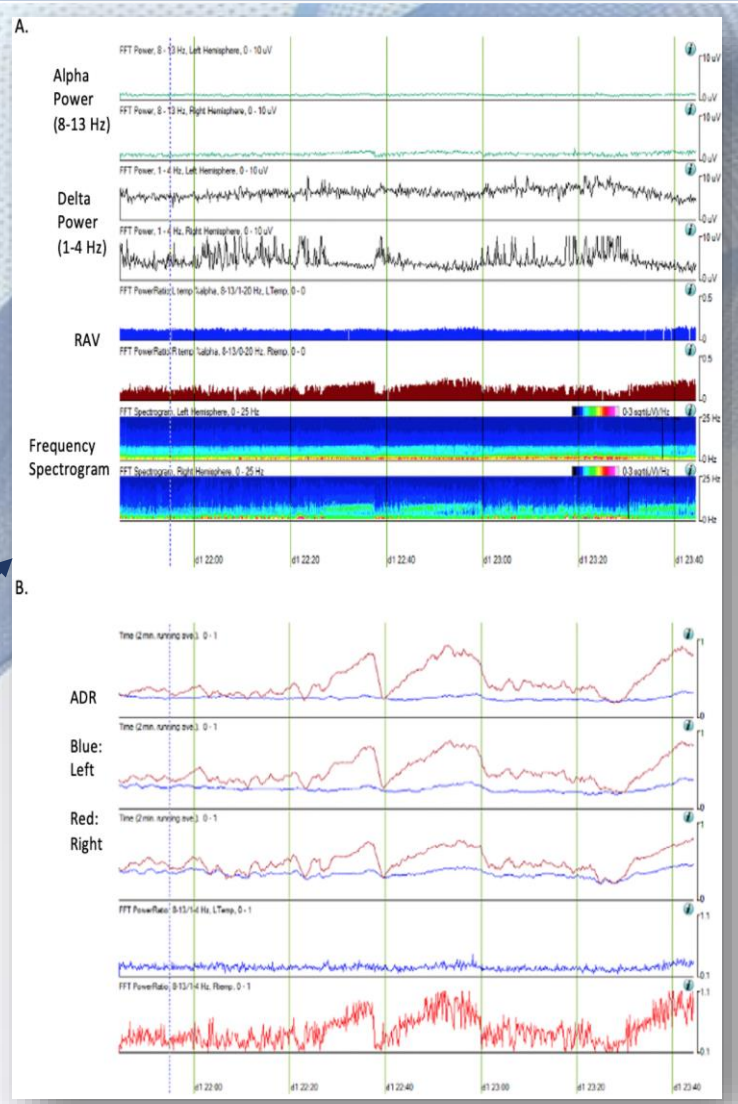
Figure 1.
Relative alpha variability scoring chart. Adapted from Vespa et al. 1997 (with permission from Elsevier Limited).

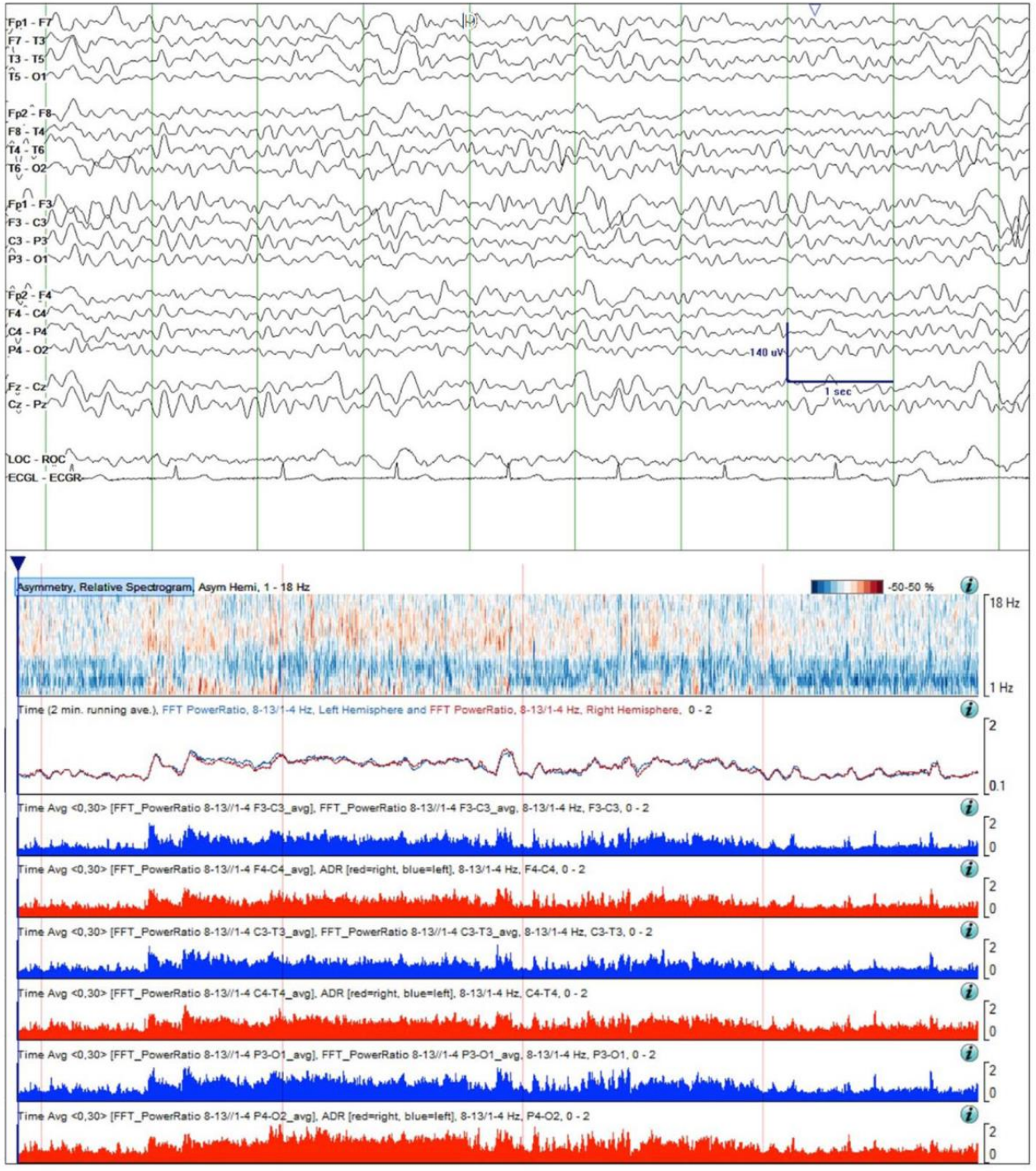
Variabilité de la puissance dans la bande alpha : « réactivité » cérébrale

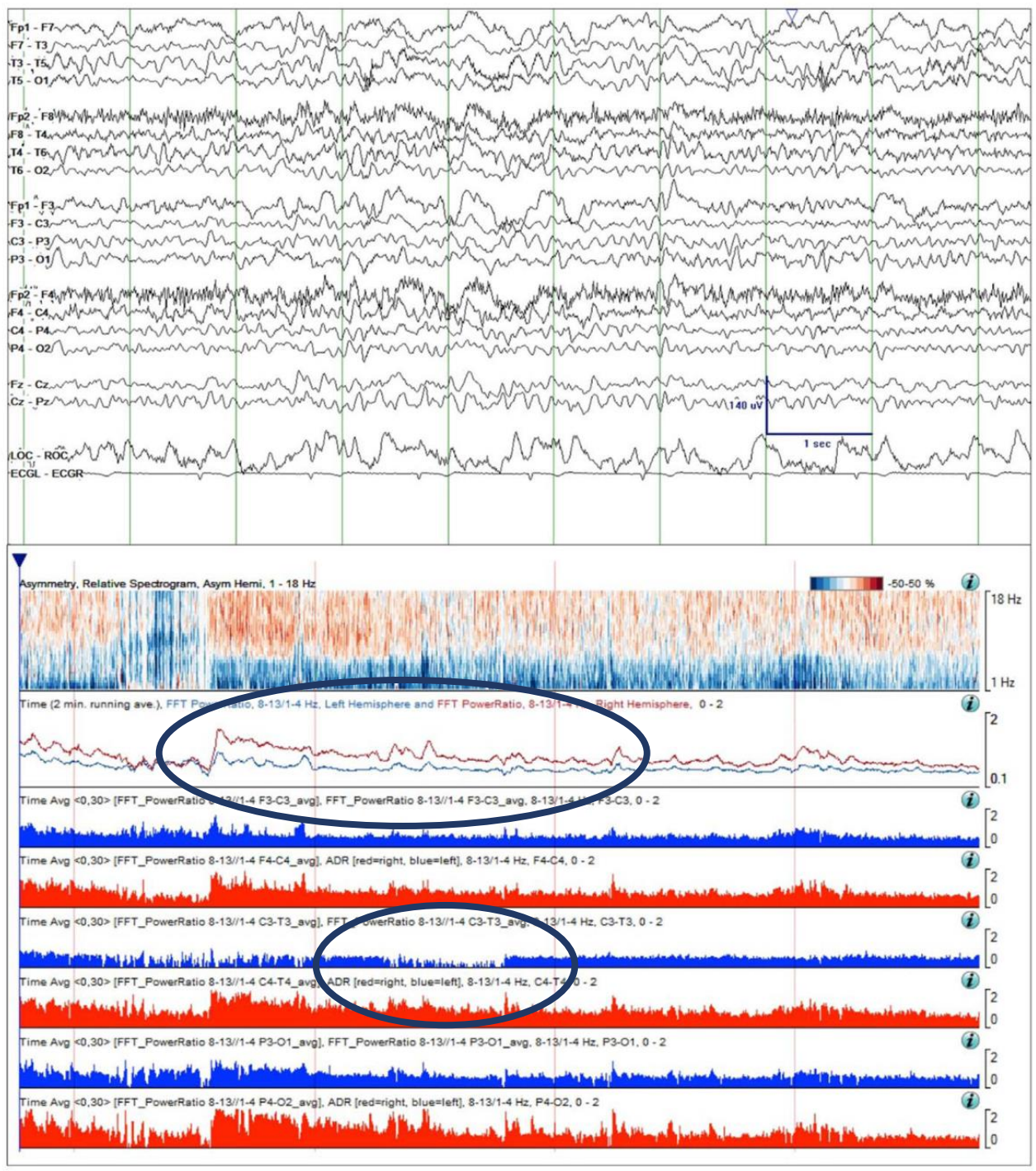
Muniz CF, Shenoy AV, O'Connor KL, et al. Clinical Development and Implementation of an Institutional Guideline for Prospective EEG Monitoring and Reporting of Delayed Cerebral Ischemia. *J Clin Neurophysiol*. 2016;33(3):217-226. doi:10.1097/WNP.0000000000000281

Chute puissance alpha / delta : « ralentissement »

Baang HY, Chen HY, Herman AL, et al. The Utility of Quantitative EEG in Detecting Delayed Cerebral Ischemia After Aneurysmal Subarachnoid Hemorrhage. *J Clin Neurophysiol*. 2022;39(3):207-215. doi:10.1097/WNP.0000000000000754




Fp1 - F7
F7 - T3
T3 - T5
T5 - O1
Fp2 - F8
F8 - T4
T4 - T6
T6 - O2
Fp1 - F3
F3 - C3
C3 - P3
P3 - O1
Fp2 - F4
F4 - C4
C4 - P4
P4 - O2
Fz - Cz
Cz - Pz
LOC - ROC
ECGL - ECGR
140 uV
1 sec
Asymmetry, Relative Spectrogram, Asym Hemi, 1 - 18 Hz
-50-50 %
18 Hz
1 Hz
Time (2 min. running ave.), FFT PowerRatio, 8-13/1-4 Hz, Left Hemisphere and FFT PowerRatio, 8-13/1-4 Hz, Right Hemisphere, 0 - 2
Time Avg <0,30> [FFT_PowerRatio 8-13//1-4 F3-C3_avg], FFT_PowerRatio 8-13//1-4 F3-C3_avg, 8-13/1-4 Hz, F3-C3, 0 - 2
Time Avg <0,30> [FFT_PowerRatio 8-13//1-4 F4-C4_avg], ADR [red=right, blue=left], 8-13/1-4 Hz, F4-C4, 0 - 2
Time Avg <0,30> [FFT_PowerRatio 8-13//1-4 C3-T3_avg], FFT_PowerRatio 8-13//1-4 C3-T3_avg, 8-13/1-4 Hz, C3-T3, 0 - 2
Time Avg <0,30> [FFT_PowerRatio 8-13//1-4 C4-T4_avg], ADR [red=right, blue=left], 8-13/1-4 Hz, C4-T4, 0 - 2
Time Avg <0,30> [FFT_PowerRatio 8-13//1-4 P3-O1_avg], FFT_PowerRatio 8-13//1-4 P3-O1_avg, 8-13/1-4 Hz, P3-O1, 0 - 2
Time Avg <0,30> [FFT_PowerRatio 8-13//1-4 P4-O2_avg], ADR [red=right, blue=left], 8-13/1-4 Hz, P4-O2, 0 - 2


Fp1 - F7
F7 - T3
T3 - T5
T5 - O1
Fp2 - F8
F8 - T4
T4 - T6
T6 - O2
Fp1 - F3
F3 - C3
C3 - P3
P3 - O1
Fp2 - F4
F4 - C4
C4 - P4
P4 - O2
Fz - Cz
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140 uV
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Asymmetry, Relative Spectrogram, Asym Hemi, 1 - 18 Hz
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Time (2 min. running ave.), FFT PowerRatio, 8-13/1-4 Hz, Left Hemisphere and FFT PowerRatio, 8-13/1-4 Hz, Right Hemisphere, 0 - 2
Time Avg <0,30> [FFT_PowerRatio 8-13//1-4 F3-C3_avg], FFT_PowerRatio 8-13//1-4 F3-C3_avg, 8-13/1-4 Hz, F3-C3, 0 - 2
Time Avg <0,30> [FFT_PowerRatio 8-13//1-4 F4-C4_avg], ADR [red=right, blue=left], 8-13/1-4 Hz, F4-C4, 0 - 2
Time Avg <0,30> [FFT_PowerRatio 8-13//1-4 C3-T3_avg], FFT_PowerRatio 8-13//1-4 C3-T3_avg, 8-13/1-4 Hz, C3-T3, 0 - 2
Time Avg <0,30> [FFT_PowerRatio 8-13//1-4 C4-T4_avg], ADR [red=right, blue=left], 8-13/1-4 Hz, C4-T4, 0 - 2
Time Avg <0,30> [FFT_PowerRatio 8-13//1-4 P3-O1_avg], FFT_PowerRatio 8-13//1-4 P3-O1_avg, 8-13/1-4 Hz, P3-O1, 0 - 2
Time Avg <0,30> [FFT_PowerRatio 8-13//1-4 P4-O2_avg], ADR [red=right, blue=left], 8-13/1-4 Hz, P4-O2, 0 - 2

II. Utile ou futile ?

EEGc et état de mal non – convulsif | EEGc et crises non – convulsives | **EEGc et détection de l'ischémie**

Table 3

Performance measures for DCI prediction following SAH using cEEG monitoring, stratified by composite admission risk score

	Low Risk [risk score = 1]	Medium Risk [risk score = 2.5]	High Risk [risk score = 4]
Sensitivity (%)	91 [81–98]	94 [88–99]	95 [87–99]
Specificity (%)	83 [71–93]	80 [69–90]	77 [36–99]
LR+	5.37 [3.1–13.2]	4.7 [3.0–9.8]	4.2 [1.5–66.3]
LR–	0.1 [0.02–0.24]	0.08 [0.02–0.15]	0.06 [0.01–0.22]
PTP (%)	37 [25–50]	58 [50–66]	79 [61–92]
ARI (%)	39 [26–51]	29 [21–36]	15 [4–28]
PPV (%)	76 [58–90]	87 [79–94]	94 [79–100]
ARR (%)	32 [20–43]	48 [39–57]	60 [30–77]
NPV (%)	94 [87–99]	90 [81–98]	81 [47–97]
DOR	52 [16–448]	57 [24–321]	69 [8 – 4204]
NNM	2.6 [2.0–3.8]	3.5 [2.8–4.8]	6.7 [3.6–25.3]

Table 2

Univariate association between time-dependent predictors and subsequent DCI

	DCI (n=52)	No DCI (n=51)	OR [95% CI]	p-value
Any EEG alarm documented	96.2%	19.6%	102.5 [21.3, 494]	<0.01
Worsening slowing, ADR or RAV	63.5%	17.7%	8.11 [3.25, 20.2]	<0.01
Worsening focal slowing	15.4%	7.8%	2.14 [0.60, 7.60]	0.19
Worsening ADR	32.7%	9.8%	4.47 [1.50, 13.3]	<0.01
Worsening RAV	42.3%	2.0%	36.7 [4.70, 286.11]	<0.01
New epileptiform abnormality	63.5%	7.84%	20.4 [6.36, 65.5]	<0.01
Sonographic vasospasm				
Maximum PSV > 200 cm/sec	75.0%	45.1%	3.65 [1.58, 8.42]	<0.01
Maximum PSV > 250 cm/sec	57.7%	33.3%	2.73 [1.2, 6.1]	0.01
Maximum PSV > 300 cm/sec	30.8%	19.6%	1.80 [0.73, 4.52]	0.14

ARD = alpha-to-delta ratio; CI = confidence interval; DCI = delayed cerebral ischemia; EEG = electroencephalography; PSV = transcranial Doppler ultrasound peak systolic velocity; RAV = relative alpha variability.

Rosenthal ES, Biswal S, Zafar SF, et al. Continuous electroencephalography predicts delayed cerebral ischemia after subarachnoid hemorrhage: A prospective study of diagnostic accuracy. *Ann Neurol*. 2018;83(5):958-969. doi:10.1002/ana.25232

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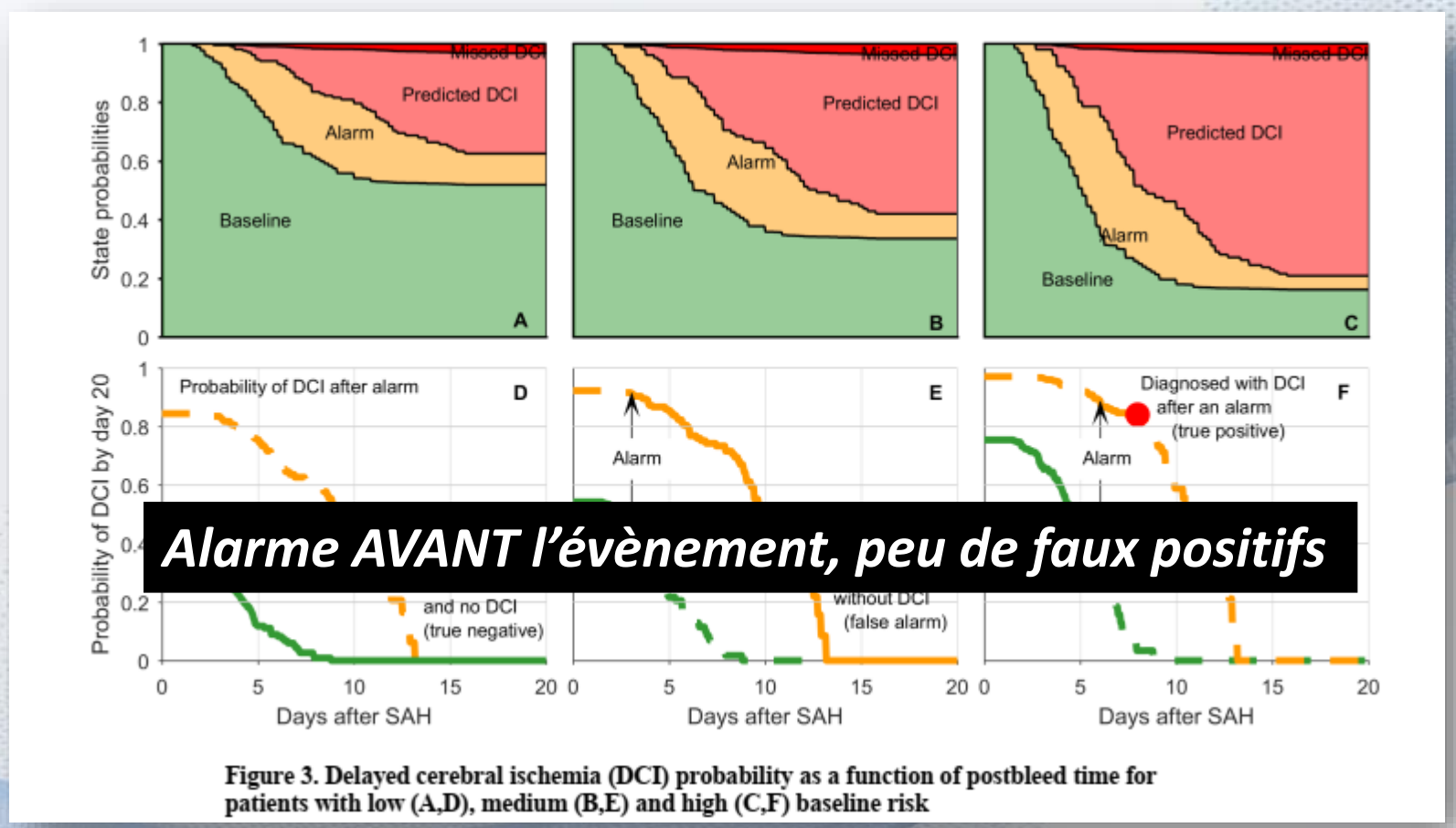
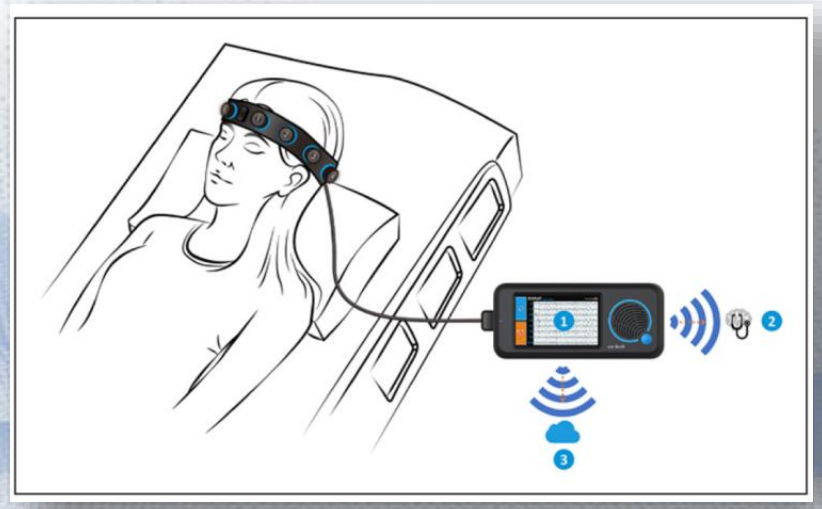


Alarme AVANT l'évènement, peu de faux positifs

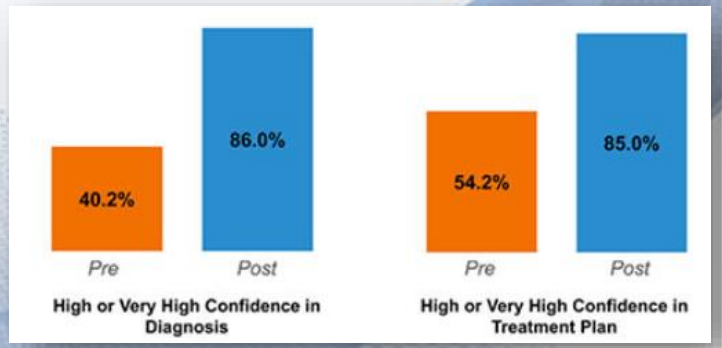
Figure 3. Delayed cerebral ischemia (DCI) probability as a function of postbleed time for patients with low (A,D), medium (B,E) and high (C,F) baseline risk

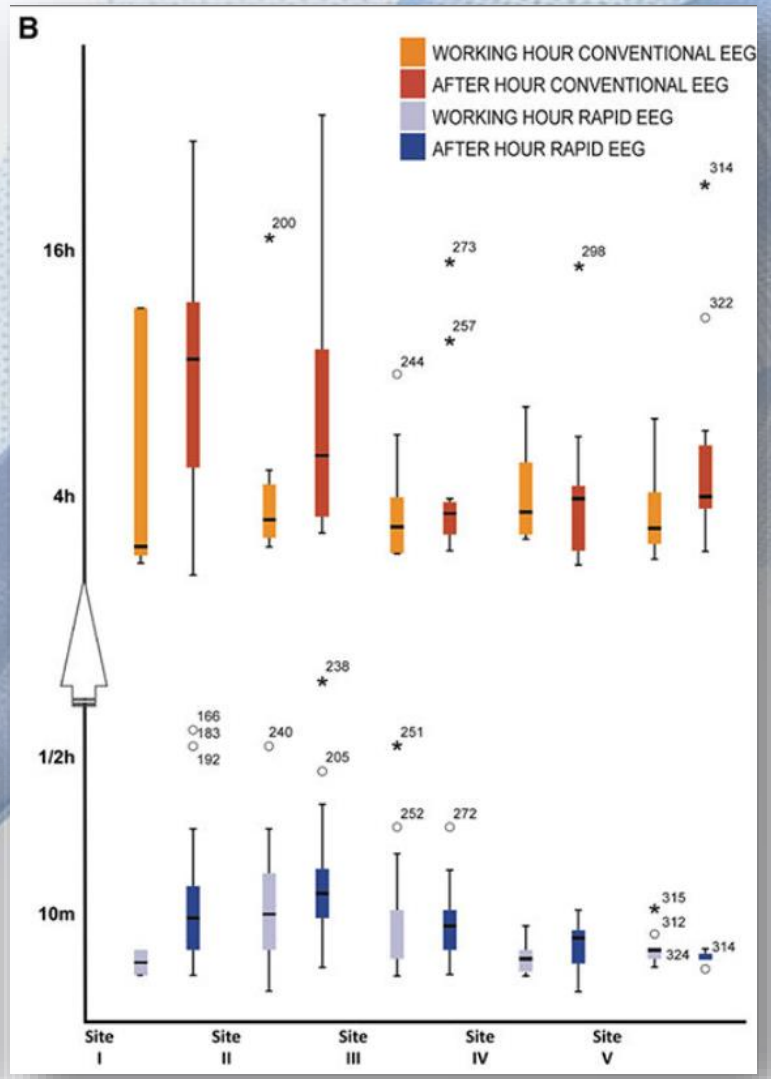
Rosenthal ES, Biswal S, Zafar SF, et al. Continuous electroencephalography predicts delayed cerebral ischemia after subarachnoid hemorrhage: A prospective study of diagnostic accuracy. *Ann Neurol*. 2018;83(5):958-969. doi:10.1002/ana.25232

III. Conclusion : vers un monitorage de routine ?



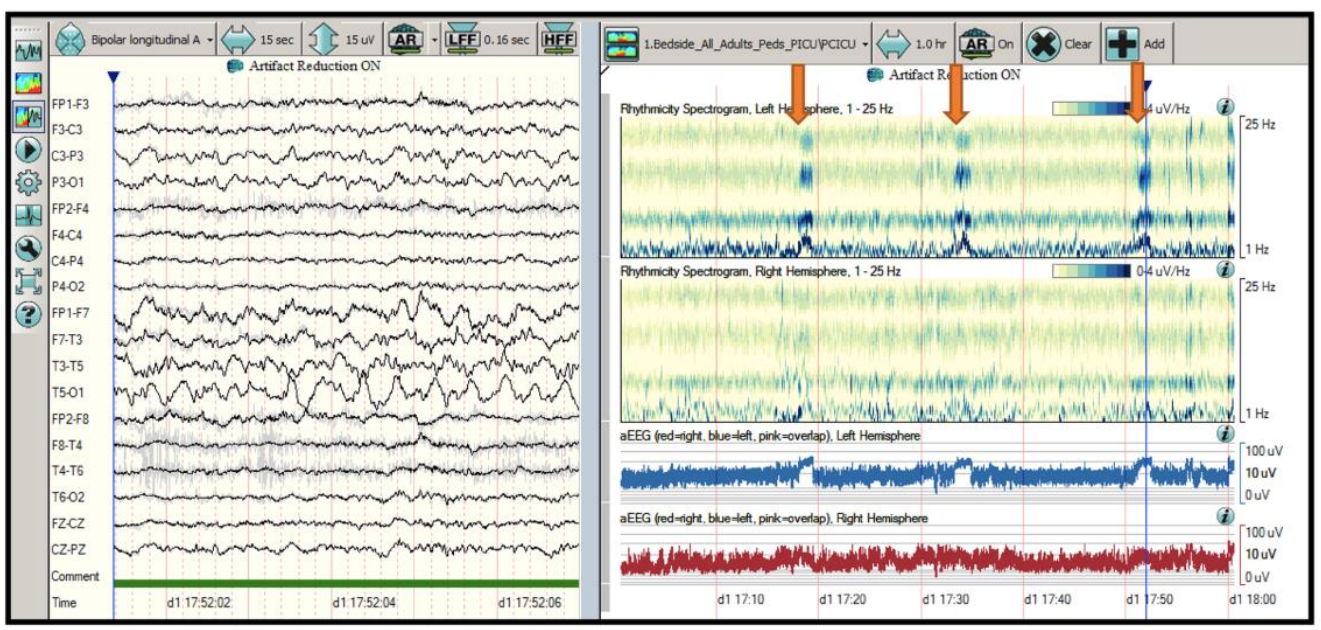
Decide Trial

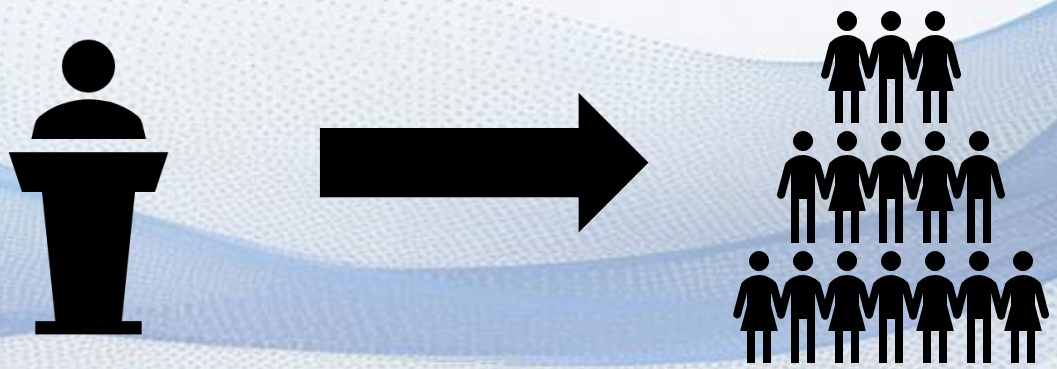




Vespa PM, Olson DM, John S, et al. Evaluating the Clinical Impact of Rapid Response Electroencephalography: The DECIDE Multicenter Prospective Observational Clinical Study. *Crit Care Med*. 2020;48(9):1249-1257. doi:10.1097/CCM.0000000000004428

III. Conclusion : vers un monitorage de routine ?





IDE neuro – réa

Kaleem et al. 2021 :
Sensibilité 74 % Spécificité 92 %

Kang et al. 2019 :
Sensibilité 85 % Spécificité 90 %

Ganesan et al. 2018 :
Sensibilité aEEG
- ***Internes réa 83.8%***
- ***IDE réa 73.1%***
- ***Neuro 81.5%***

Sensibilité DSA
- ***Internes réa 82.4%***
- ***IDE réa 88.2%***
- ***Neuro 83.3%***

III. Conclusion : vers un monitorage de routine ?

I. Accessible ou ~~élitiste~~ ?

- EEG quantifié

II. Utile ou ~~futile~~ ?

- Etat de mal et crises non – convulsives = > diagnostic difficile
- Ischémie = > Monitorage multimodal de l'HSA

III. Conclusion : vers un monitorage de routine ?

- [(IDE + Rea) x EEG quantifie]^{Neurologues} = Scope EEG

Merci de votre attention ! et pour aller plus loin …

… un DU …

UNIVERSITÉ de Picardie Jules Verne

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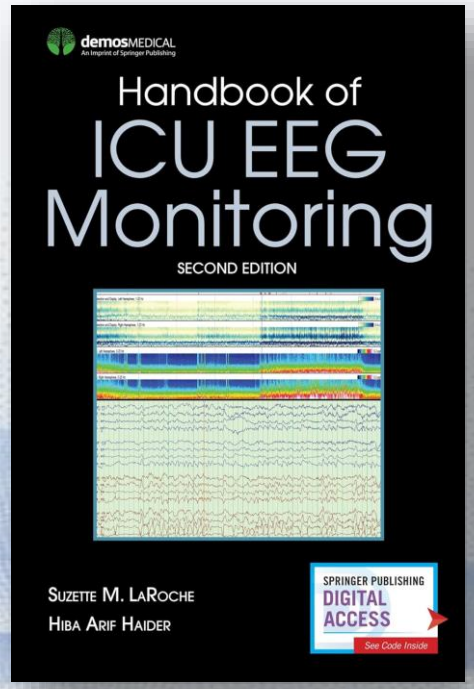
80036 Amiens
https://medecine.u-picardie.fr/

DU
ELECTROPHYSIOLOGIE EN RÉANIMATION

Objectifs

Les objectifs du Diplôme d'Université ElectroPhysiologie en Réanimation sont de :

- Former les médecins réanimateurs à l'utilisation et à l'interprétation des examens électro physiologiques
- Améliorer les compétences des neurophysiologistes sur l'interprétation des examens électro physiologiques effectués en réanimation



… un livre de référence …

Bitar *et al. Critical Care* (2024) 28:244
https://doi.org/10.1186/s13054-024-04986-0

Critical Care

REVIEW Open Access

Utility and rationale for continuous EEG monitoring: a primer for the general intensivist

Ribal Bitar[1], Usaamah M. Khan[1] and Eric S. Rosenthal[1*]

… ou une revue récente !