université de BORDEAUX

DIU Pratique et théorie de l'électroconvulsivothérapie

9h30 – 12 h15
Histoire et concept électricité et stimulations cérébrales non invasives

14h00 – 16h00
Rappel sur l'électrophysiologie
Lecture EEG lors ECT
Machines ECT, quels choix

SANPSY
SOMMEIL-ATTENTION-NEUROPSYCHIATRIE
cnrs
CHU Hôpitaux de Bordeaux
université de BORDEAUX

DIU Pratique et théorie de l'électroconvulsivothérapie

Diplôme Inter-Universitaire « PRATIQUE ET THÉORIE DE L'ÉLECTROCONVULSIVOTHÉRAPIE »
Année universitaire 2021-2022 / Université de Bordeaux – Nantes – Lyon

SEMINAIRE 1 BORDEAUX du 31 janvier au 2 février 2022

https://formatoile2.u-bordeaux.fr/course/view.php?id=3366

https://u-bordeaux-fr.zoom.us/j/87470030133?pwd=M2ZEQU9YTnkyYnJGbmZ1cVRnNXZYdz09
ID de réunion : 874 7003 0133
Code secret : 781942

Lundi 31 janvier 2022	Mardi 1er février 2022	Mercredi 2 février 2022
Cours enregistré, vidéo en différé (lien à venir) : Informations générales / le DIU ECT en 60 mn **(Marc AURIACOMBE)** **13 h 00 – 14 h 00** Session en direct : questions et réponses au sujet du DIU ECT	**9 h 30 – 12 h 15 (intervention en direct)** Histoire et concept électricité et stimulations cérébrales non invasives **(Christophe DAUDET)** **(Jean-Arthur MICOULAUD-FRANCHI)**	**10 h00 – 11 h 30 (intervention en direct)** Stimulation cérébrale non invasive et réseaux neuronaux **(Christophe DAUDET)** **11 h 30 - 12 h 30** Mémoires **Discussions des sujets**
14 h 00 – 16 h 45 (intervention en direct) Mémoire et dépression, Comment les mesurer avec quels outils ? **(Sophie AURIACOMBE)** Les effets de l'ECT sur la cognition : rappels sur la mémoire, Mémoire et dépression, (**Sophie AURIACOMBE**)	**14 h 00 – 16 h 00 (intervention en direct)** Rappel sur l'électrophysiologie Lecture EEG lors ECT Machines ECT, quels choix **(Jean-Arthur MICOULAUD-FRANCHI)** **(Christophe DAUDET**	**14 h 30 – 16 h 30 (intervention en direct)** Phénoménologie de l'ECT. Rôle de la crise et de l'électricité **(Marc AURIACOMBE)** **Cours enregistré, vidéo en différé (lien à venir) :** Données de neuroimagerie dans la dépression dans le cadre de l'utilisation des ECT et de la rTMS

Renseignements pédagogiques : Pr Marc Auriacombe : marc.auriacombe@u-bordeaux.fr; Pr Emmanuel Poulet : emmanuel.poulet@chu-lyon.fr;
Pr Anne Sauvaget : Anne.sauvaget@chu-nantes.fr

Renseignements administratifs pour Lyon : claudine.martinenghi claudine.martinenghi@chu-lyon.fr
pour Nantes : anne.sauvaget anne.sauvaget@chu-nantes.fr
pour Bordeaux : alexia.larran alexia.larran@u-bordeaux.fr

Examen écrit : 1ére session	juin 2022 à Bordeaux, Lyon, Nantes	11 h - 13 h
2éme session (si échec à la 1ére session)	septembre 2022 à Bordeaux, Lyon, Nantes	11 h - 13 h
Date limite remise mémoire	octobre 2022 (validation sujet avril 2022)	
Soutenance des mémoires validé	décembre 2022, en visio Bordeaux, Lyon, Nantes	

Programme

1. ***Evolutions des objets technologiques de stimulations électriques cérébrales*** - 3h

- *En lien avec les évolutions sociales de l'électricité: entre vie et mort* - 1h30
  - *Evolution des technologies électriques : une vielle histoire (jam)*
  - *Deux types d'électricité : galvanisation (continu) / faradisation (alternatif) (cd)*

- *En lien avec le monde médicale : la recherche de la preuve* - 1h30
  - *Le cas Mesmer : naissance de l'essai contrôlé randomisé (jam)*
  - *Le cas des thérapies électriques et magnétiques : des fièvres aux chocs (cd)*

2. La mesure électro-physiologique EEG pendant les ECT - 1h
  - *Enregistrement EEG pendant une séance d'ECT*
  - *Lecture EEG*
  - *Adaptation de la cure en fonction de l'EEG*

3. Choix d'une machine d'ECT - 1h
  - *Evolution des machines*
  - *Critères de comparaisons et de choix*
  - *La recherche sur les machines ECT*

L'EEG

université de BORDEAUX

Les machines d’ECT actuel
sont aussi des machines d’EEG

Le plaidoyer

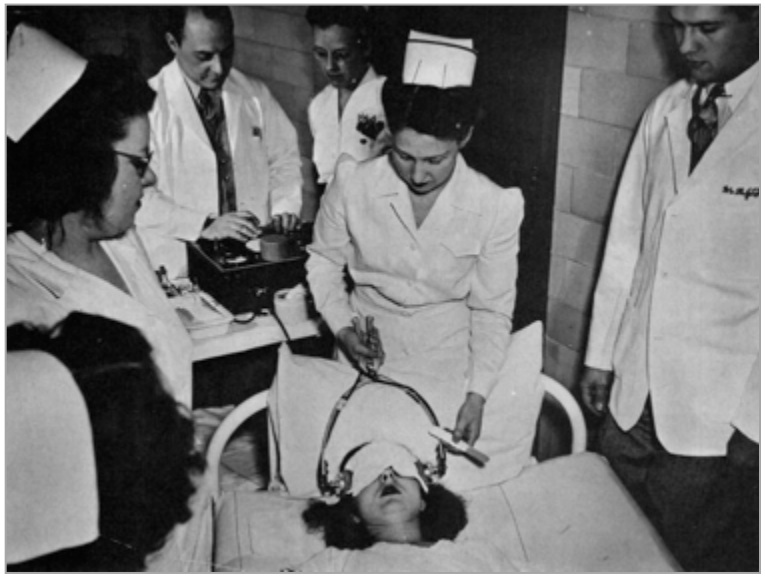
LES ECT SONT UNE TECHNIQUE

DE NEUROPHYSIOLOGIE INTERVENTIONNELLE !

Qui a réalisé de la neurophysiologie interventionnelle en premier ?

LES PSYCHIATRES !

Le début des ECT, n’est pas le début de l’électrothérapie



Cerletti et Beneti
ECT
1938

L’électrophysiologie interventionnelle

ÉLECTROPHYSIOLOGIE INTERVENTIONNELLE

La technique se propose de repérer par cartographie endocavitaire, puis de détruire la zone de myocarde arythmogène, les voies accessoires ou le tissu de conduction pour guérir définitivement le patient de son arythmie ou pour améliorer la tolérance fonctionnelle des tachycardies récidivantes [7-21]. La destruction est opérée par le cathéter d’ablation au travers duquel une source d’énergie est appliquée sur le substrat arythmogène.

RECOMMANDATIONS

Société Française de Cardiologie

Recommandations
de la Société française de cardiologie
concernant l’électrophysiologie
diagnostique et interventionnelle,
la stimulation cardiaque permanente
et la défibrillation automatique
implantable

La neurophysiologie interventionnelle

Neurophysiol Clin 2001 ; 31 : 215-7

S0987705301002660/EDI
www.elsevier.fr/direct/nc-cn

ÉDITORIAL INVITÉ

Plaidoyer pour une neurophysiologie interventionnelle

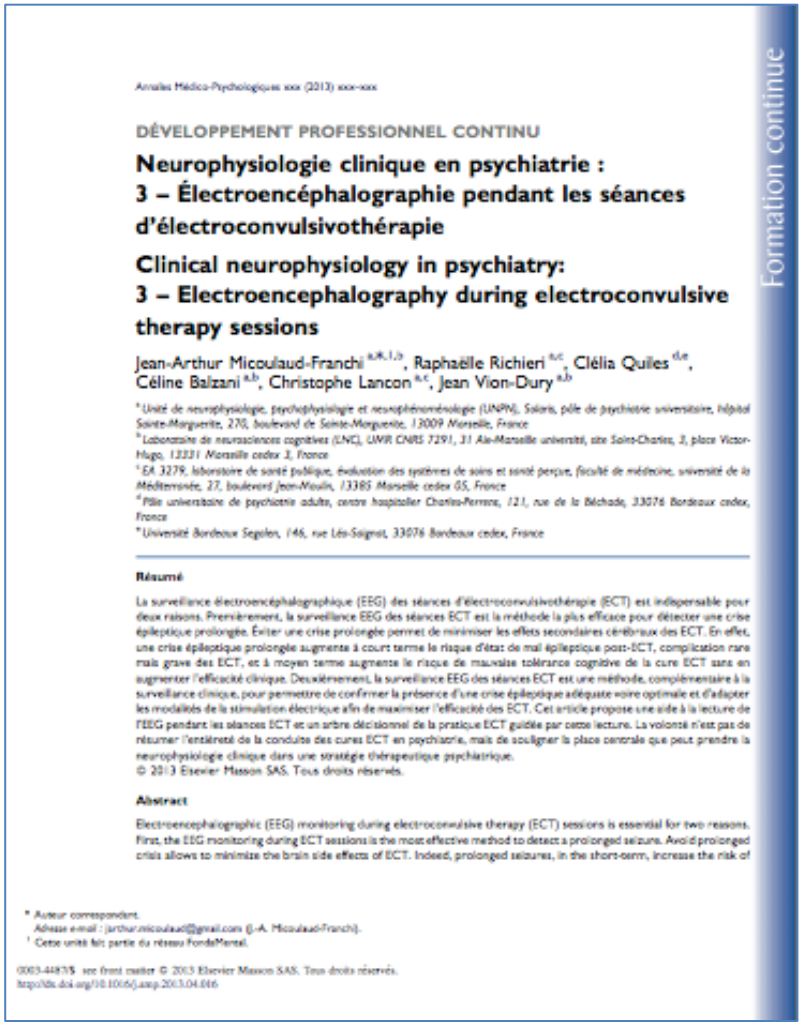
La participation de la neurophysiologie clinique prend place non seulement en salle d'opération au cours de l'intervention chirurgicale elle-même – c'est le « *Monitoring* peropératoire »

la neurophysiologie est, non pas seulement utile, mais réellement nécessaire à la thérapeutique. Plus que cela même, elle fait partie de cette thérapeutique et ne peut être dissociée de l'acte chirurgical

Les ECT et la neurophysiologie clinique

Il s'agit d'un excellent travail mais qui intéressera davantage
des non-spécialistes en neurophysiologie clinique
faisant appel à la méthode, en particulier, ***des psychiatres****.*

Ma suggestion serait dès lors de le soumettre à une revue psychiatrique, soit française ***(je ne les connais pas bien****),*
soit belge (par exemple, les Acta Psychiatrica Belgica).
Je suis certain qu'un tel article pourrait leur être d'une grande utilité.



Annales Médico-Psychologiques xxx (2013) xxx–xxx

DÉVELOPPEMENT PROFESSIONNEL CONTINU

Formation continue

Neurophysiologie clinique en psychiatrie : 3 – Électroencéphalographie pendant les séances d'électroconvulsivothérapie

Clinical neurophysiology in psychiatry: 3 – Electroencephalography during electroconvulsive therapy sessions

Jean-Arthur Micoulaud-Franchi [a,b,1,*], Raphaëlle Richieri [a,c], Clélia Quiles [d,e], Céline Balzani [a,b], Christophe Lancon [a,c], Jean Vion-Dury [a,b]

[a] Unité de neurophysiologie, psychophysiologie et neuropharmacologie (UNPN), Solaris, pôle de psychiatrie universitaire, hôpital Sainte-Marguerite, 270, boulevard de Sainte-Marguerite, 13009 Marseille, France
[b] Laboratoire de neurosciences cognitives (LNC), UMR CNRS 7291, 31 Aix-Marseille université, site Saint-Charles, 3, place Victor-Hugo, 13331 Marseille cedex 3, France
[c] EA 3279, laboratoire de santé publique, évaluation des systèmes de soins et santé perçue, faculté de médecine, université de la Méditerranée, 27, boulevard Jean-Moulin, 13385 Marseille cedex 05, France
[d] Pôle universitaire de psychiatrie adulte, centre hospitalier Charles-Perrens, 121, rue de la Béchade, 33076 Bordeaux cedex, France
[e] Université Bordeaux Segalen, 146, rue Léo-Saignat, 33076 Bordeaux cedex, France

Résumé

La surveillance électroencéphalographique (EEG) des séances d'électroconvulsivothérapie (ECT) est indispensable pour deux raisons. Premièrement, la surveillance EEG des séances ECT est la méthode la plus efficace pour détecter une crise épileptique prolongée. Éviter une crise prolongée permet de minimiser les effets secondaires cérébraux des ECT. En effet, une crise épileptique prolongée augmente à court terme le risque d'état de mal épileptique post-ECT, complication rare mais grave des ECT, et à moyen terme augmente le risque de mauvaise tolérance cognitive de la cure ECT sans en augmenter l'efficacité clinique. Deuxièmement, la surveillance EEG des séances ECT est une méthode, complémentaire à la surveillance clinique, pour permettre de confirmer la présence d'une crise épileptique adéquate voire optimale et d'adapter les modalités de la stimulation électrique afin de maximiser l'efficacité des ECT. Cet article propose une aide à la lecture de l'EEG pendant les séances ECT et un arbre décisionnel de la pratique ECT guidée par cette lecture. La volonté n'est pas de résumer l'entièreté de la conduite des cures ECT en psychiatrie, mais de souligner la place centrale que peut prendre la neurophysiologie clinique dans une stratégie thérapeutique psychiatrique.

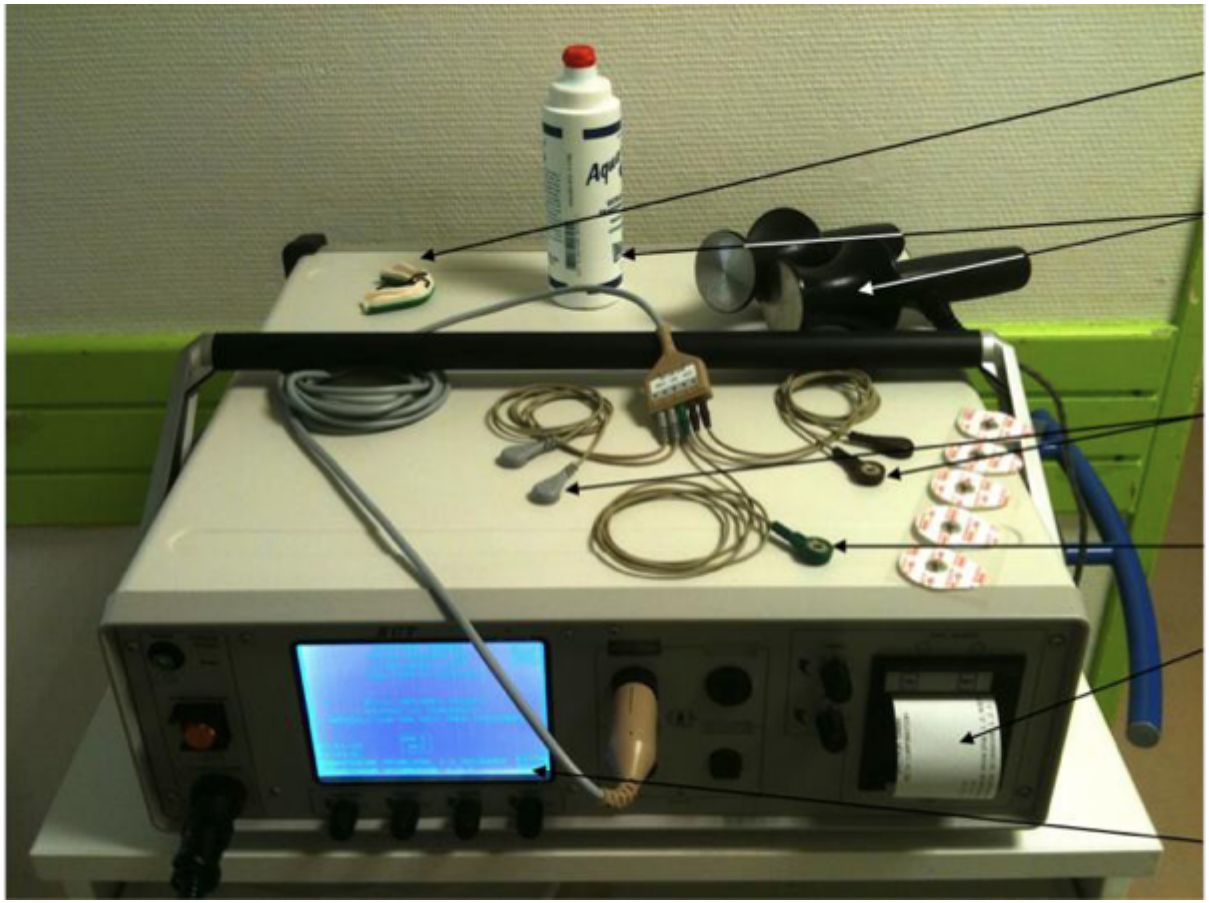
Abstract

Electroencephalographic (EEG) monitoring during electroconvulsive therapy (ECT) sessions is essential for two reasons. First, the EEG monitoring during ECT sessions is the most effective method to detect a prolonged seizure. Avoid prolonged crisis allows to minimize the brain side effects of ECT. Indeed, prolonged seizures, in the short-term, increase the risk of

* Auteur correspondant.
Adresse e-mail : jarthur.micoulaud@gmail.com (J.-A. Micoulaud-Franchi).
[1] Cette unité fait partie du réseau FondaMental.

0003-4487/$ – see front matter © 2013 Elsevier Masson SAS. Tous droits réservés.
http://dx.doi.org/10.1016/j.amp.2013.04.016

Outil de stimulation et d'enregistrement électrique



Gouttière dentaire de protection

Electrodes de stimulation et pâte conductrice

Electrodes d'enregistrement voie gauche et voie droite

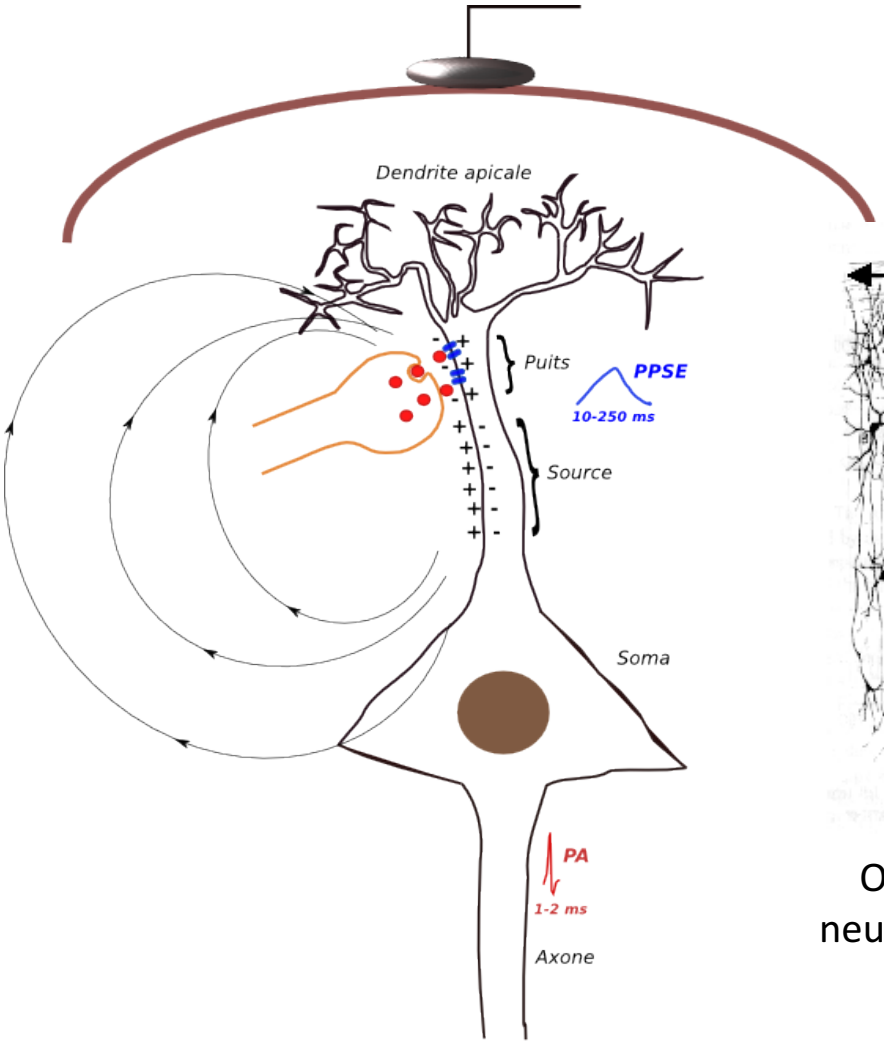
Electrode de terre

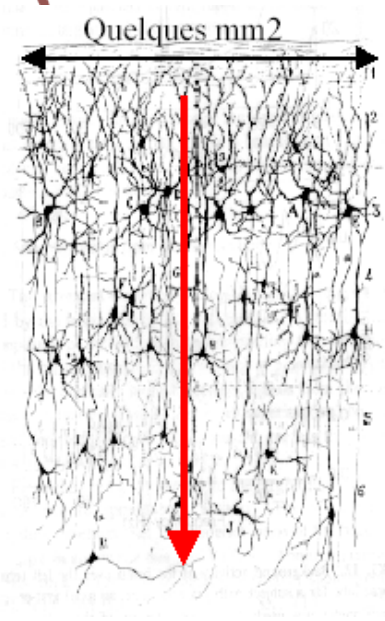
Papier d'enregistrement EEG

Ecran de réglages des paramètres de stimulation et d'enregistrement EEG

Qu’enregistre un signal EEG ?

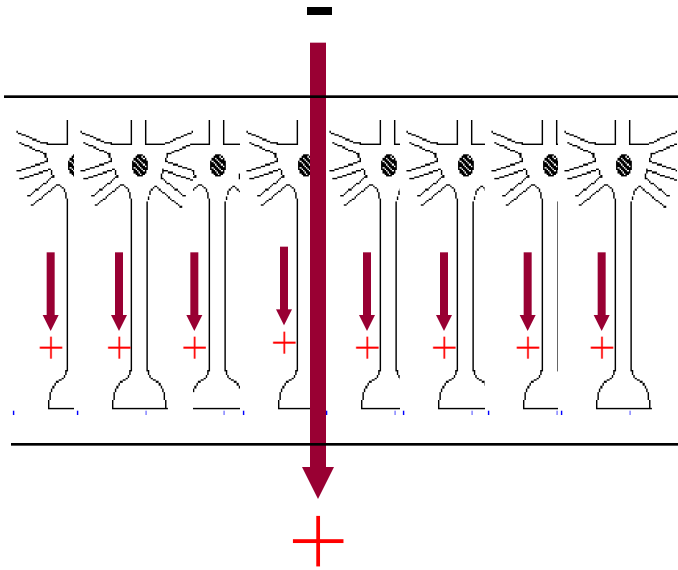
Qu'enregistre l'EEG ?



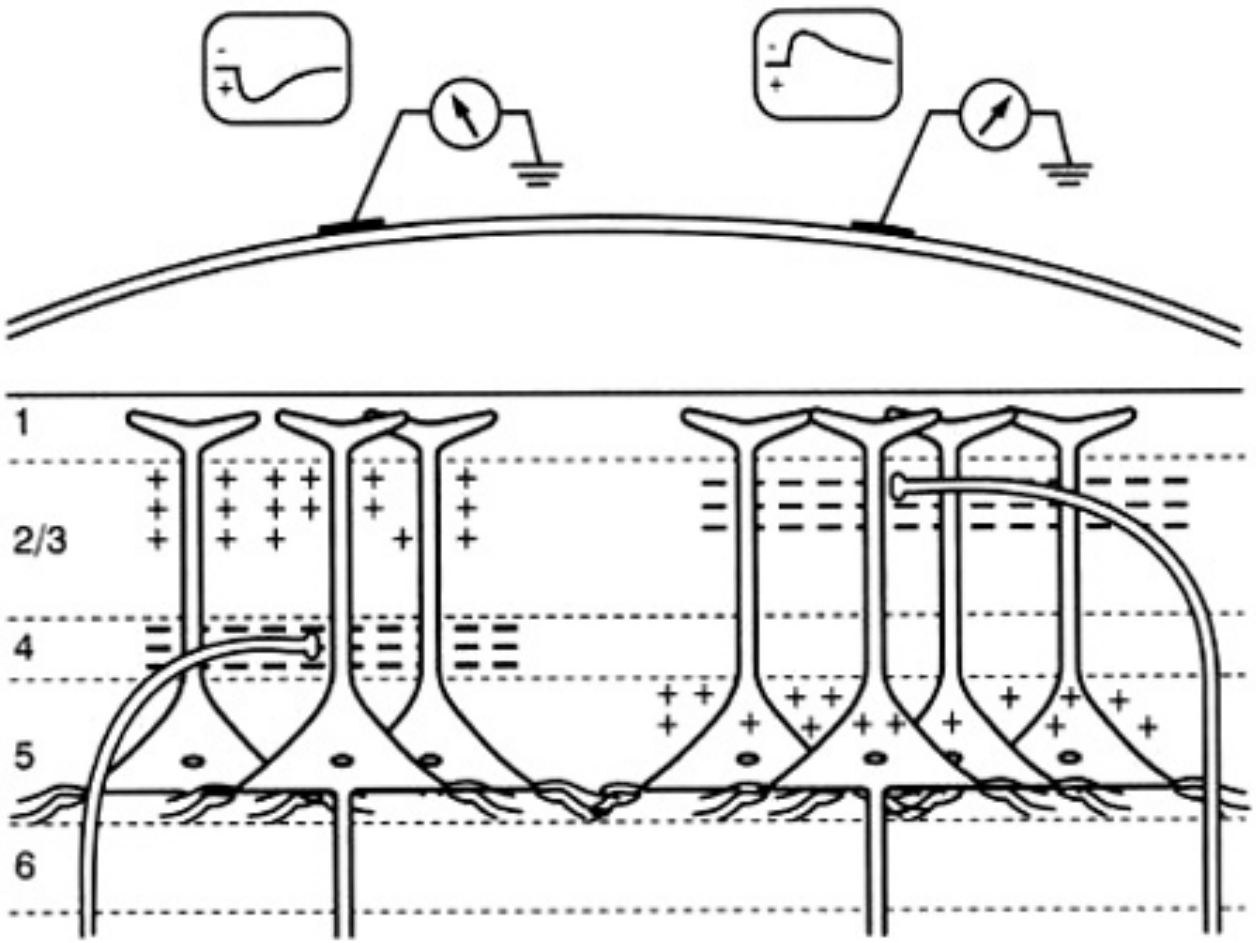


Organisation // des neurones dans le cortex

Dipole résultant
= Σ vectorielle des dipoles unitaires

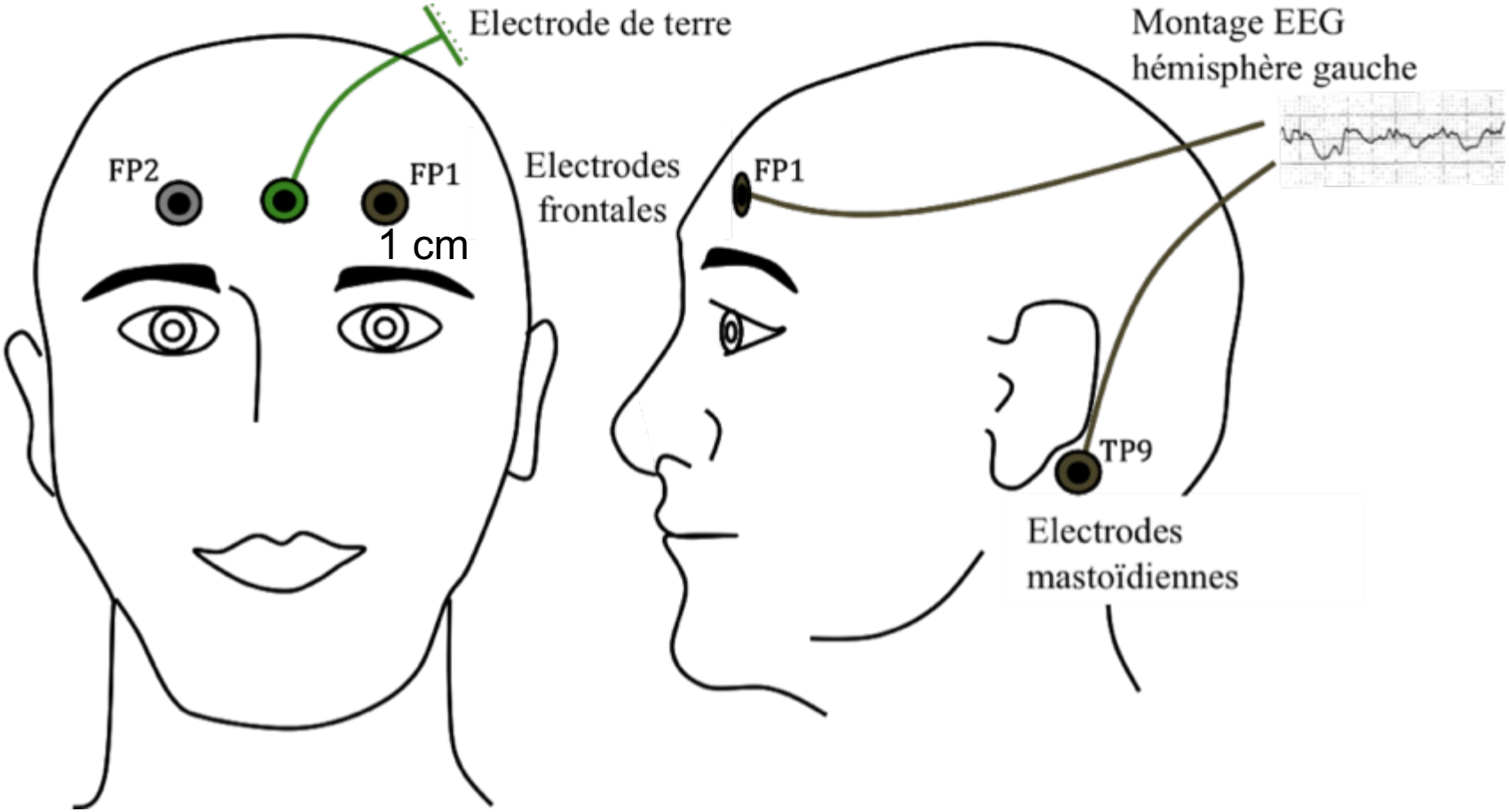


Qu’enregistre l’EEG ?



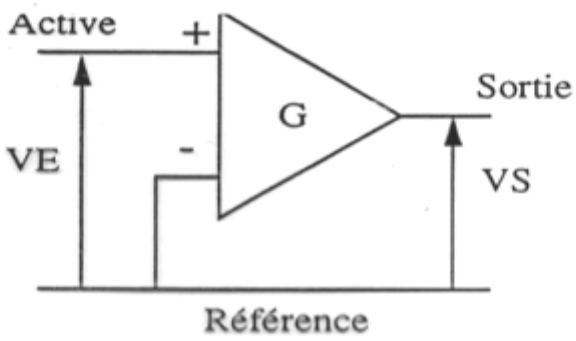
Comment enregistrer un signal EEG ?

Placement des électrodes



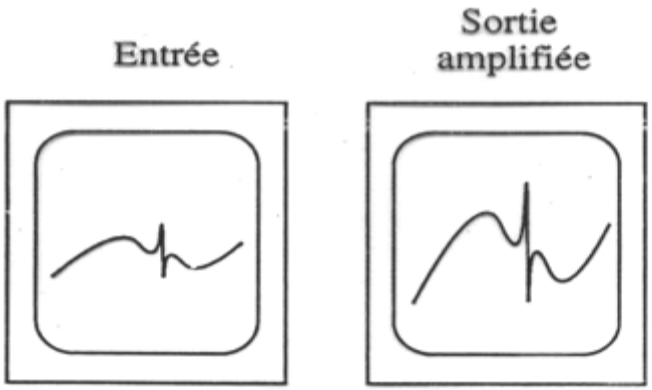
Amplification

Amplificateur simple

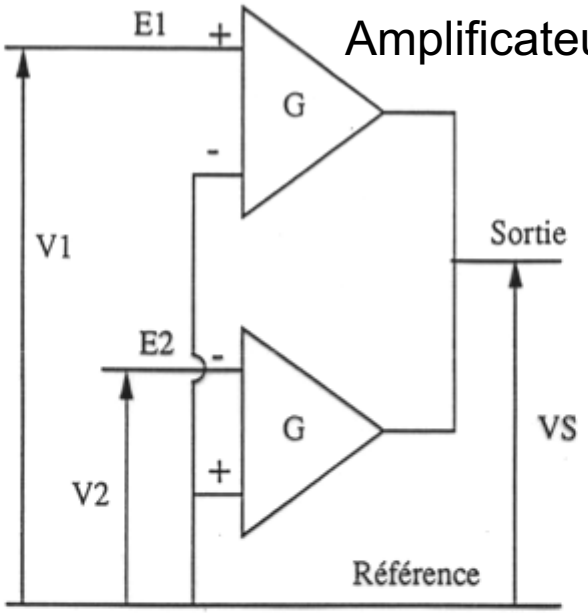


VS =G x VE

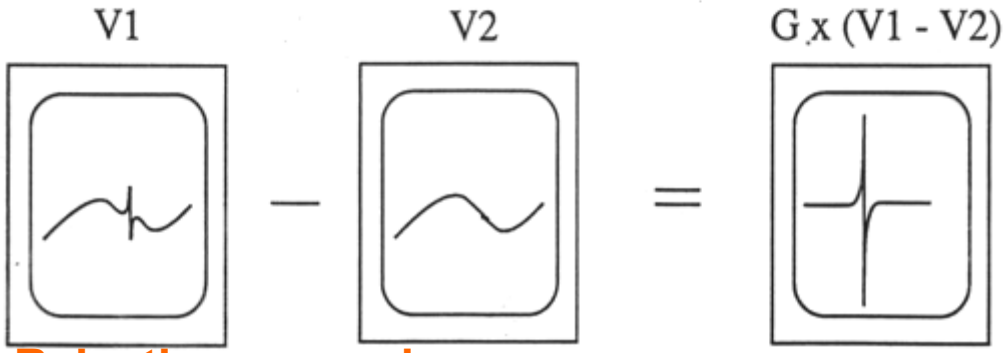
Gain G = VS/VE



Amplificateur différentiel



VS =.G x (V1-V2)



Rejection en mode commun

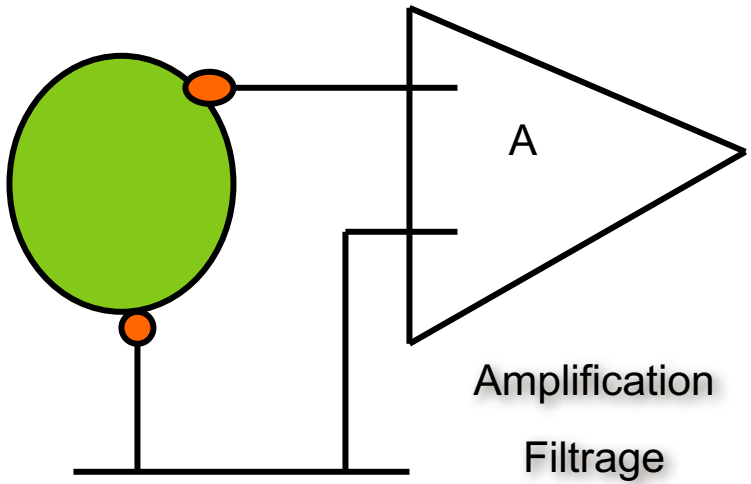
La chaine d’acquisition

Potentiel d’électrode et impédance

EEG : 100 µV, 0,16 - 30 Hz
EMG : 10 m V, 20 - 10 000 Hz
Gain d’amplification
Sensibilité (saturation)

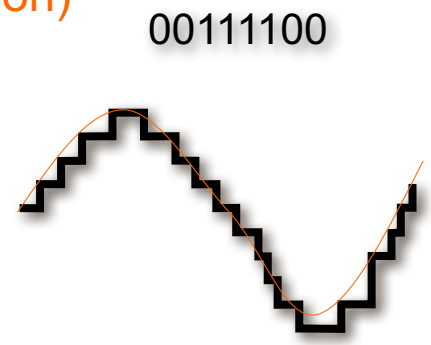
Résolution
Précision

Gain à l ’affichage
Filtre à l’affichage



Amplification

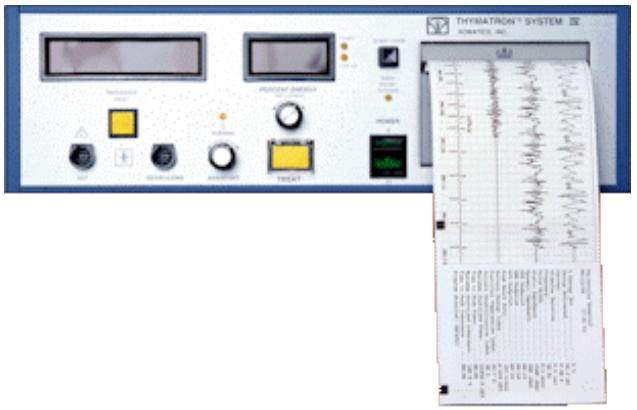
Filtrage



Conversion

Analogique Numérique

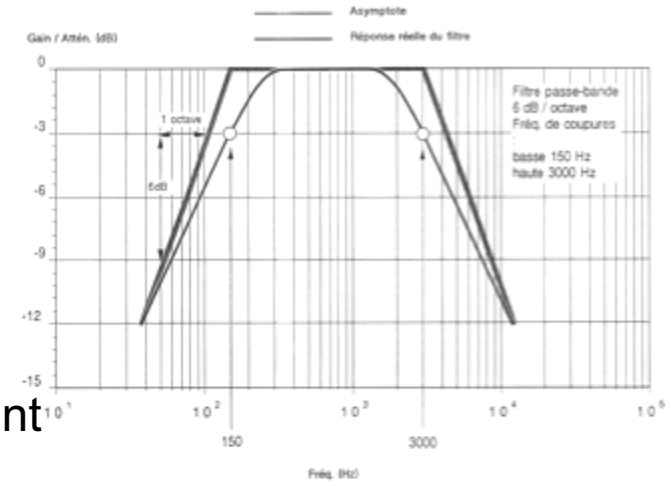
Echantillonnage



Visualisation du signal

Traitement du signal

Filtres



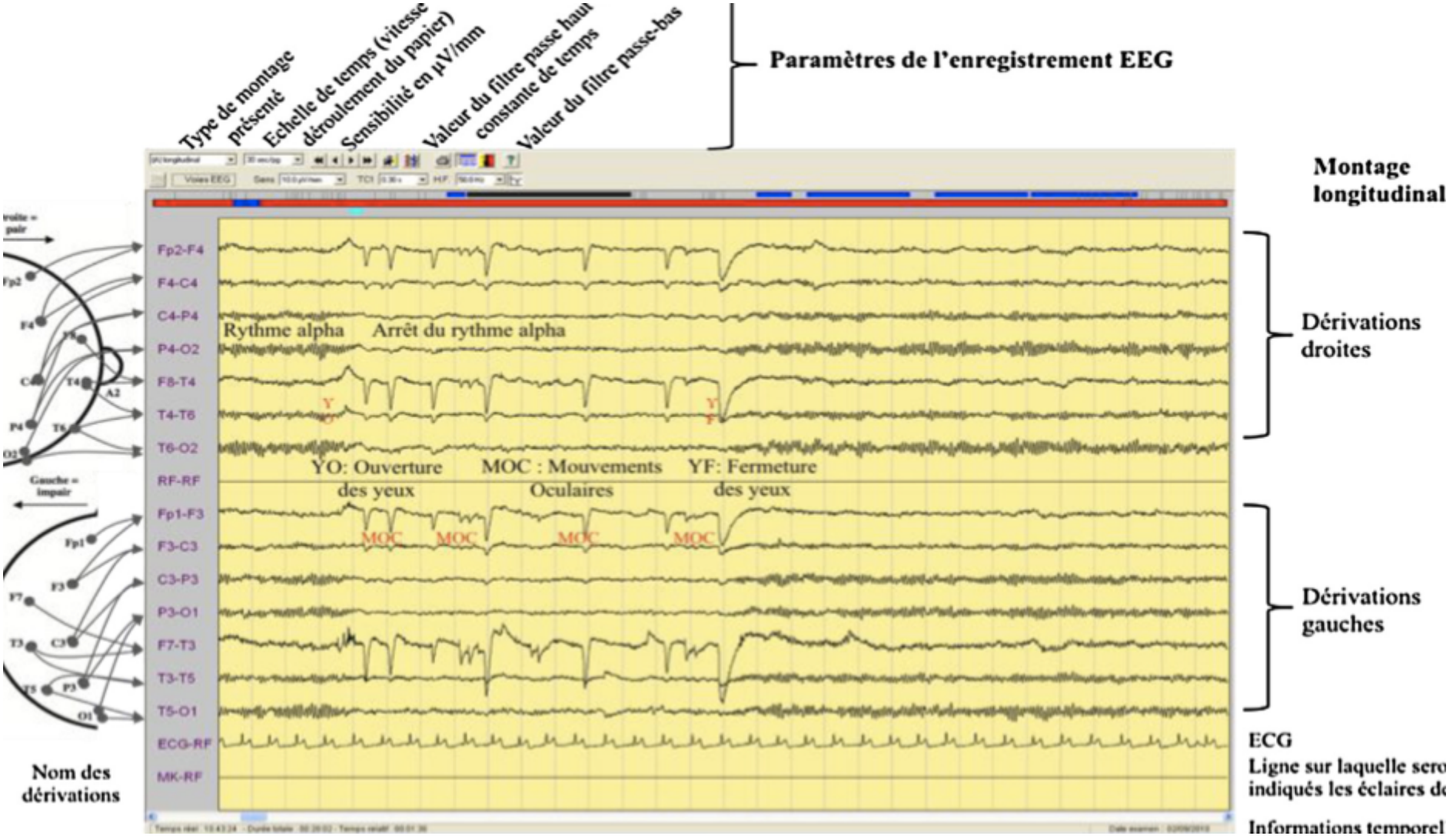
Mouvement
Sudation

EMG
Bruits électriques

Filtre passe haut **Filtre passe bas**

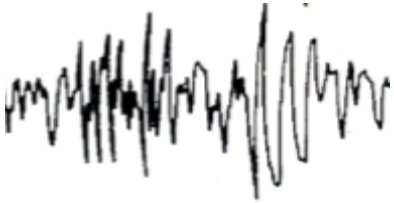
L’EEG traditionnel

L'EEG conventionnel



Le vocabulaire de description d'un EEG

Activités paroxystiques « épileptiformes »



Pointe

PolyP

P Onde

Poly PO

Activité paroxystique atypique
(onde lente angulaire)

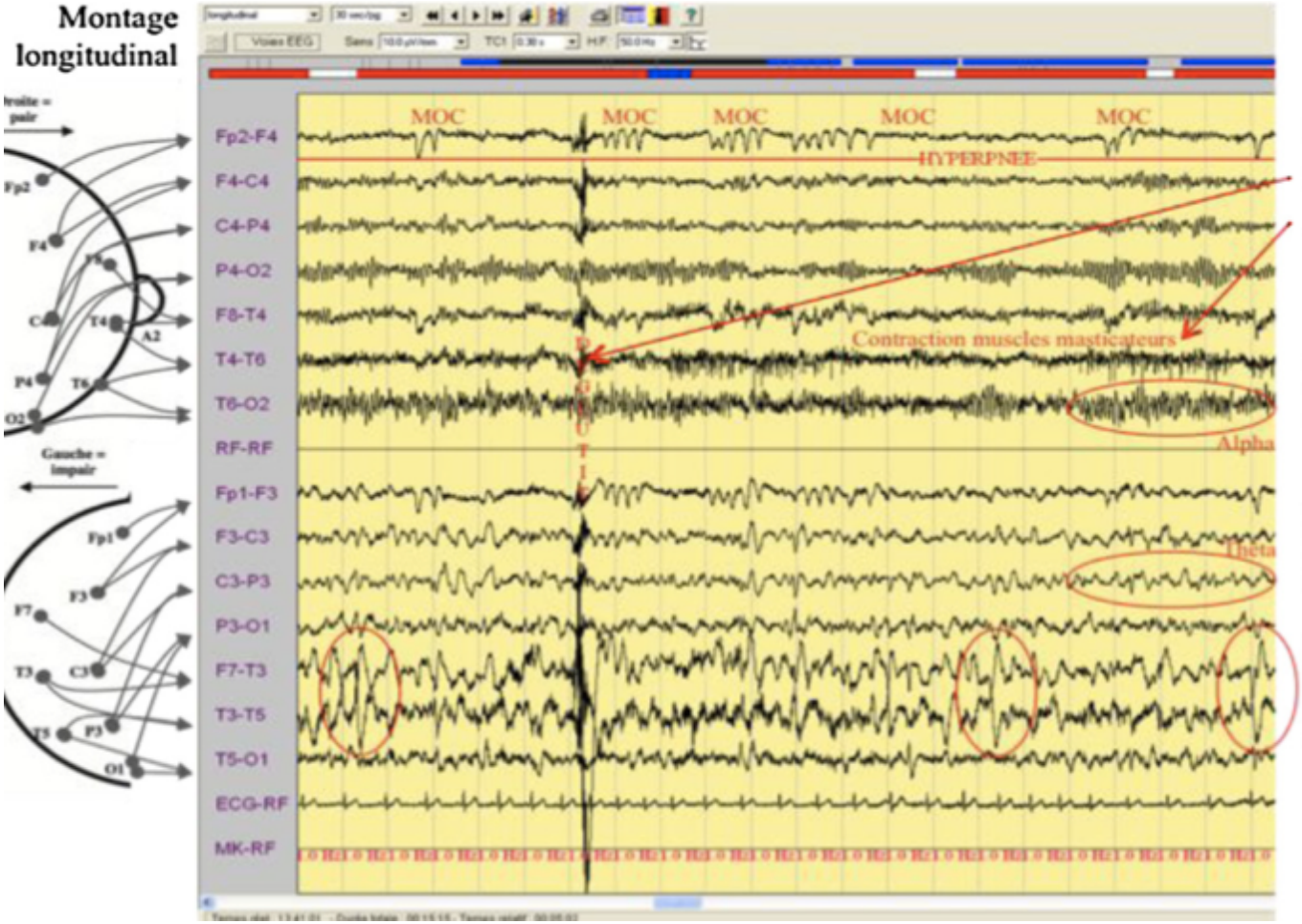
Rythme de fond

Beta

Alpha

Delta

Ce que l'on peut voir sur un EEG



Descriptions EEG

Signifi EE

Mouvements oculaires
Mouvement de déglutition
Activités musculaires

} Artéf biolo

Activité de fond postérieure dans la bande alpha, au niveau de l'hémisphère droit

} Activ physi droite

Rythme de fond hémisphérique gauche ralenti dans la bande thêta

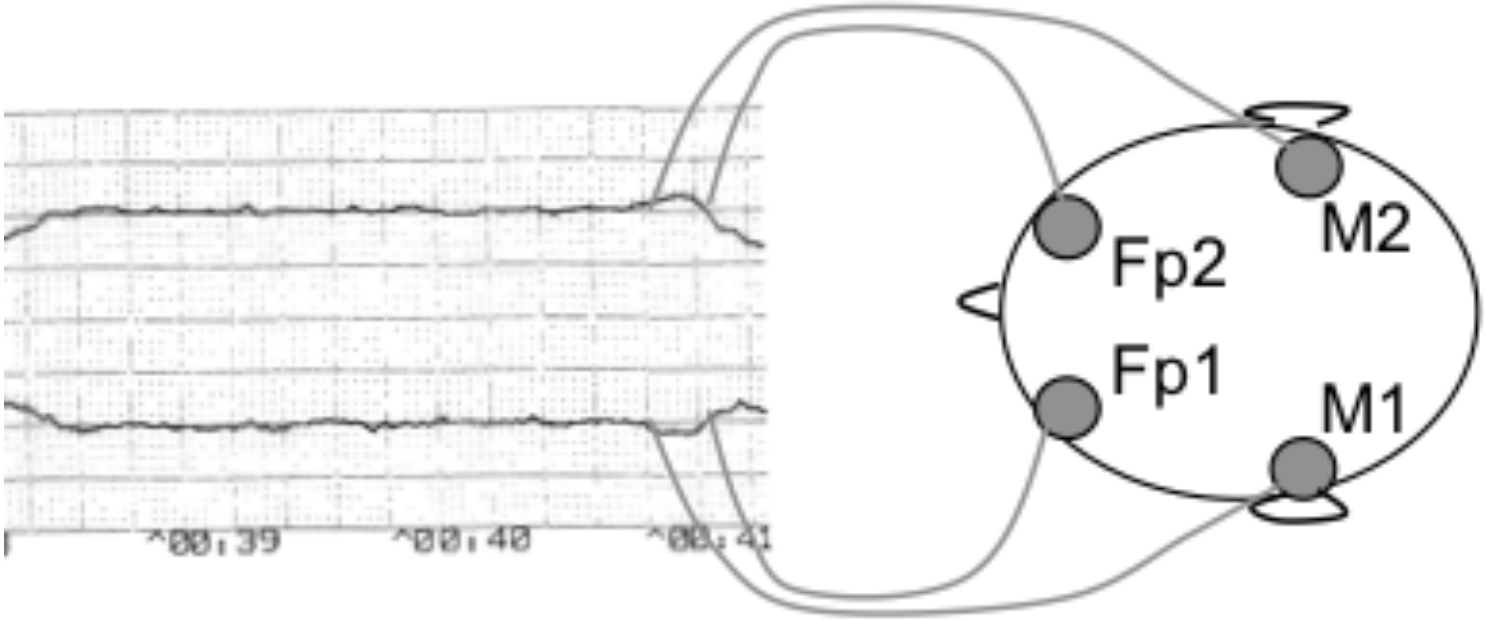
} Rythr patho gauch

Paroxysmes de type ondes lentes angulaires et pointes ondes dégradés focalisés (en opposition de phase) sur T3

} Parox inter-

L’EEG des ECT

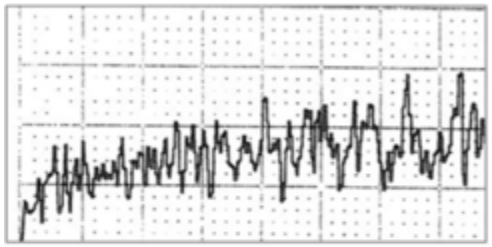
Droite



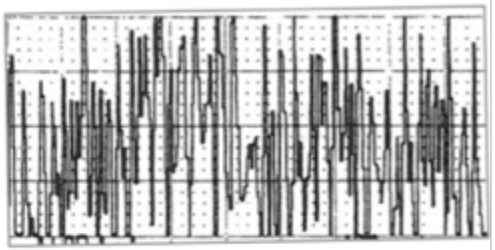
Gauche

Reconnaître les phases EEG de la crise

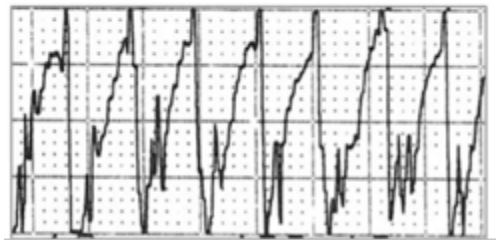
Phase critique 1:
Recrutement



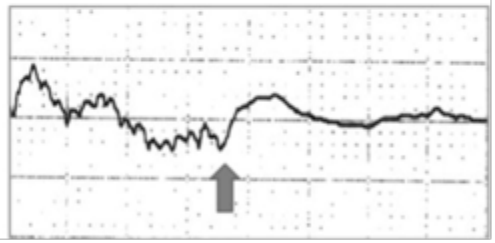
Phase critique 2:
Tonique (pointes)



Phase critique 3:
Clonique (pointes ondes)

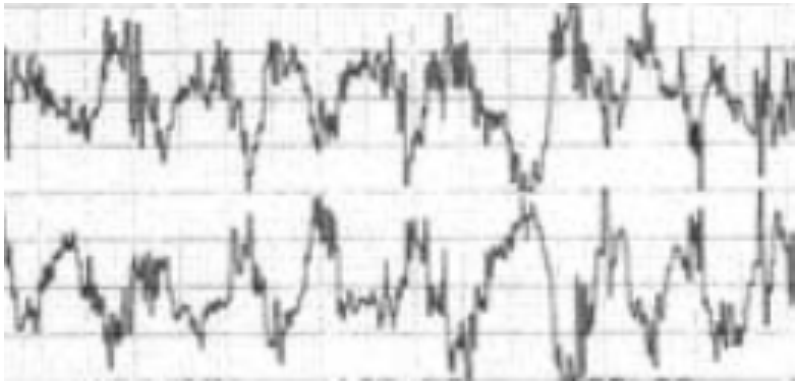


Phase critique 4 et
Suppression post-critique

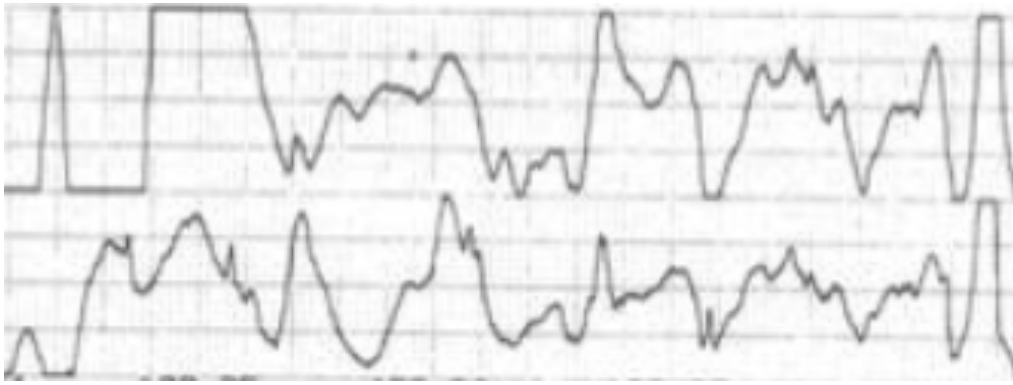


Reconnaître les artéfacts biologiques et techniques

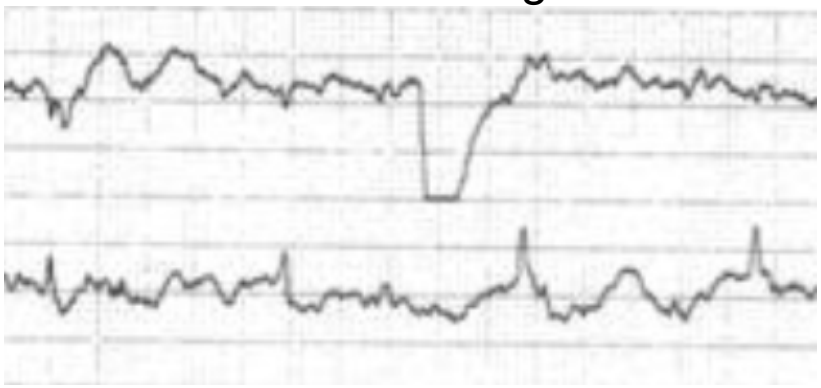
Artéfacts musculaires
(surchargeant des ondes lentes angulaires)



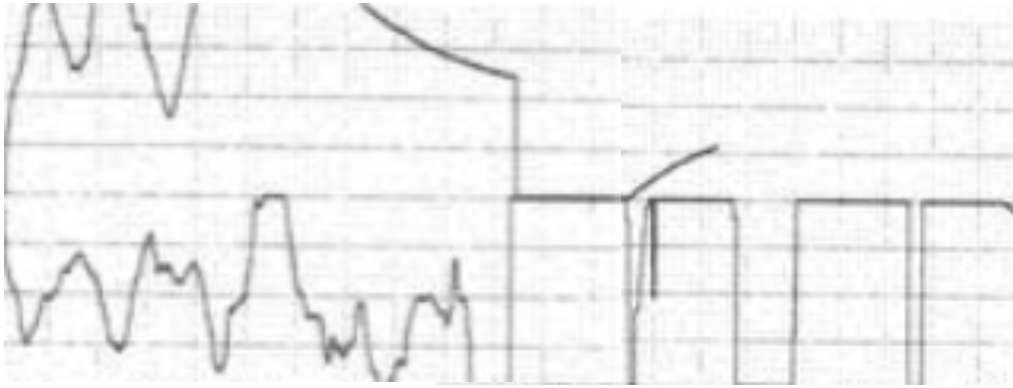
Artéfacts de mouvements
(manipulation de la tête du patient, ventilation au masque, et



Artéfacts d'électrocardiogramme

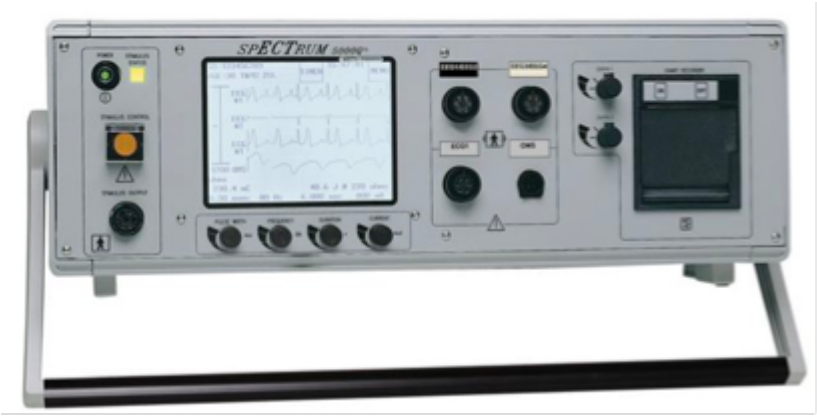


Artéfacts d'électrode



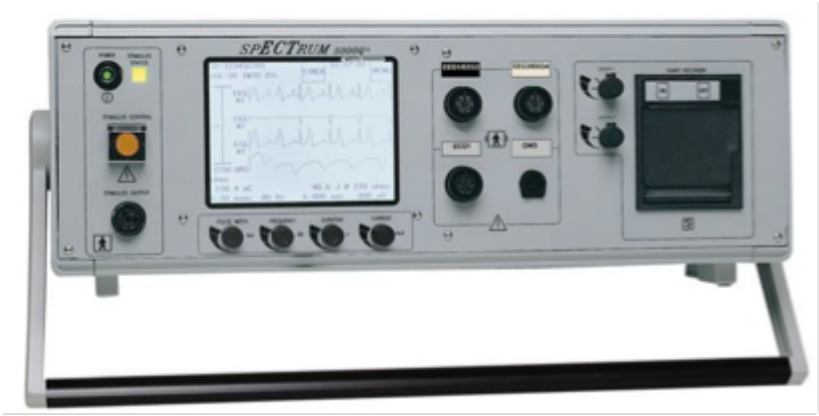
L’EEG et les machines ECT

MECTA (spectrum) vs THYMATRON



Différence de principe de choix de dose

Spectrum



Thymatron

Titration

Sackheim
Duke université

Age / dose

Abrams

Table de titration

Exemple de table avec des *pulses* brefs sur MECTA spECTrum® pour comprendre le principe de la titration et l'augmentation par palier des charges électriques délivrées.

	Durée du *pulse*	Fréquence de stimulation	Durée de la stimulation	Intensité	Charge électrique (mC)	Quantité d'énergie (pour une résistance de 300 Ω)
1	1	40	0,5	0,8	32	7,6
2	1	40	0,75	0,8	48	11,5
3	1	40	1,25	0,8	80	19,2
4	1	40	2	0,8	128	30,7
5	1	60	2	0,8	192	46
6	1	60	3	0,8	288	69,1
7	1	90	3	0,8	432	103
8	1,8	90	2,5	0,8	648	155
9	1,8	90	3,5	0,8	907,2	248
10	2	90	4	0,8	1 152	275

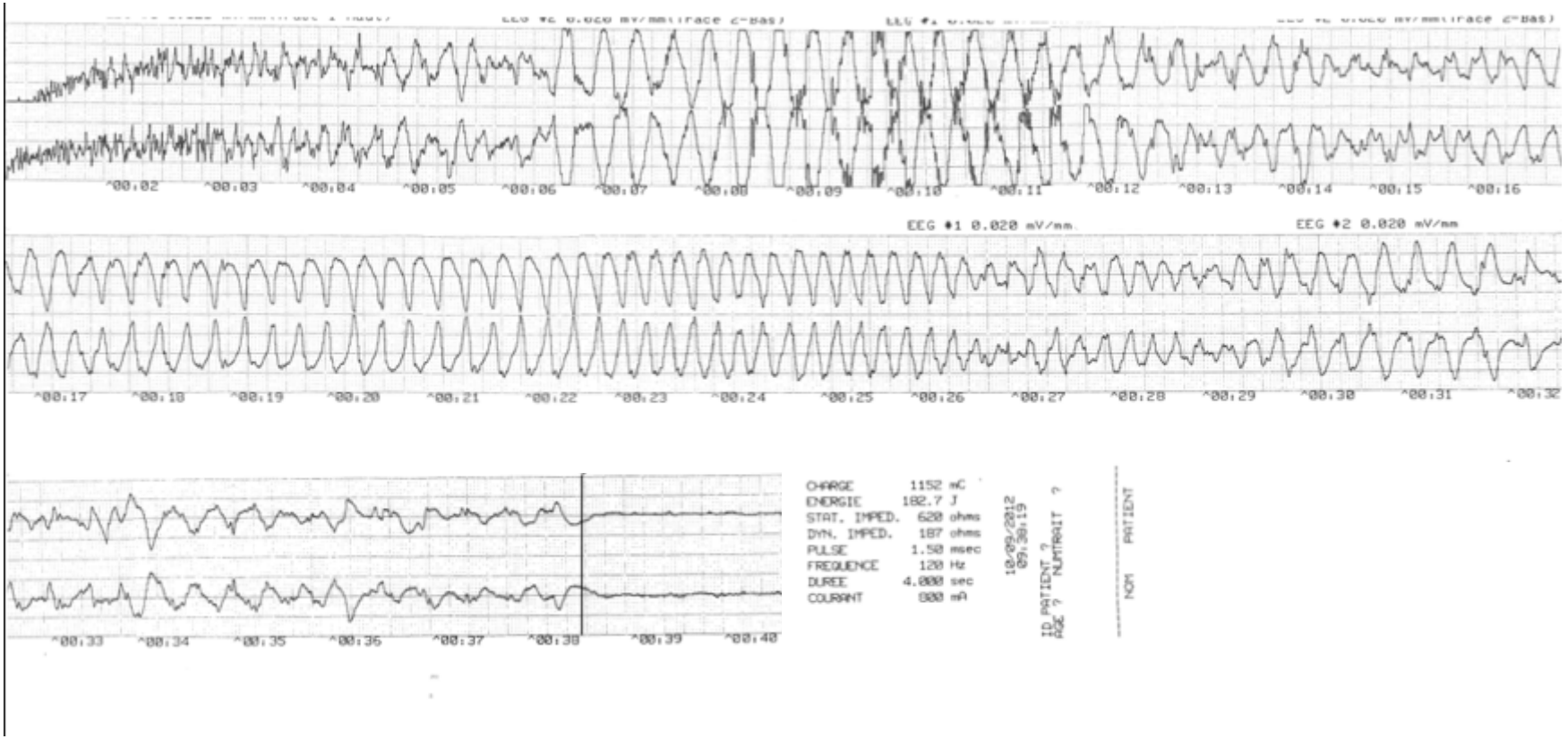
Il existe différents types de tables de titration qui peuvent dépendre du type de machine (MECTA spECTrum® et Somatics Thymatron®) et du type de *pulse* (ultra-bref ou bref), mais le principe reste le même.

Age / dose

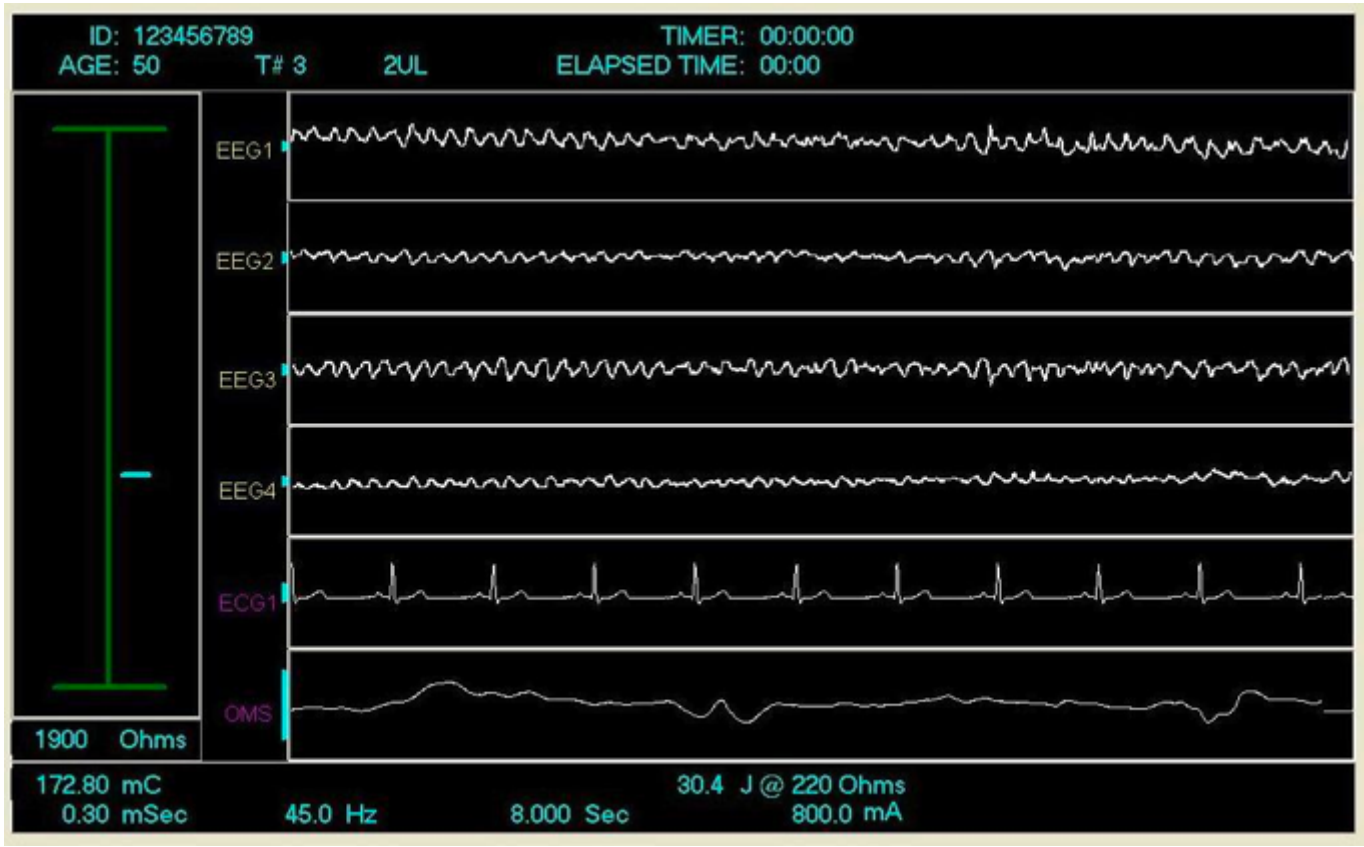
Exemple de table âge/dose pour comprendre le principe de la détermination de la charge électrique à délivrer en fonction de l'âge.

Âge	Fréquence de stimulation	Durée de la stimulation	Charge électrique (mC)
5	30	0,47	25,2
10	30	0,93	50,4
15	340	1,4	75,6
20	30	1,87	100,8
25	30	2,33	126
30	50	1,68	151,2
35	50	1,96	176,4
40	50	2,24	201,6
45	50	2,52	226,8
50	50	2,8	252
55	70	2,2	277,2
60	70	2,4	302,4
65	70	2,6	327,6
70	70	2,8	352,8
75	70	3	378
80	70	3,2	403,2
85	70	3,4	428,4
90	70	3,6	453,6
95	70	3,8	478,8
100	70	4	504

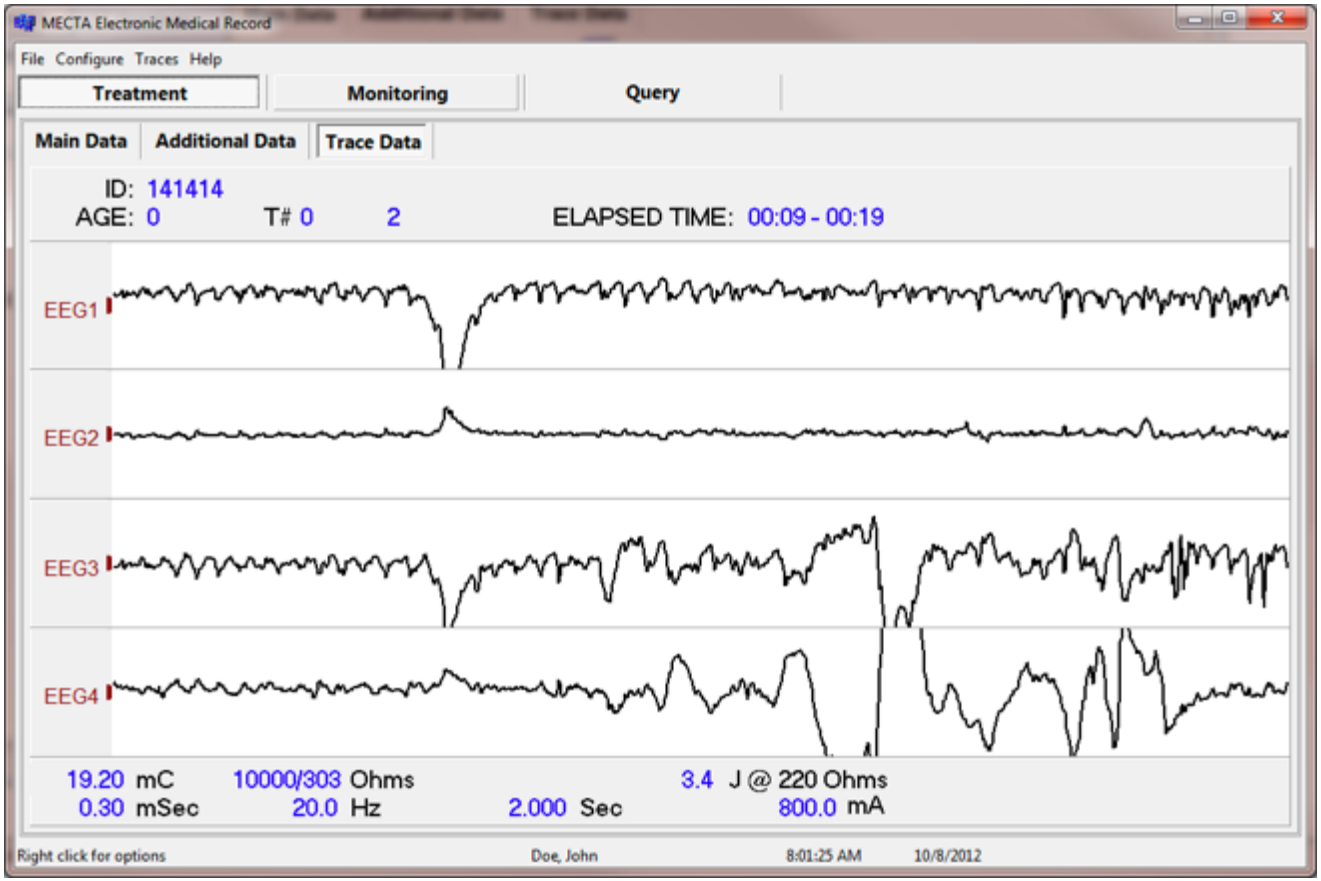
MECTA, EEG papier



MECTA, EEG numérisé



MECTA, EEG numérisé



MECTA, EEG numérisé

Charle perrens

STIMULUS and MONITORING REPORT

Patient
Patient ID **MRN**
Sex **Encounter**

Date 24/03/2017 **Time** 08:22:33 **Course** 1 **Session** 1 **Treatment Number** 1
PW ,5 **Freq** 70 **Dur** 7,5 **Current** 900 **Charge** 472,5 **Energy** 69,2

Start 0:00 **End** 0:09

EEG1

EEG2

Start 0:09 **End** 0:18

EEG1

EEG2

Start 0:18 **End** 0:27

EEG1

EEG2

Start 0:27 **End** 0:37

EEG1

EEG2

MECTA, EEG indice de « seizure adequacy »

Analyse des données EEG : l'index « Seizure Adequacy » a été démontré comme pertinent pour les cliniciens. Basé sur 10 années de recherche et d'analyse partagée au sein de la Duke University, il s'agit d'un index efficace breveté, sous la licence exclusive de Mecta.

Krystal AD, Weiner RD.
ECT seizure therapeutic adequacy.
Convuls Ther. 1994 Jun;10(2):153-64.

MECTA,
EEG indice de « seizure adequacy »

US005626627A

United States Patent [19]
Krystal et al.

[11] **Patent Number: 5,626,627**
[45] **Date of Patent: May 6, 1997**

[54] **ELECTROCONVULSIVE THERAPY METHOD USING ICTAL EEG DATA AS AN INDICATOR OF ECT SEIZURE ADEQUACY**

[75] Inventors: **Andrew D. Krystal**; **Richard D. Weiner**, both of Durham, N.C.

[73] Assignee: **Duke University**, Durham, N.C.

[21] Appl. No.: **508,062**

[22] Filed: **Jul. 27, 1995**

[51] **Int. Cl.**[6] **A61N 1/32**
[52] **U.S. Cl.** **607/45**; 128/731
[58] **Field of Search** 128/731; 607/45

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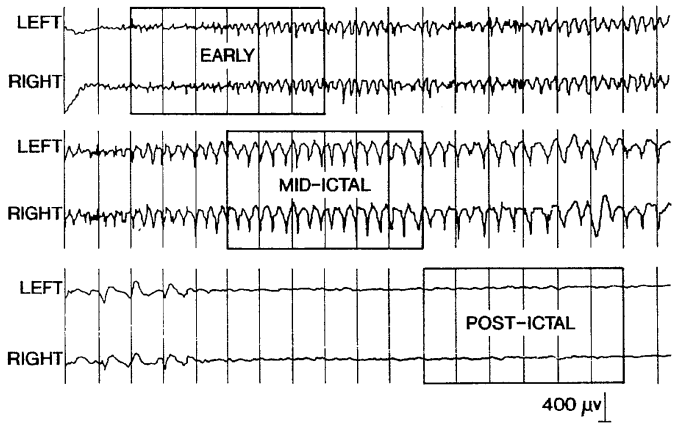
Conrad Melton Swartz, "Low-Frequency Ictal EEG Activity and ECT Therapeutic Impact", *Convulsive Therapy,* vol. 9, No. 3, pp. 220–224 (1993).

Primary Examiner—William E. Kamm
Attorney, Agent, or Firm—Richard E. Jenkins, P.A.

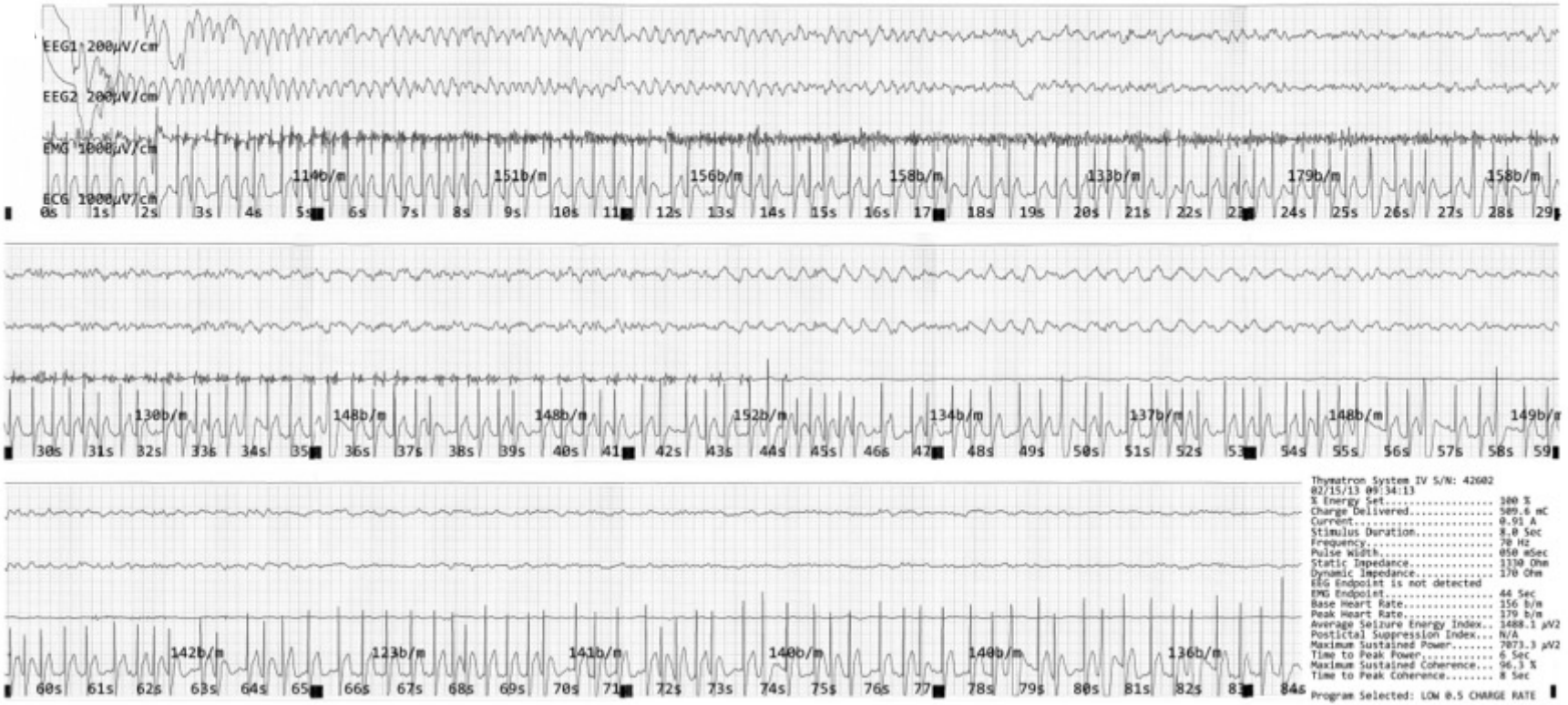
[57] **ABSTRACT**

A method in electroconvulsive therapy (ECT) to use ictal EEG data for clinical determination of the adequacy of an induced seizure in a patient. The method includes employing an ECT device to apply electricity to the patient in an ECT session to induce seizure activity. The electroencephalographic (EEG) data is detected during the seizure and selected EEG data parameters are derived therefrom. Next, the likely adequacy of the induced seizure is computed by comparing the selected EEG data parameters of the patient to ictal EEG data parameters wherein the adequacy of the corresponding seizure or seizures is known, and the computed likely therapeutic adequacy of the induced seizure is displayed.

23 Claims, 1 Drawing Sheet



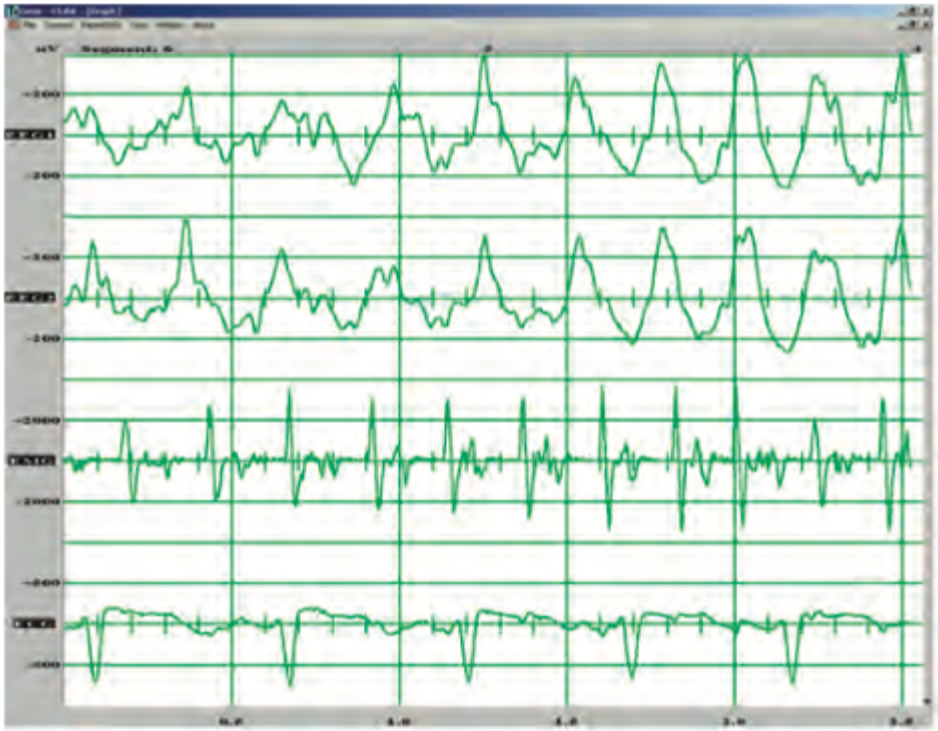
THYMATRON, EEG papier



THYMATRON, EEG numérisé

GENIE™ IV

EEG Analysis Software for the Thymatron® System IV



THYMATRON, EEG numérisé

THYMATRON, EEG numérisé

SEIZURE MONITORING

The Thymatron® System IV allows the physician to monitor the physiological variables of EEG, ECG, and EMG. The paper tracing provides the wave forms and beats per minute for the ECG. The EEG and EMG also appear on the tracings, with additional information provided.

EEG SEIZURE MONITORING

1) The *Audible EEG™* seizure monitor
2) The EEG paper recording
3) The Ictal Line™ seizure indicator
4) The EEG endpoint and indices determined values

Audible EEG™ Seizure Monitor

This feature operates automatically when the "TREAT" button is pressed and released. The knob marked "VOLUME" on the back panel controls the volume of the tone. To inactivate this feature, turn the volume control knob all the way counterclockwise.

The pitch of the *Audible EEG™* signal varies with the amplitude of the EEG. It will waver and warble intensely and rapidly during the initial tonic phase. It becomes increasingly irregular, with superimposed staccato bursts, during the clonic phase, and tends to correspond to each muscular contraction. Seizure termination is marked by a change to a nearly steady tone with little modulation or variability. Each Thymatron® System IV is supplied with a cassette tape guide for the interpretation of the *Audible EEG™* seizure monitor.

EEG paper recording

a) *Paper EEG recording prior to the treatment stimulus* can be initiated (after the EEG electrodes have been properly applied) by pressing the "START/STOP" button on the front panel. This will provide a paper record of the patient's baseline recording. The printer stops during treatment stimulus administration.
b) *Automatic paper EEG recording* begins or resumes when the treatment stimulus ends. The EEG recording continues through ictal and postictal periods, until the "START/STOP" button is pressed, which generates the end-of-treatment report.

NOTE: Obtaining a paper baseline EEG record does not replace *the baseline EEG collection* procedures described above.

Ictal Line™ Seizure Indicator

After baseline EEG collection is completed by the Thymatron® System IV and the "READY" message light appears, a thin black line is printed along the top of the paper recording strip when the EEG amplitude exceeds a specified baseline value. An unbroken, solid black line reflects continuous seizure activity. A broken or intermittent line reflects waxing and waning, or intermittent seizure activity. Complete cessation of the black line reflects EEG seizure termination, as determined by the Thymatron® System IV. *Wait several seconds before pressing the "START/STOP" button to terminate recording because the computer takes that long to process and report the seizure endpoints and indices.*

Endpoints and Indices

A unique feature of the Thymatron® System IV, (U.S. patents: 4873981, 4878498, 5269302 and 5871517), provides two computer-determined estimates of the duration of the induced seizure, derived from the EEG and EMG data.

Automatic EEG Seizure Endpoint Determination

The Thymatron® System IV continuously monitors the EEG for the endpoint of seizure activity and prints the EEG seizure duration, in seconds, on the end-of-treatment report, *provided the baseline EEG collection procedures have been properly followed and the "READY" message has appeared. (If the treatment stimulus is administered before the "READY" message appears, automatic EEG analysis will not occur and the end-of-treatment report will state the message* "Baseline not available.")

In about 10-20% of ECT treatments, the EEG endpoint is not readily determined (Abrams, 1997). This typically occurs when paroxysmal activity decreases too gradually to provide a clear visual endpoint, or when the immediate post-seizure EEG contains high amplitude activity. In these circumstances, inability to detect a precise EEG endpoint is expected with any method of examination. The Ictal Line™ might show an on-again-off-again broken line pattern, and the end-of-treatment report might state: "EEG Endpoint is not detected".

Automatic EMG (Motor) Seizure Endpoint Determination

The Thymatron® System IV is shipped with the EMG monitor enabled in channel 3. When EMG monitoring electrodes have been properly applied, the lead-wires and monitoring cable connected, then EMG tracing automatically appears on the paper record after the treatment stimulus ends.

The Thymatron® System IV continuously monitors the EMG for motor seizure activity and prints the EMG endpoint seizure duration in seconds, on the end-of-treatment report. Baseline EMG collection is neither required, nor possible, in obtaining this measure.

CAUTION: The computer-derived endpoint seizure duration measures, including the Ictal Line™ seizure indicator, are derived solely by calculation and are provided to aid, not replace, the physician's judgment. It is possible for seizure activity to continue in the brain after any or all of the computer reports indicate seizure termination. It is also possible for artifact to be interpreted by the computer programs as seizure activity.

THYMATRON, EEG indices

- **EEG COHERENCE MEASURES** of *maximum sustained coherence*, and *time to peak coherence*, interhemispheric cross-correlation measures reported to reflect seizure quality and clinical impact (Krystal & Weiner, 1994; Krystal et al, 1995; Krystal, 1998).
- **EEG AMPLITUDE** measures of *maximum sustained EEG power*, and *average seizure energy*, with separate values for *early, mid–* and *postictal seizure phases*, found by the Duke University group to be important correlates of seizure quality and efficacy (Krystal & Weiner, 1994; Krystal et al, 1995; Krystal, 1998).
- The **POSTICTAL SUPPRESSION INDEX** reports the degree of EEG flattening immediately following the seizure, which correlates with clinical efficacy (Nobler et al, 1993; Krystal & Weiner, 1994; Krystal et al, 1995; Krystal, 1998; Nobler et al, 2000). A recent study of the Thymatron®'s *Postictal Suppression Index* found that it significantly differentiated ECT remitters from non-remitters (Petrides et al, 2000). The authors concluded: *"higher PSI values (more abrupt ending of ictal EEG) are correlated with better clinical outcome of ECT in depression"*.

Krystal AD, Weiner RD (1994): ECT seizure therapeutic adequacy. Convul. Ther. 10:153-164.
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Petrides G, Kellner C et al (2000): Can Ictal EEG Indices predict response to ECT? [presentation] Jan. 2000 NCDEU meeting.

THYMATRON, EEG numérisé

SEIZURE QUALITY MEASURES

The Thymatron® System IV provides 7 Seizure Quality Measures under the "INDEXES" function level that can be individually enabled/disabled. EEG monitoring must be enabled to obtain these measures. Their names and FlexDial™ designations are as follows:

Average Seizure Energy Index	**ASEI ON/OFF**
Postictal Suppression Index	**PSI ON/OFF**
Maximum Sustained Power and Time to Peak Power	**MSP ON/OFF**
Maximum Sustained Coherence and Time to Peak Coherence	**COH ON/OFF**
Duke University Amplitude Measures	**DUKE ON/OFF**

The AVERAGE SEIZURE ENERGY INDEX (ASEI) integrates the total ictal EEG power across the entire seizure and divides the result by the total seizure duration.

The POSTICTAL SUPPRESSION INDEX (PSI) measures the percentage decrease in ictal EEG amplitude immediately following seizure termination.

The MAXIMUM SUSTAINED POWER (MSP) measure reports the mean value of the 10-second EEG segment with the highest average power recorded during the seizure.

TIME TO PEAK POWER is the time elapsed from stimulus termination to the point of maximum EEG power.

The MAXIMUM SUSTAINED COHERENCE (COH) measure reports the mean value of the 5-second EEG segment with the highest average coherence recorded

TIME TO PEAK COHERENCE is the time elapsed from stimulus termination to the point of maximum EEG coherence.

DUKE UNIVERSITY AMPLITUDE MEASURES display the amplitudes of the 3 seizure segments (early ictal, mid-ictal, and post-ictal) reported by Duke University investigators to correlate with ECT treatment response.

BASELINE RETENTION

Baseline Retention, BLV, found under ENDPOINTS, is the length of time the EEG baseline will be kept in memory after the treatment. It can be set from 0 - 5 minutes. After this time a new EEG baseline must be acquired. This feature is useful for re-stimulation without acquiring a new EEG baseline.

Approche clinique

université de BORDEAUX

La première utilité de l’EEG pendant les ECT :

Evaluer la duré de la crise

Pourquoi ?

Crise prolongé

A court terme

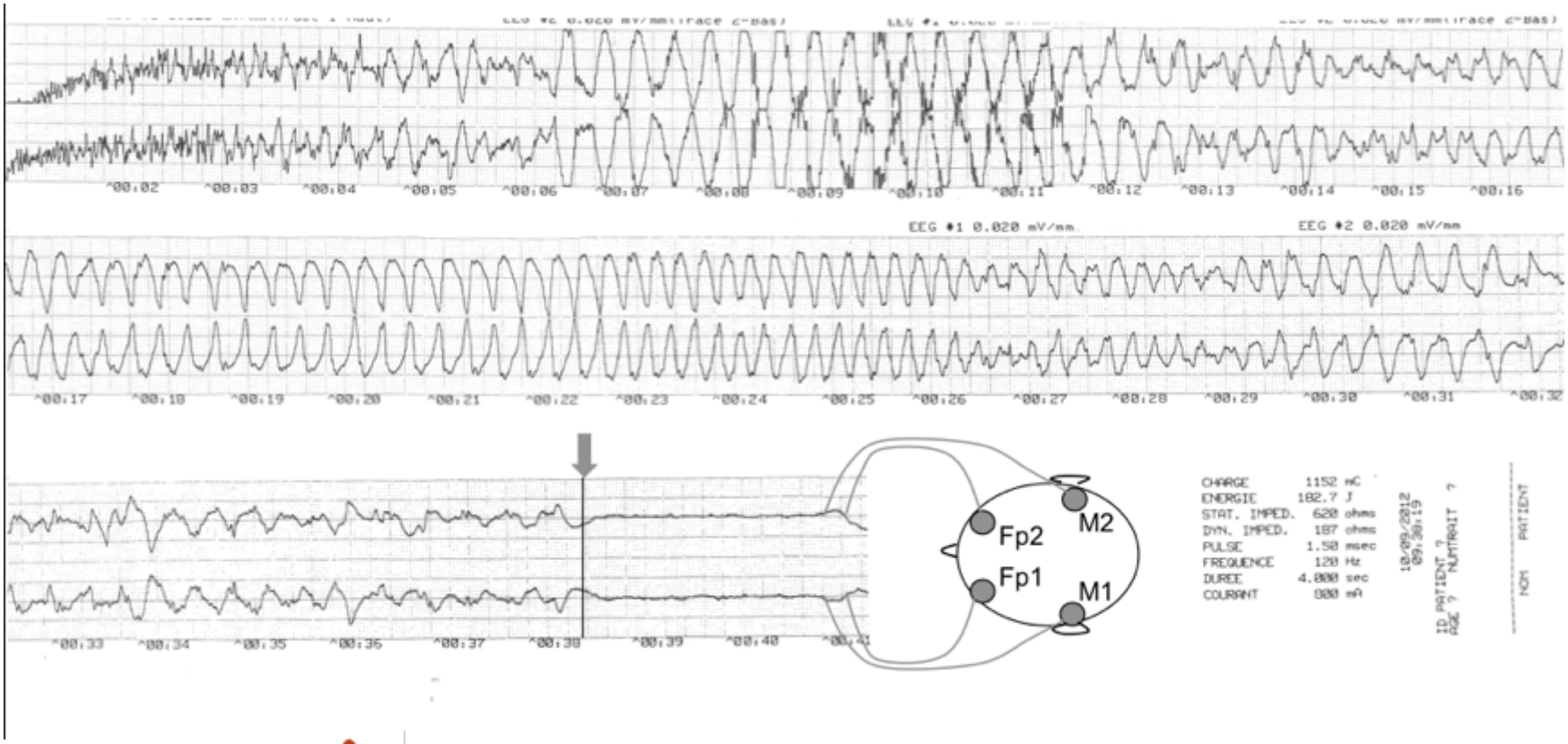
ETAT DE MAL EPILEPTIQUE

A moyen terme

MAUVAISE TOLERANCE COGNITIVE

Meilleur efficacité

Fixer la durée de la crise induite



Arrêt des signes cliniques fins avant les signes EEG

Fixer la durée de la crise induite

La surveillance EEG
des séances d'ECT
permet de repérer une
crise épileptique prolongée (>3min, définition APA**)**

Difficultés pour déterminer la durée de la crise

1. Diminution progressive de l'activité de la phase critique et continuité avec la phase post critique
2. Suppression post critique incomplète
3. Fin de crise artefactée

1. Laisser défiler le papier 10 secondes (*when in doubt, play it out*)
2. Période de *hand-off*
3. Relire le tracé en partant de la fin

Pourquoi ?

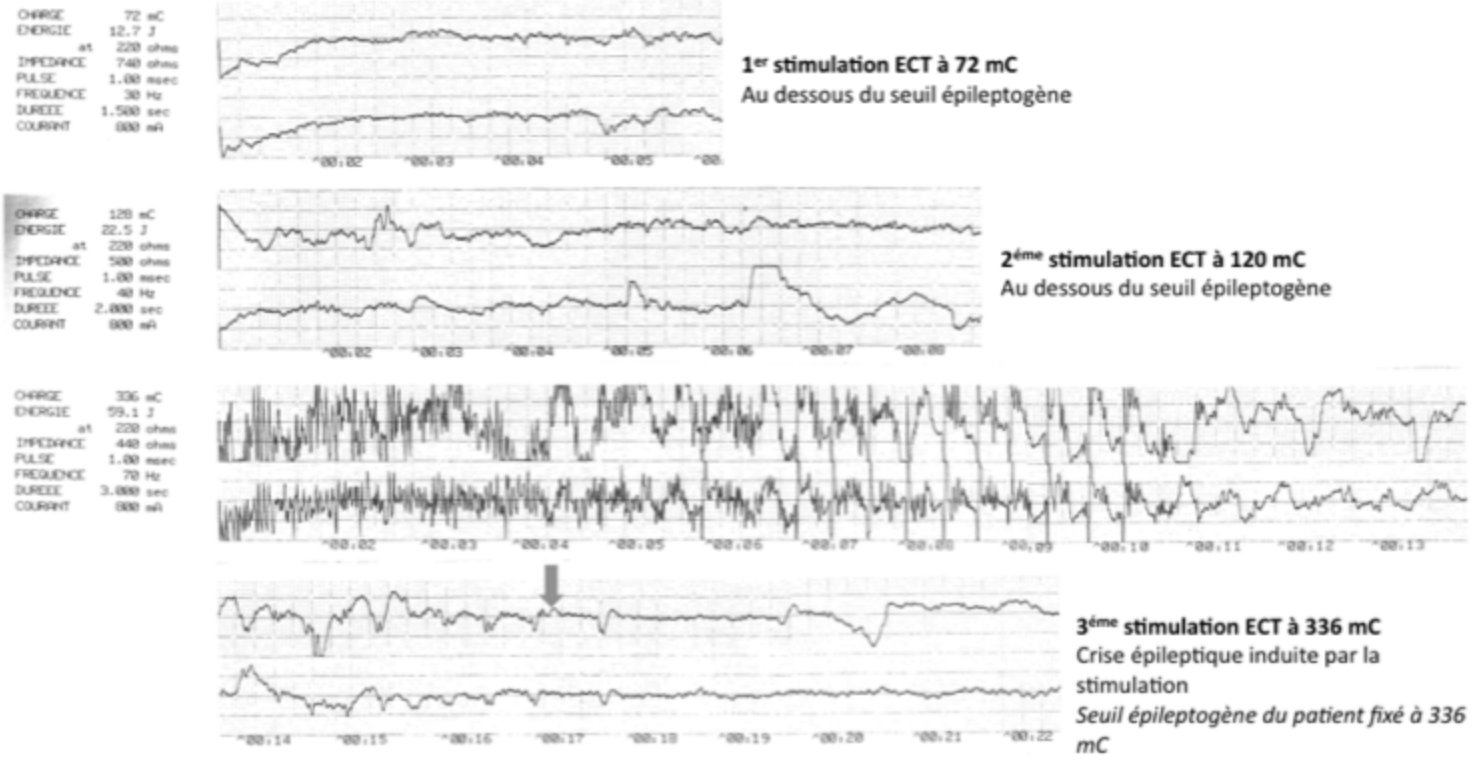
Titration → Ajuster la charge électrique Au seuil épileptogène du patient

→ AUGMENTER EFFICACITE DE LA CURE ECT

→ REDUIRE MAUVAISE TOLERANCE COGNITIVE

Fixer le seuil épileptogène pour un patient

Enregistrer 15-20 secondes
Car possible **crise retardée**



Fixer le seuil épileptogène pour un patient

La surveillance EEG
des séances d'ECT
permet de réaliser la titration de la charge ECT

La deuxième utilité de l’EEG pendant les ECT :

Evaluer la qualité de la crise

Pourquoi ?

Crise de durée adéquate → **Crise optimale** → AUGMENTER EFFICACITE DE LA CURE ECT

Pourquoi ?

Au fur et à mesure des séances : le seuil épileptogène des patients augmentent

Diminution de la qualité de crise

DIMINUTION EFFICACITE DE LA CURE ECT

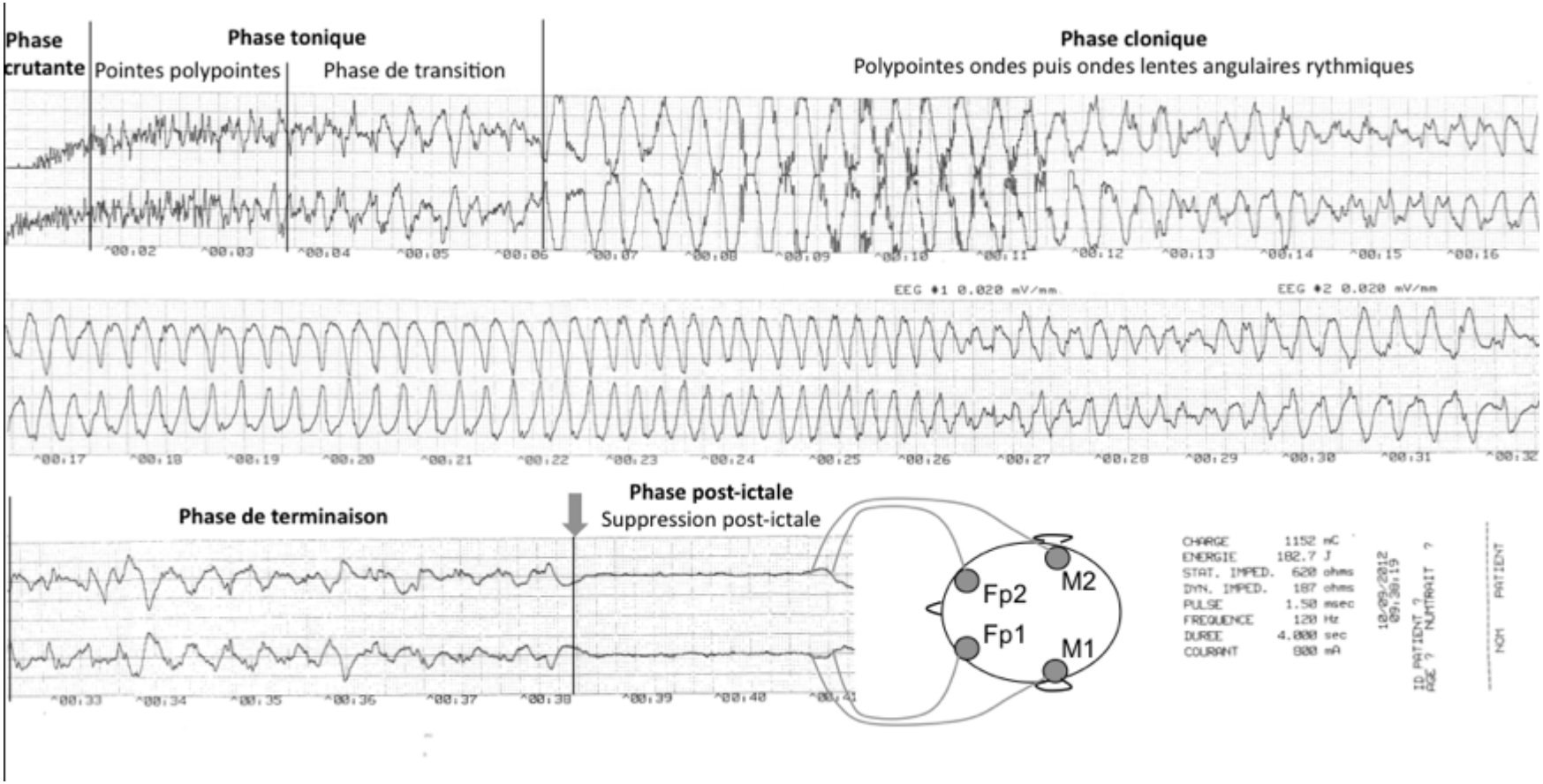
Ajustement des paramètres de stimulation
au cours des séances ECT
(et après la séance de titration)

Fixer la qualité EEG de la crise induite

La surveillance EEG
des séances d'ECT
permet de repérer une
crise épileptique avortée (<15-20 s)
crise épileptique adéquate (>20s & <3min)
crise épileptique optimale

Permet d'adapter les paramètres de stimulation pour optimiser l'efficacité des ECT

Savoir lire la trace EEG



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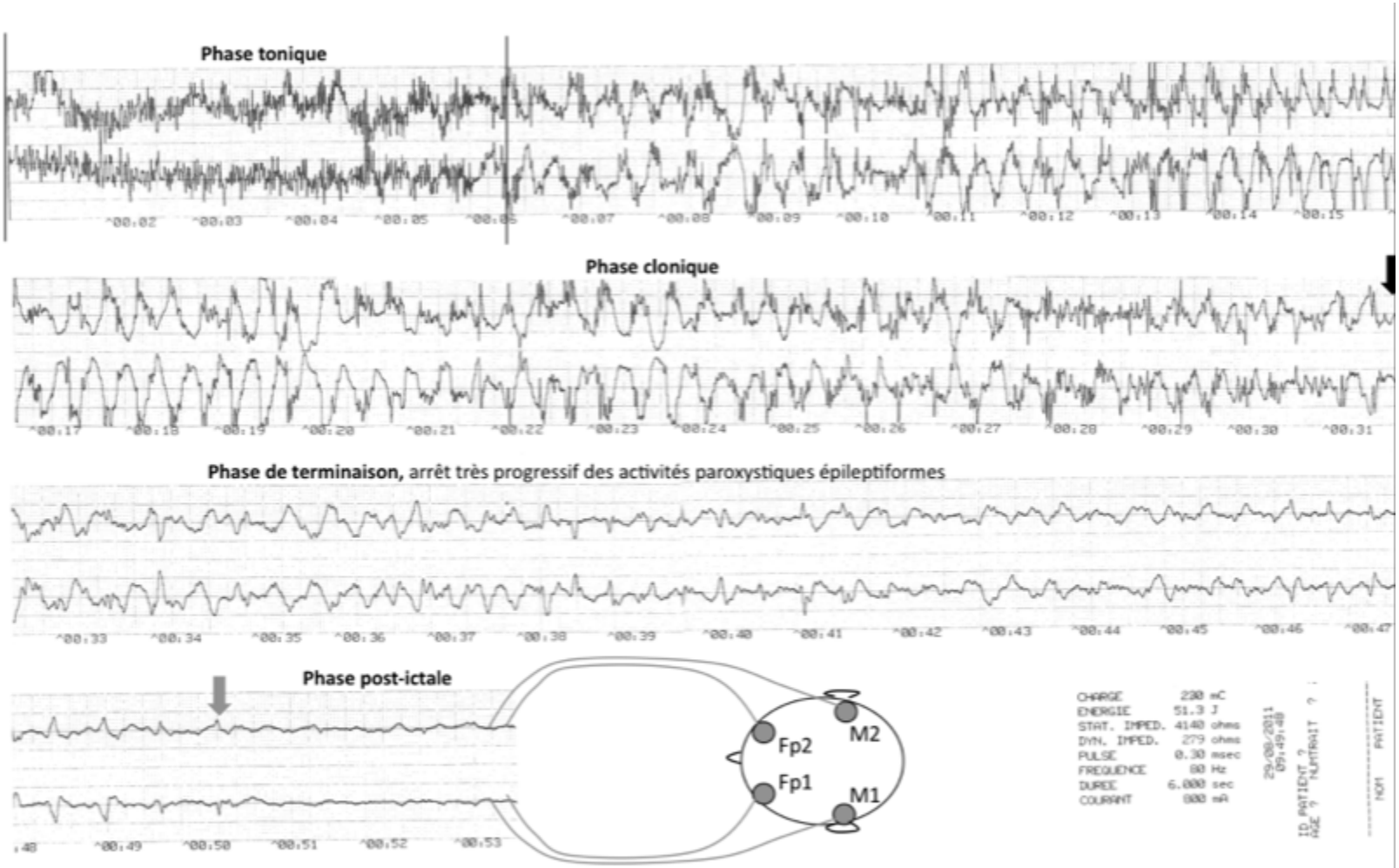
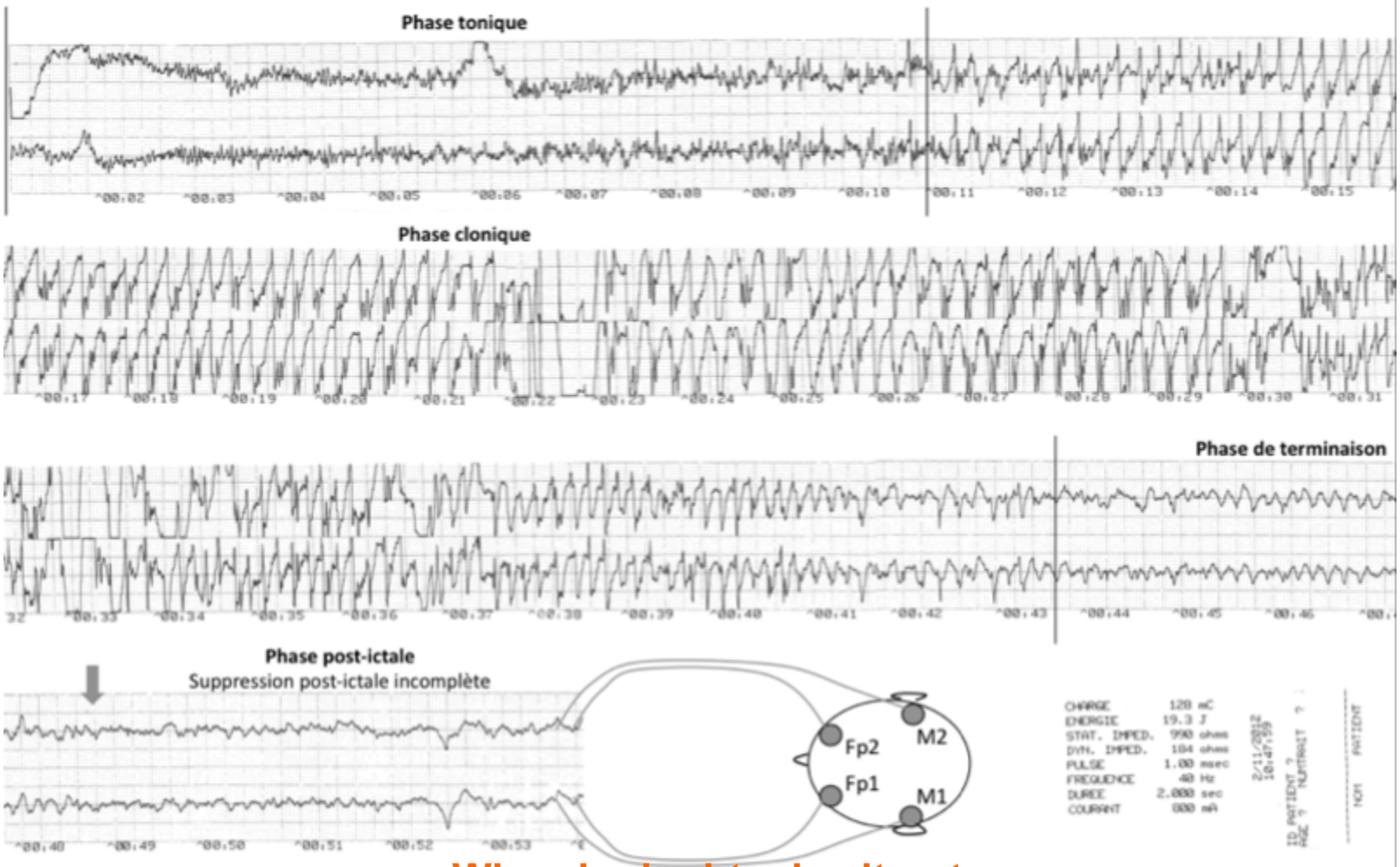


« When in doubt, play it out »

Poursuivre l'EEG 10 secondes après la fin de la crise
(pour s'assurer de l'absence de reprise de crise)

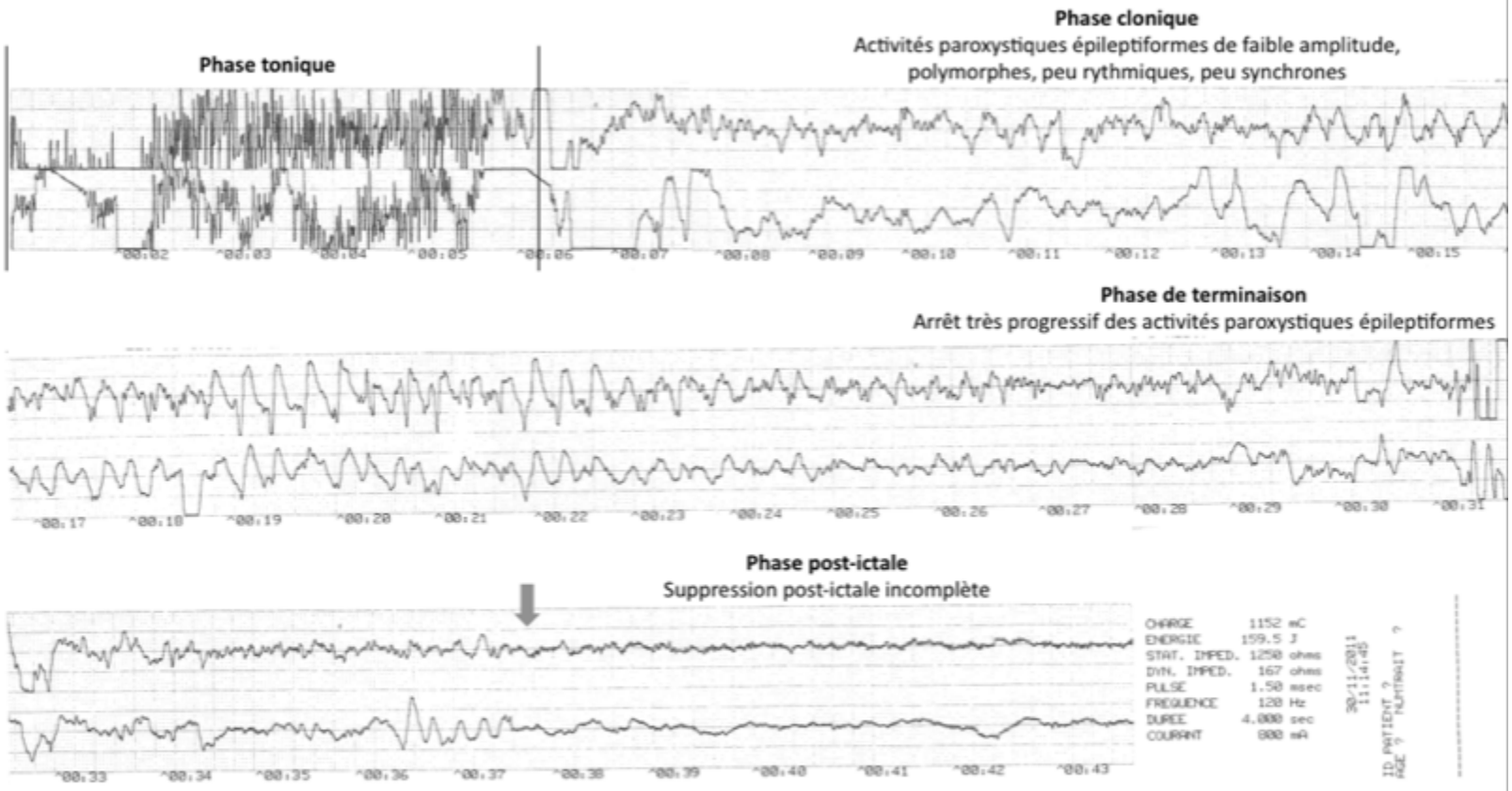
Savoir lire la trace EEG



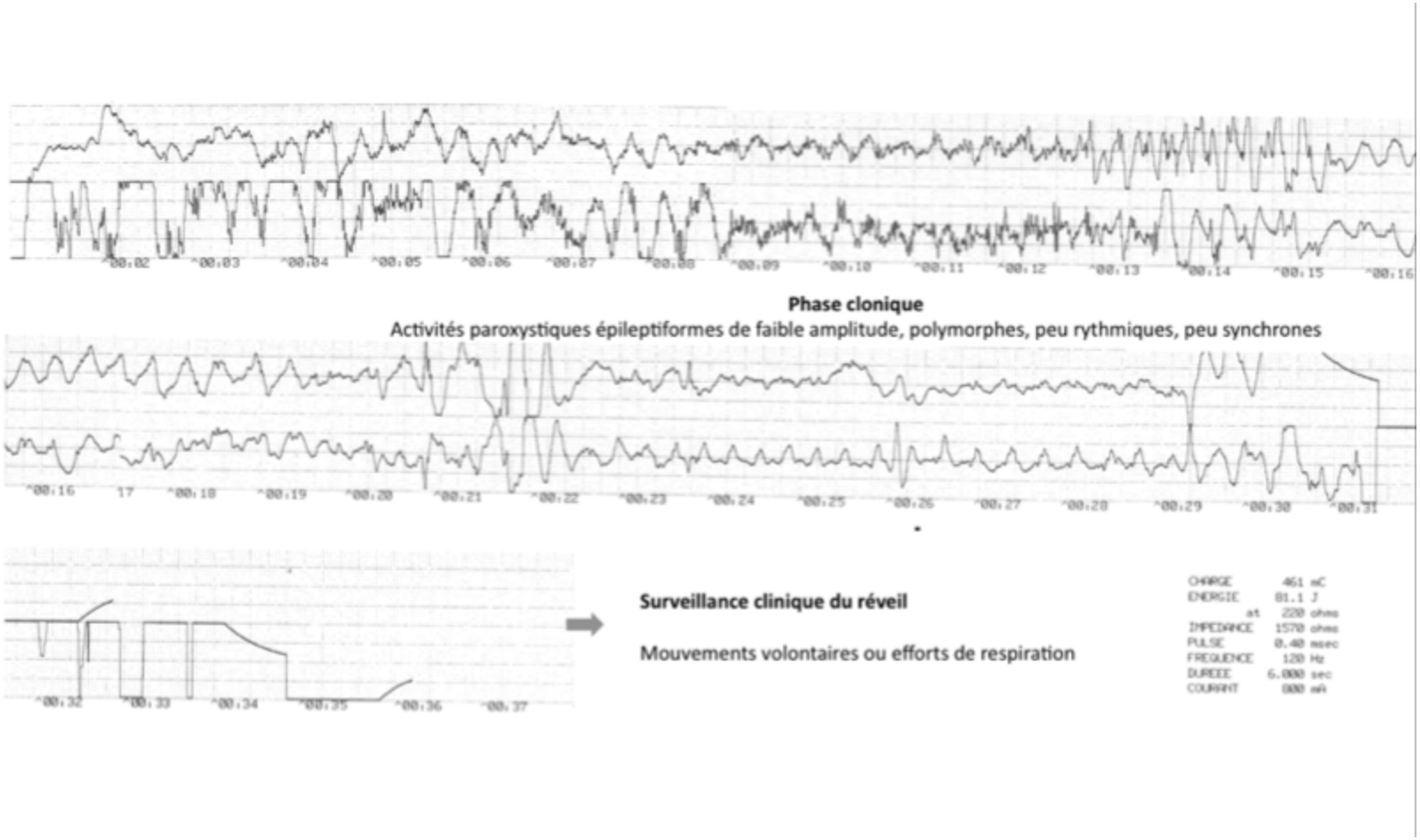
« When in doubt, play it out »

Période de hand off et s'assurer de la reprise de mouvements volontaires et d'efforts respiratoires

Savoir lire la trace EEG



Savoir lire la trace EEG



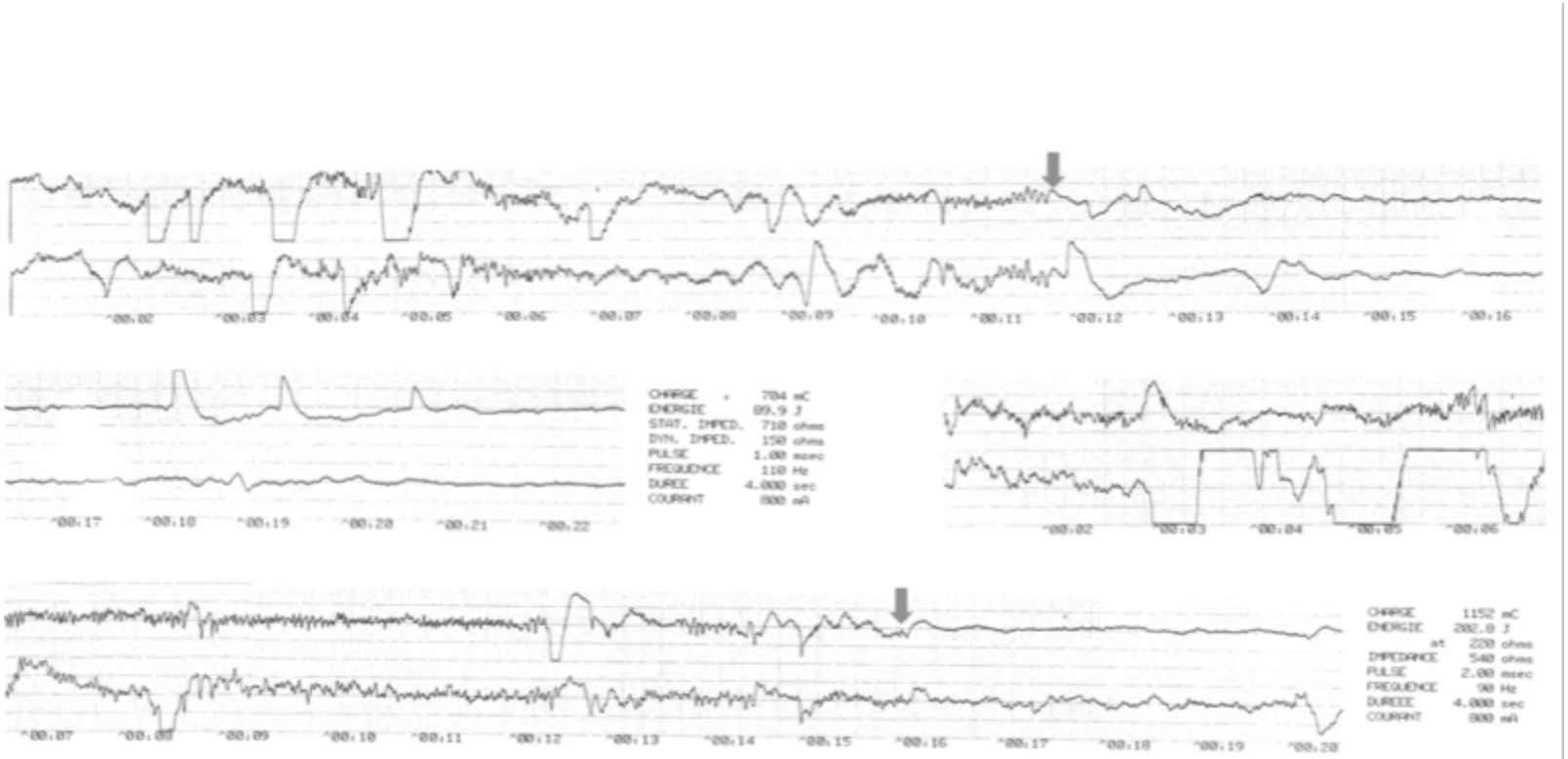
Phase clonique

Activités paroxystiques épileptiformes de faible amplitude, polymorphes, peu rythmiques, peu synchrones

Surveillance clinique du réveil

Mouvements volontaires ou efforts de respiration

Savoir lire la trace EEG

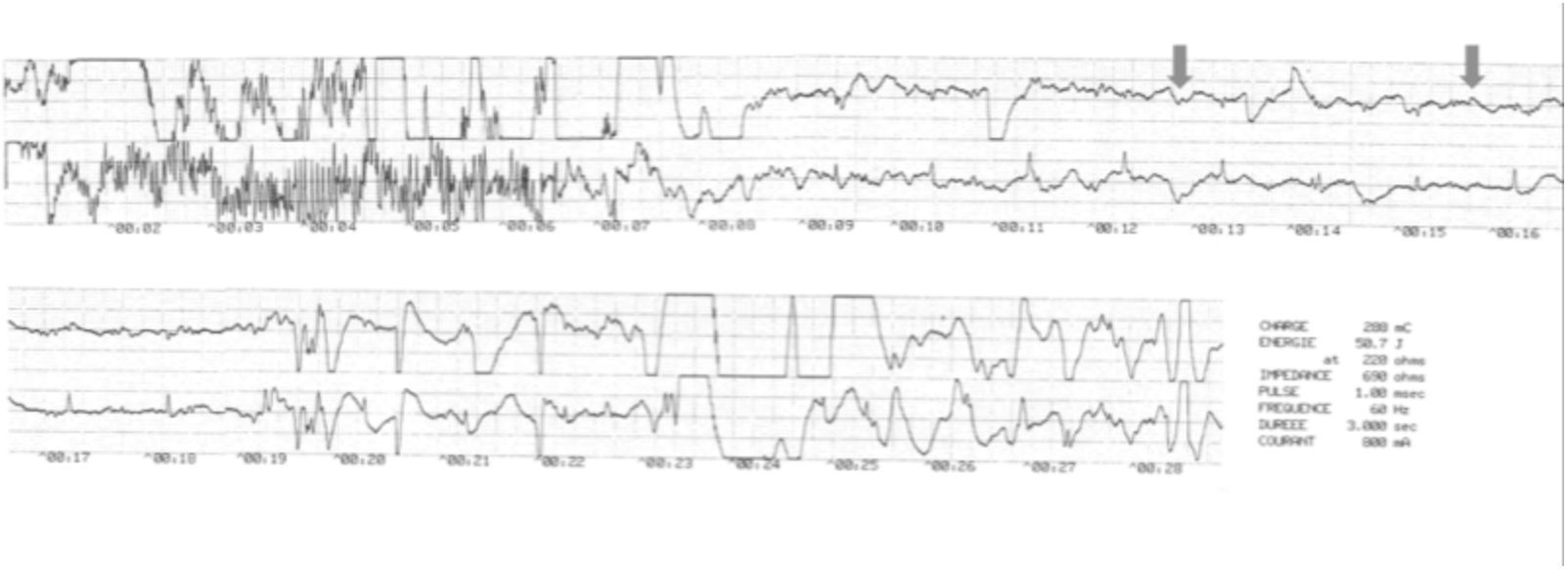


Rechercher des facteurs favorisants

Antiépileptiques?

Préférer l'étomidate (hypnomidate®) au propofol (diprivan®)

Savoir lire la trace EEG



L’échelle

université de BORDEAUX

A la quête de l'échelle électrophysiologique

Brain Stimulation 9 (2016) 72–77

Contents lists available at ScienceDirect

Brain Stimulation

journal homepage: www.brainstimjrnl.com

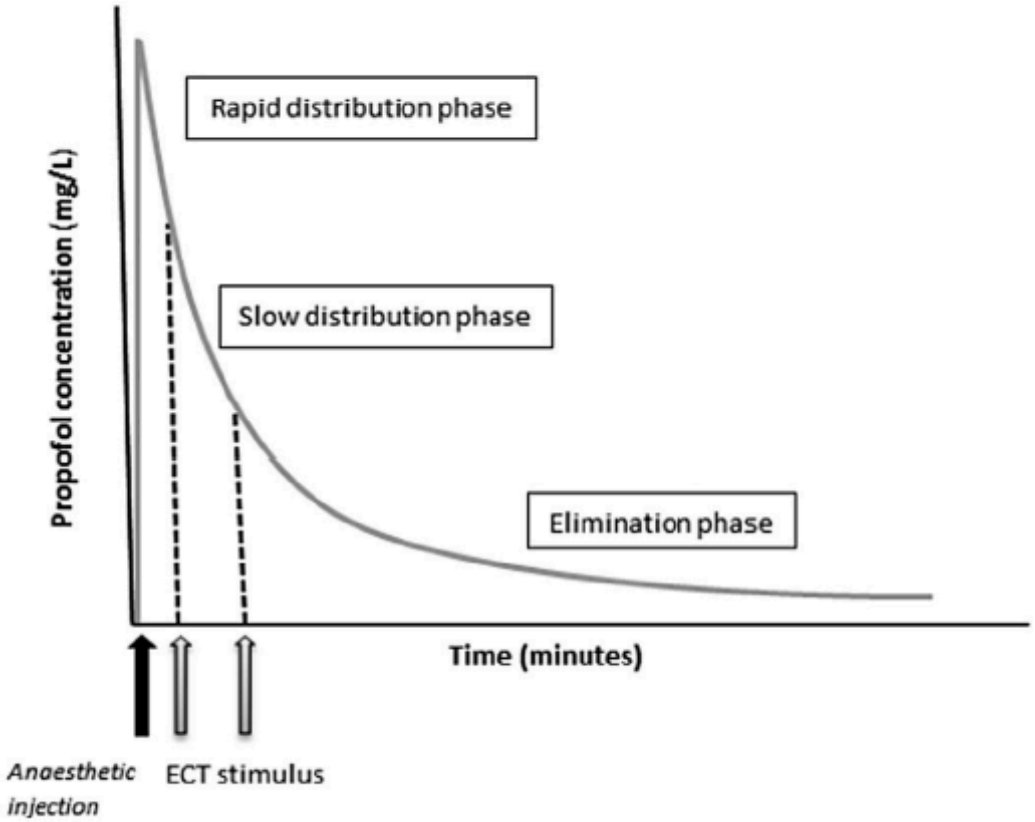
The Anaesthetic-ECT Time Interval in Electroconvulsive Therapy Practice – Is It Time to Time?

Verònica Gálvez [a,b,c], Dusan Hadzi-Pavlovic [a,b], Harry Wark [a,c,d,e], Simon Harper [c,f], John Leyden [c,g], Colleen K. Loo [a,b,c,h,*]

A la quête de l'échelle électrophysiologique

Results: Longer anaesthetic-ECT time intervals lead to significantly higher quality seizures ($p < 0.001$ for amplitude, regularity, stereotypy and post-ictal suppression).

Conclusions: These results suggest that the anaesthetic-ECT time interval is an important factor to consider in ECT practice. This time interval should be extended to as long as practically possible to facilitate the production of better quality seizures. Close collaboration between the anaesthetist and the psychiatrist is essential.



A la quête de l'échelle électrophysiologique

Seizure quality EEG indices [TSLOW (time to onset of seizure activity ≤5 Hz, seconds); peak mid-ictal amplitude (mm); regularity (e.g. intensity or morphology of the seizure (0–6)); stereotypy (or global seizure patterning, 0–3) and post-ictal suppression (0–3)], as well as seizure duration (in seconds) were rated through a qualitative–quantitative structured rating scale [33], based on the one developed by Nobler [17,34]. Ratings were performed by a single

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Brief report

Low dose lignocaine added to propofol does not attenuate the response to electroconvulsive therapy

Ross D. MacPherson [a,*], Jessica Lawford [b], Brett Simpson [c], Michelle Mahon [d], Debra Scott [e], Colleen Loo [f]

A la quête de l'échelle électrophysiologique

EEG traces were examined for EEG seizure duration and ictal quality. The latter was rated manually according to five criteria previously found to be related to the efficacy of ECT seizures (Krystal et al., 1993, 1998; McCall et al., 1996; Nobler et al., 1993; Weiner and Krystal, 1993). A manual system of rating these criteria was developed, based on descriptions provided in the above studies, with further specific guidelines as required (see Appendix A).

Appendix A. EEG Seizure Quality Rating Sheet

Parameter	Score/value
Time to onset of slowing (TSLOW) • Time from end of ECT stimulus to slowing of frequency to ≤5 Hz. • Score as 0 if frequency does not initially exceed 5 Hz.	[secs]
Peak mid-ictal amplitude • Calculate the mean value of 3 consecutive spike and wave complexes which represent the largest of the *slow wave/spike-and-wave phase* (ignore transition phases).	Wave 1: [mm] Wave 2: [mm] Wave 3: [mm] *Mean:*
Seizure regularity (0–6) • Score the predominant pattern during *slow wave/spike-and-wave phase* according to the scale (ignore transition phases). See scale by Krystal and Weiner, (1993).	
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A la quête de l'échelle

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Post-ictal su[illegible]pression (0–3; 0.5 *pt increments*) ▪ Score ba[illegible]ed on three characteristics. Score 0, 0.5 or 1 for each and sum the total. 1. Seizure[illegible]end-point (0=cannot determine end-point; 1=clear end-point). 2. Transition to seizure termination (0=gradual, the transition phase consists of >1/3 of the trace; 1=abrupt). 3. Flatness of trace after seizure end-point (0=poor; 1=very flat).	

Krystal, A., Weiner, R., McCall, V., Shelp, F., Arias, R., Smith, P., 1993. The effect of ECT stimulus dose and electrode placement on the ictal electroencephalogram: an intraindividual crossover study. Biol. Psychiatry 34, 759–767.

La compréhension de l'échelle

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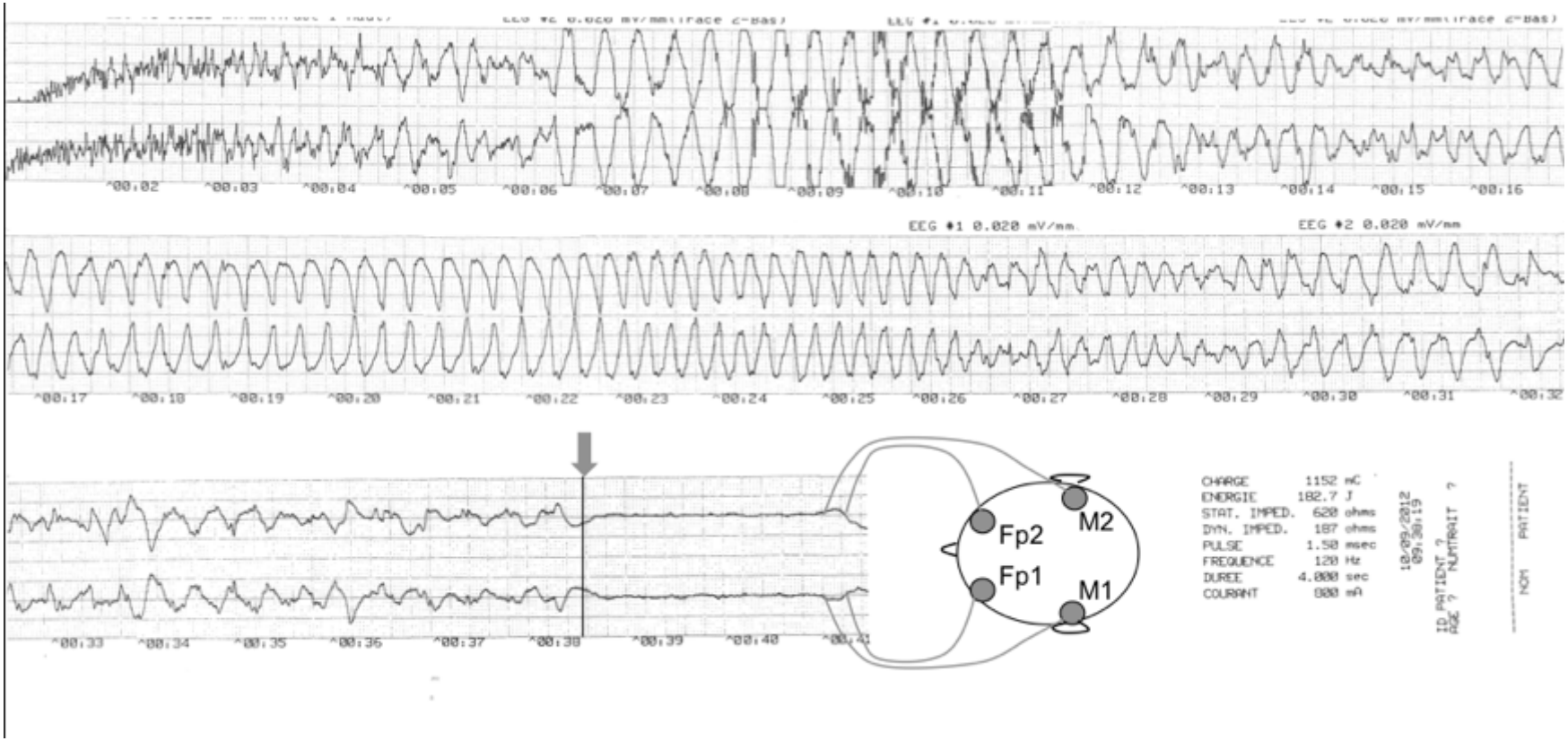
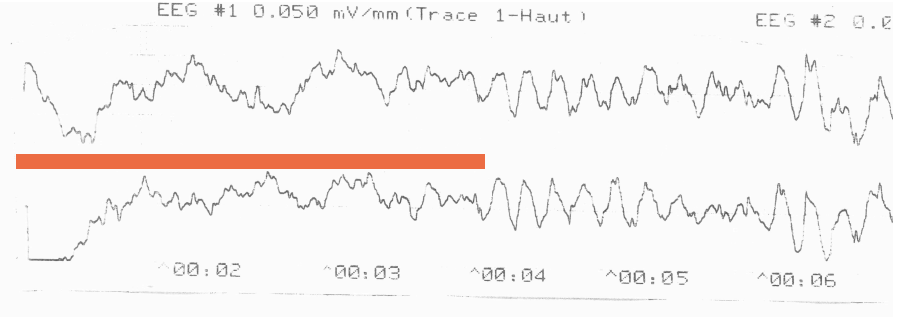
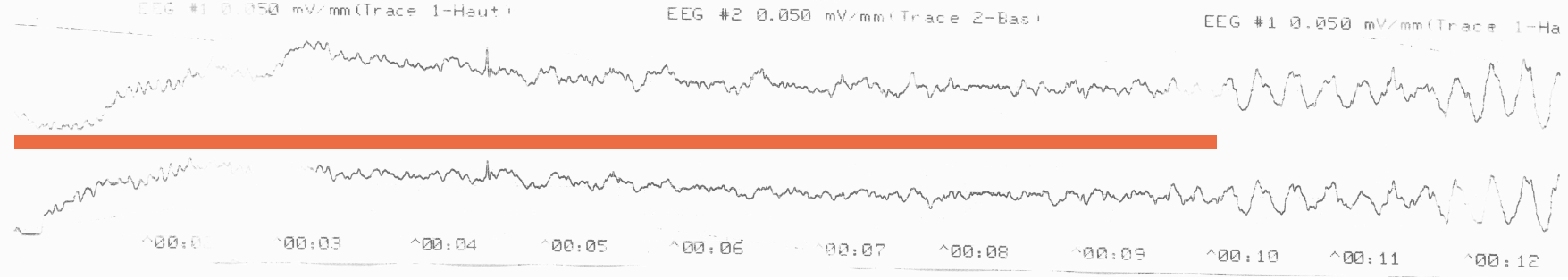
La compréhension de l'échelle

Temps avant l'activité lente (<5Hz)



Time to onset of slowing (TSLOW)





La compréhension de l'échelle

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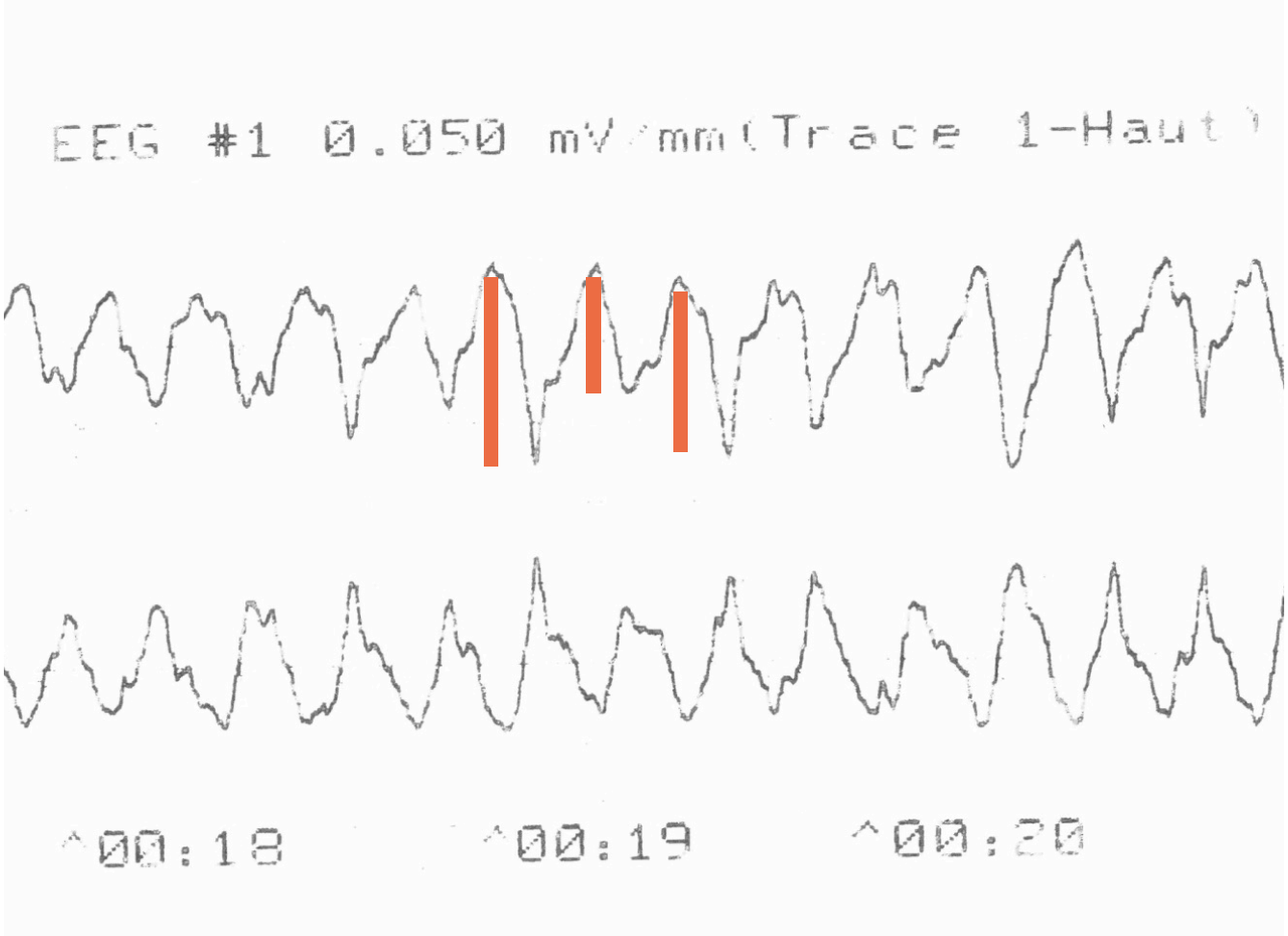
Peack mid-ictal amplitude



La compréhension de l'échelle

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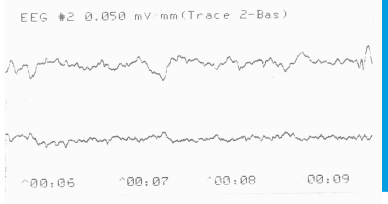
Seizure regularity

0



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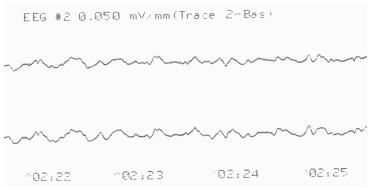

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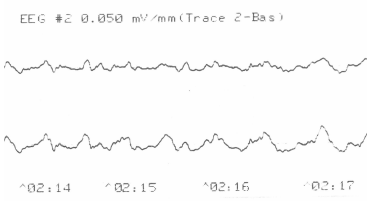

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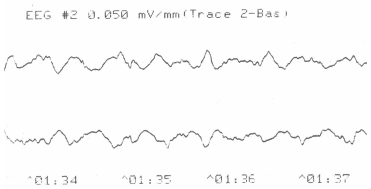

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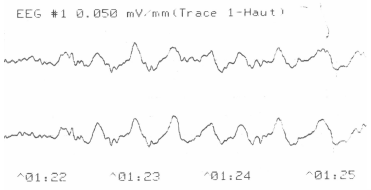

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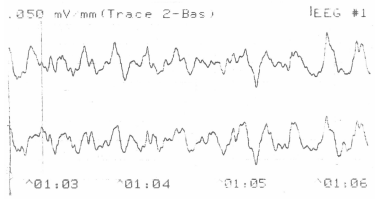

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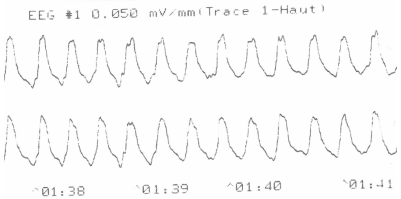

La compréhension de l'échelle

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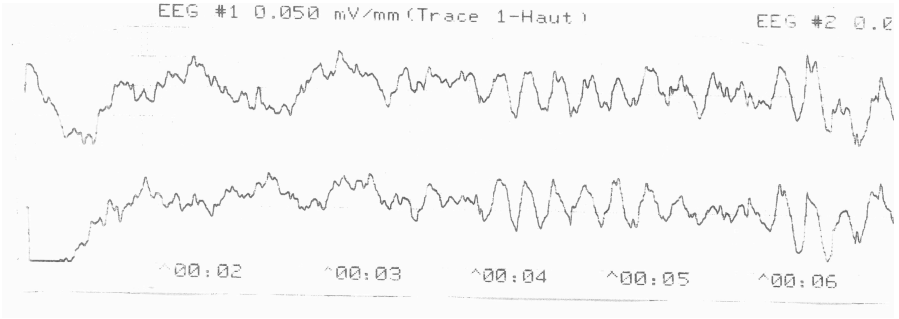
Seizure stereotypy : transition recruitement

0



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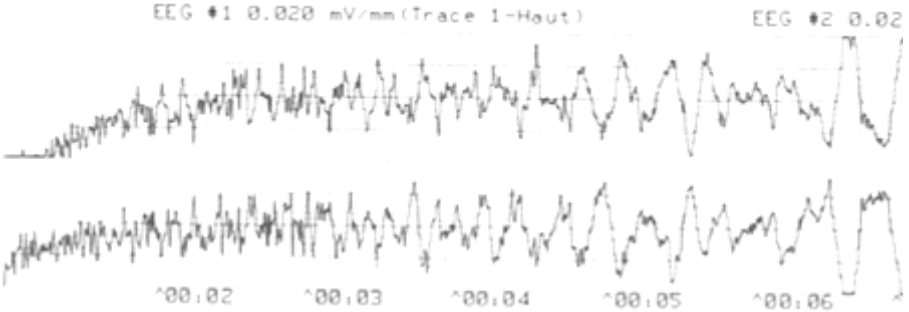
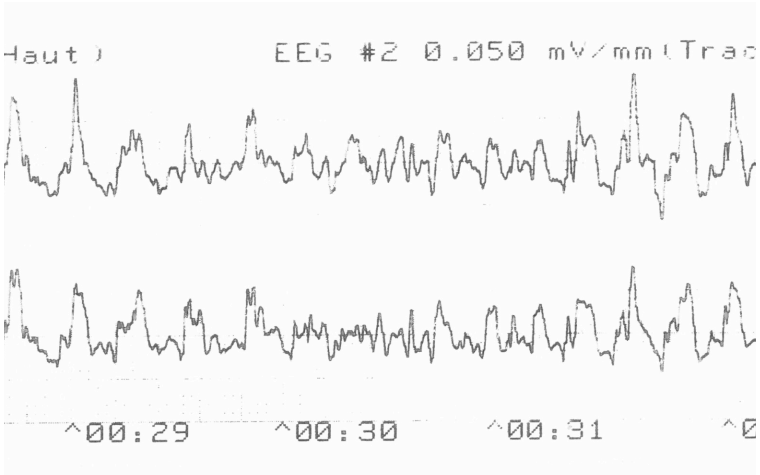


Seizure stereotypy : Chaotic polyspikes

0



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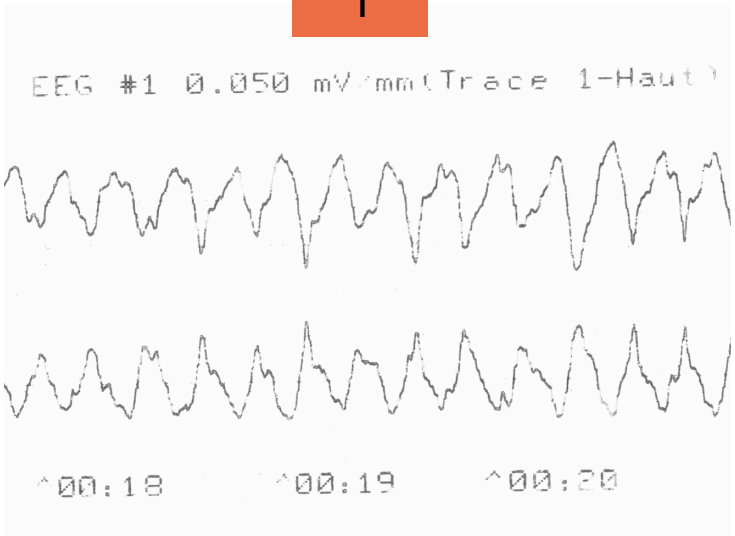
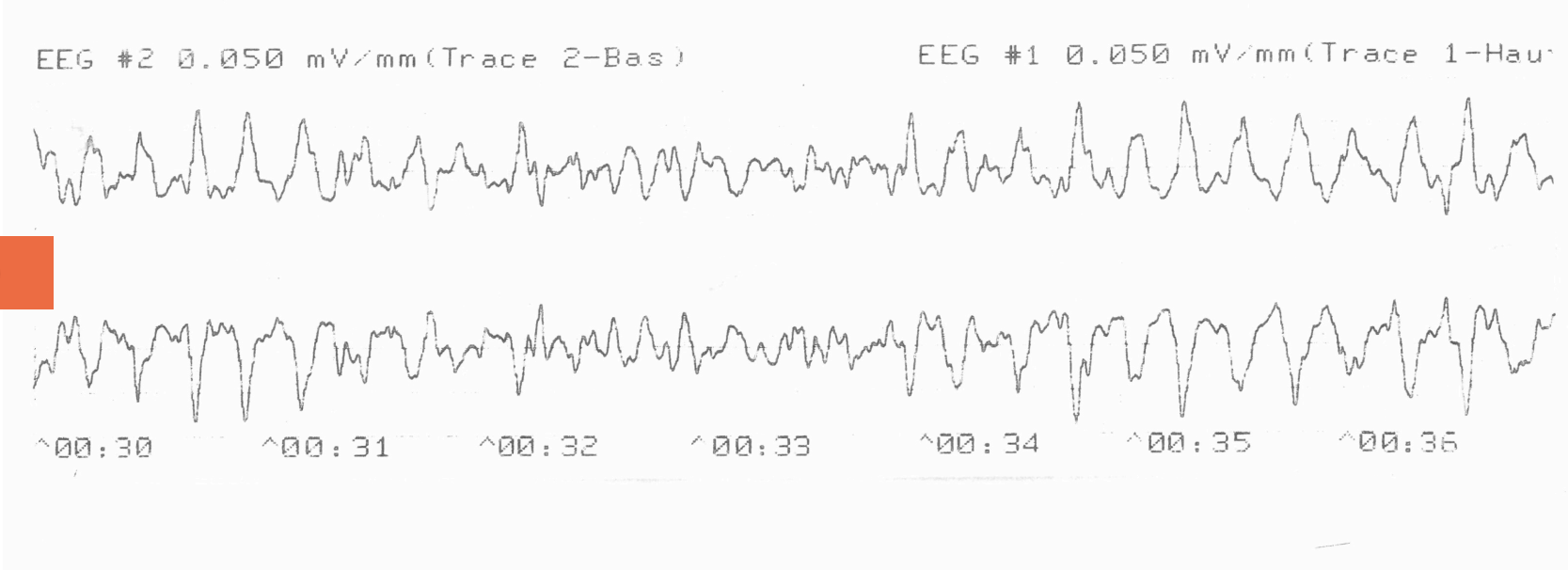


Seizure stereotypy : Variability amplitude



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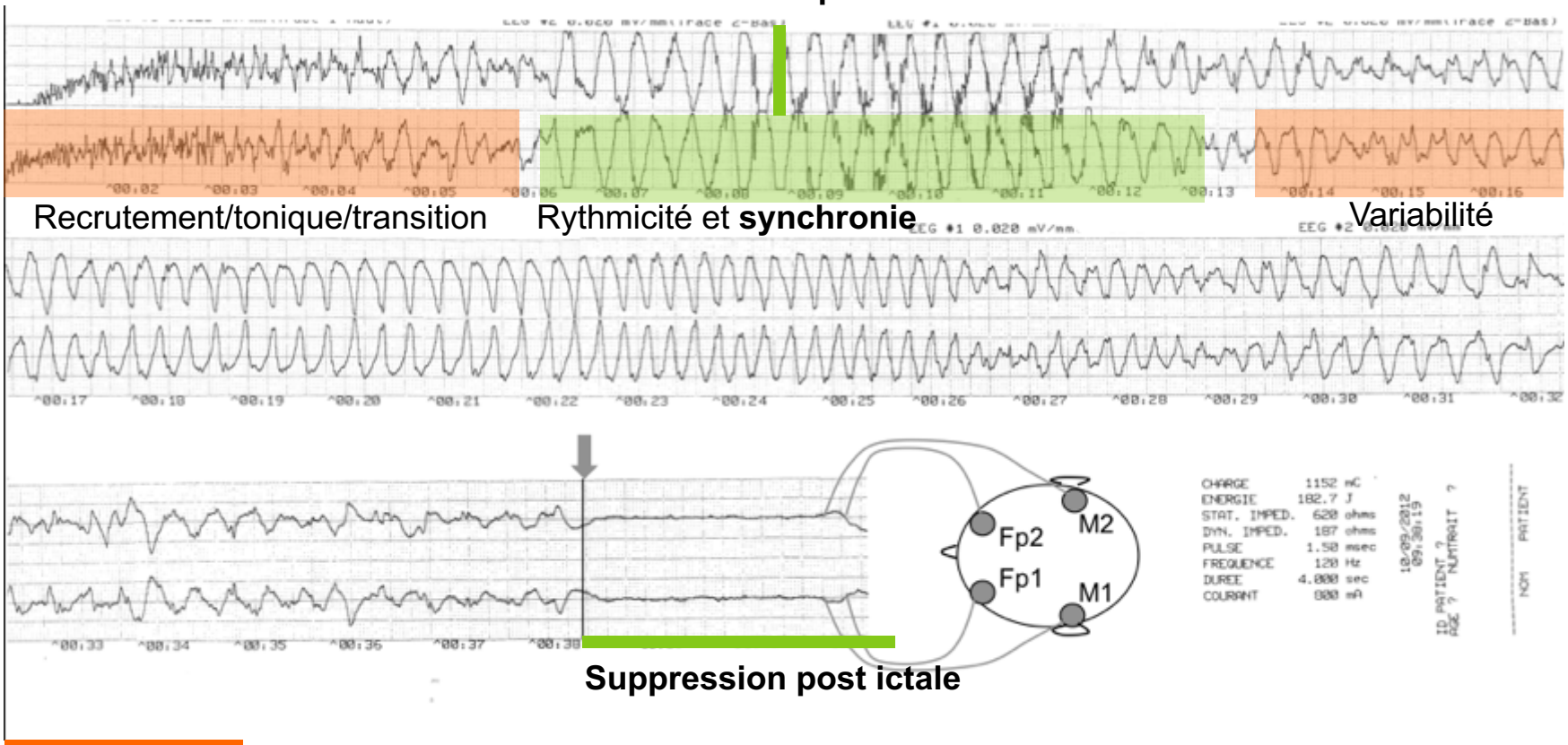
La compréhension de l'échelle

Temps avant l'activité lente (<5Hz)

Amplitude des ondes lentes



Suppression post ictale

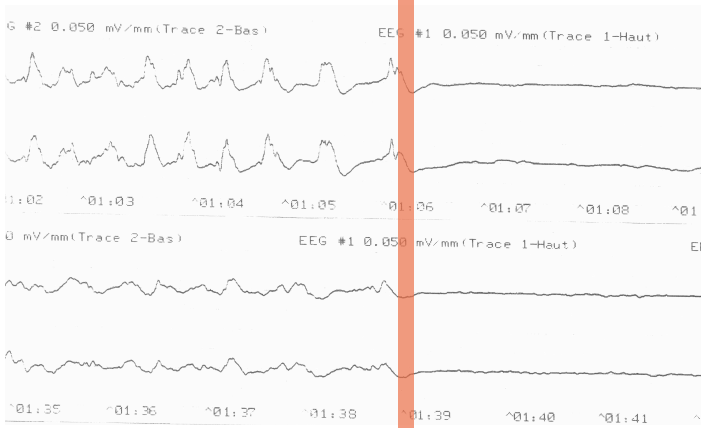
Stéréotypie

Post ictal supression

1

0,5

0,5



1

1

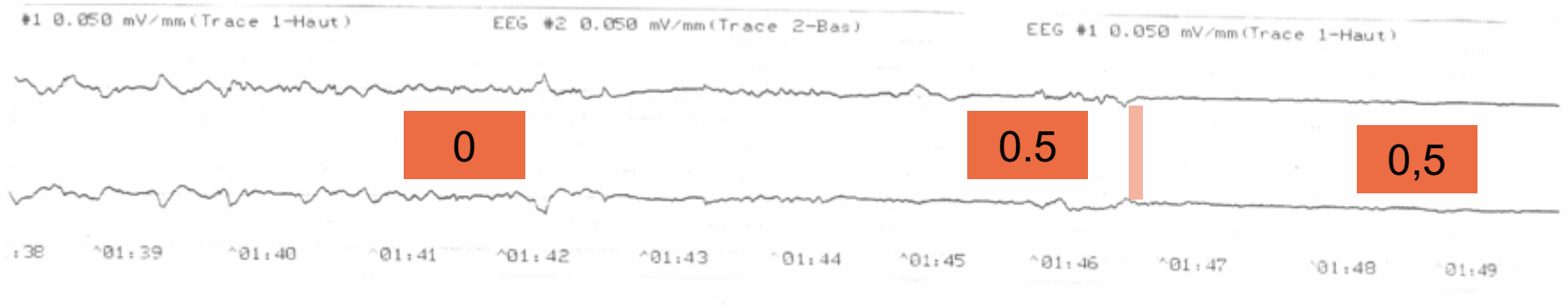
1

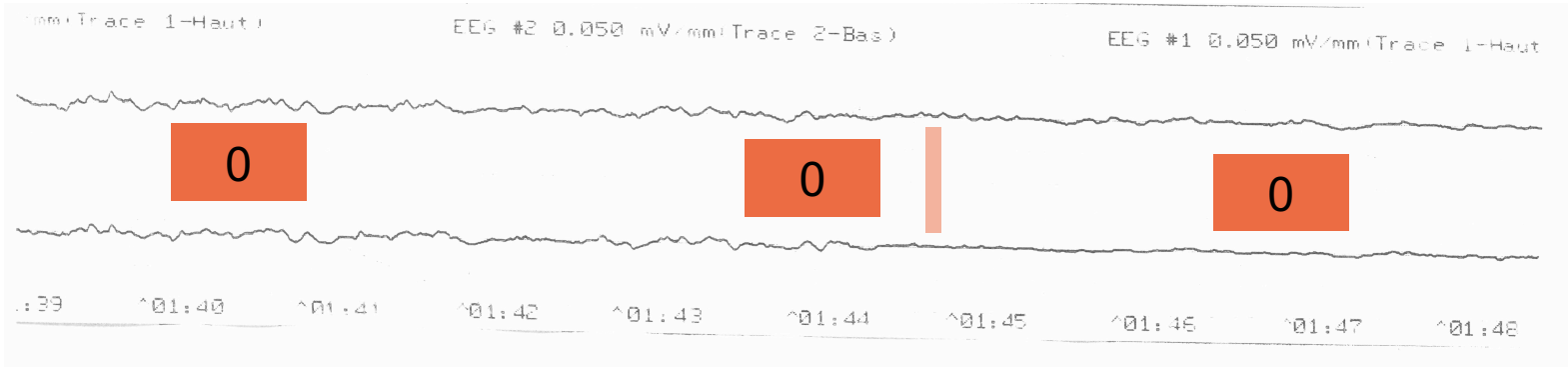
1

0.5

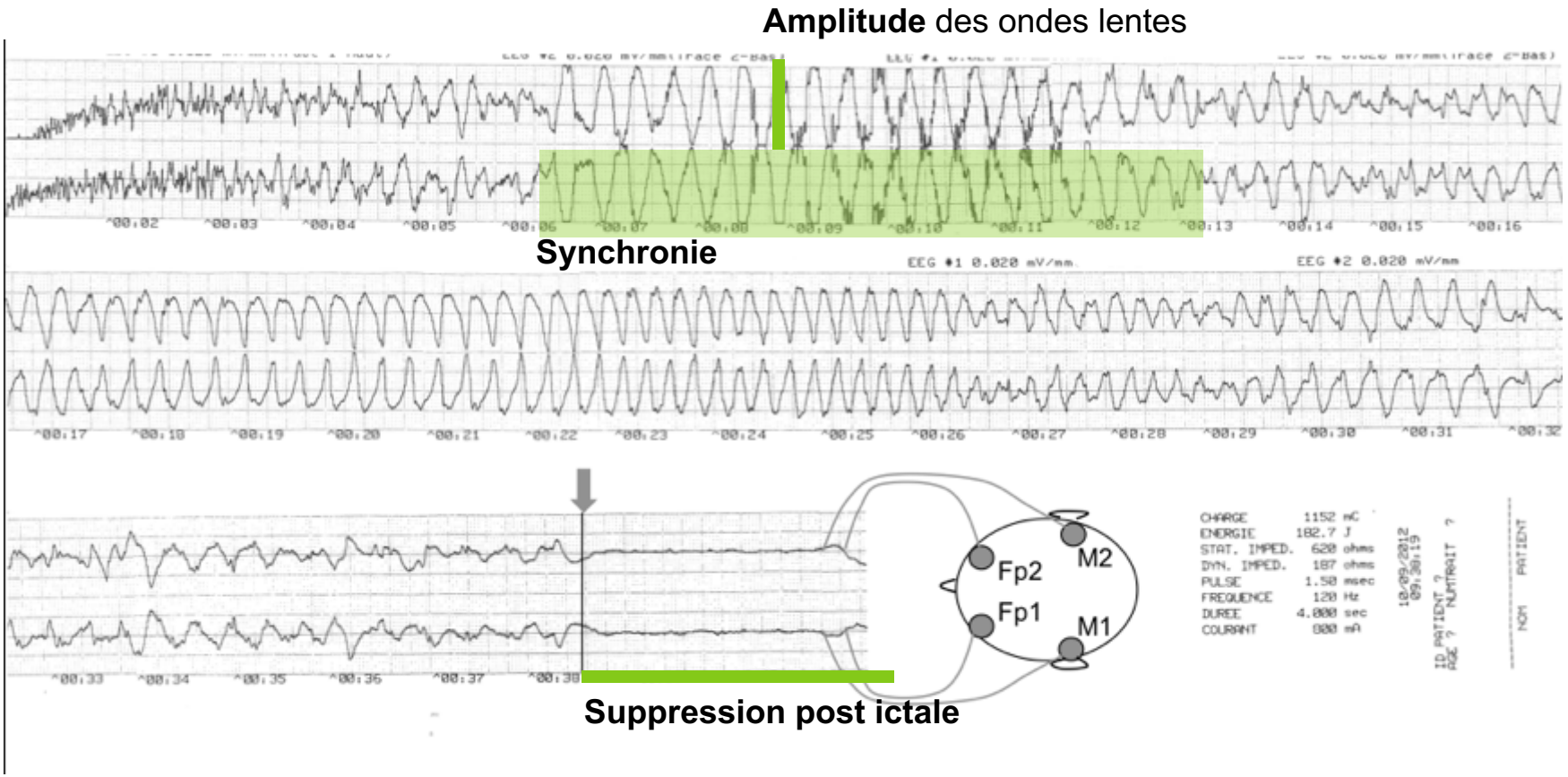
0.5

Post ictal supression





Critères quantifiés



1- Indice de suppression post-critique (ou de l'activité biocorticale, SABC)
2- Amplitude maximale de l'EEG durant la crise
3- Indice de cohérence inter hémisphérique

Le niveau de preuve

université de BORDEAUX

Quel niveau de preuve pronostique pour la cure ECT ?

UNE LITTERATURE PLUTOT ANCIENNE ?

Les prémisses

Brit. J. Psychiat. (1982), **141**, 357–366

A Double-Blind Controlled Comparison of the Therapeutic Effects of Low and High Energy Electroconvulsive Therapies

ASHLEY ROBIN and SANATH DE TISSERA

Amplitudes de crise plus amples et suppression post-ictale reliée à l'efficacité des crises

MAIS

En courant sinusoïdal

La durée de la crise n’influe pas

BIOL PSYCHIATRY
1993;34:321–330

EEG Manifestations during ECT: Effects of Electrode Placement and Stimulus Intensity

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EEG Manifestations during ECT: Effects of Electrode Placement and Stimulus Intensity

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A variety of qualitative ratings were scored on 7-point Likert-like scales ranging from 0 to 3, in increments of 0.5. These included global seizure strength, global seizure patterning (stereotypy), two indices of the termination phase (extent of amplitude and frequency reduction), and degree of immediate postictal suppression (suppression of bioelectric activity). Seizures were rated as having greater strength if slow-wave activity of high amplitude predominated during the slow-wave phase. Seizures were rated as more stereotypic if there was a clear progression from low amplitude chaotic polyspike activity to high amplitude slow-wave activity without the reappearance of chaotic polyspike activity or marked variability in amplitude during phases. Ratings for some of these features for prototypic examples of ictal activity are provided in Figure 1. In addition, ratings of total seizure duration and measurement of peak slow-wave amplitude were also made for the left hemisphere channel. Symmetry between left and right channels was rated on a scale from −3.0 to +3.0, again with 0.5 increments, with −3.0 representing markedly greater seizure strength in the left hemisphere lead, and +3.0 indicating an opposite pattern of asymmetry (see Figure 1).

La durée de la crise n'influe pas

BIOL PSYCHIATRY 321
1993;34:321–330

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UL (29)		**BL** (31)	
Faible dose	Forte dose	Faible dose	Forte dose

La durée des crises ne diffèrent pas

MAIS : les critères qualitatifs diffèrent

En particulier la suppression post ictale qui prédit les répondeurs

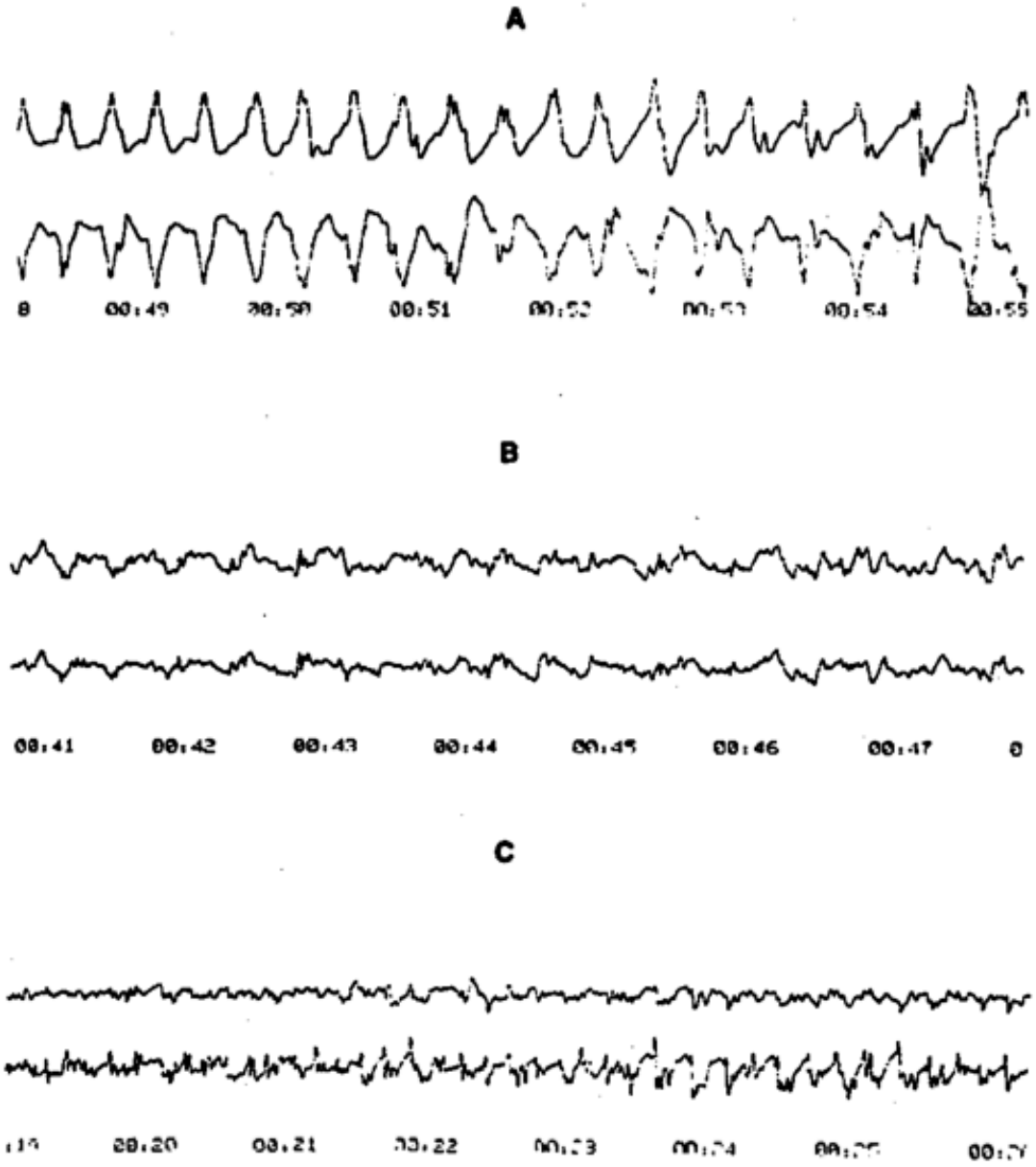
La durée de la crise n'influe pas

Table 3. Mean Values for Ictal EEG Ratings*

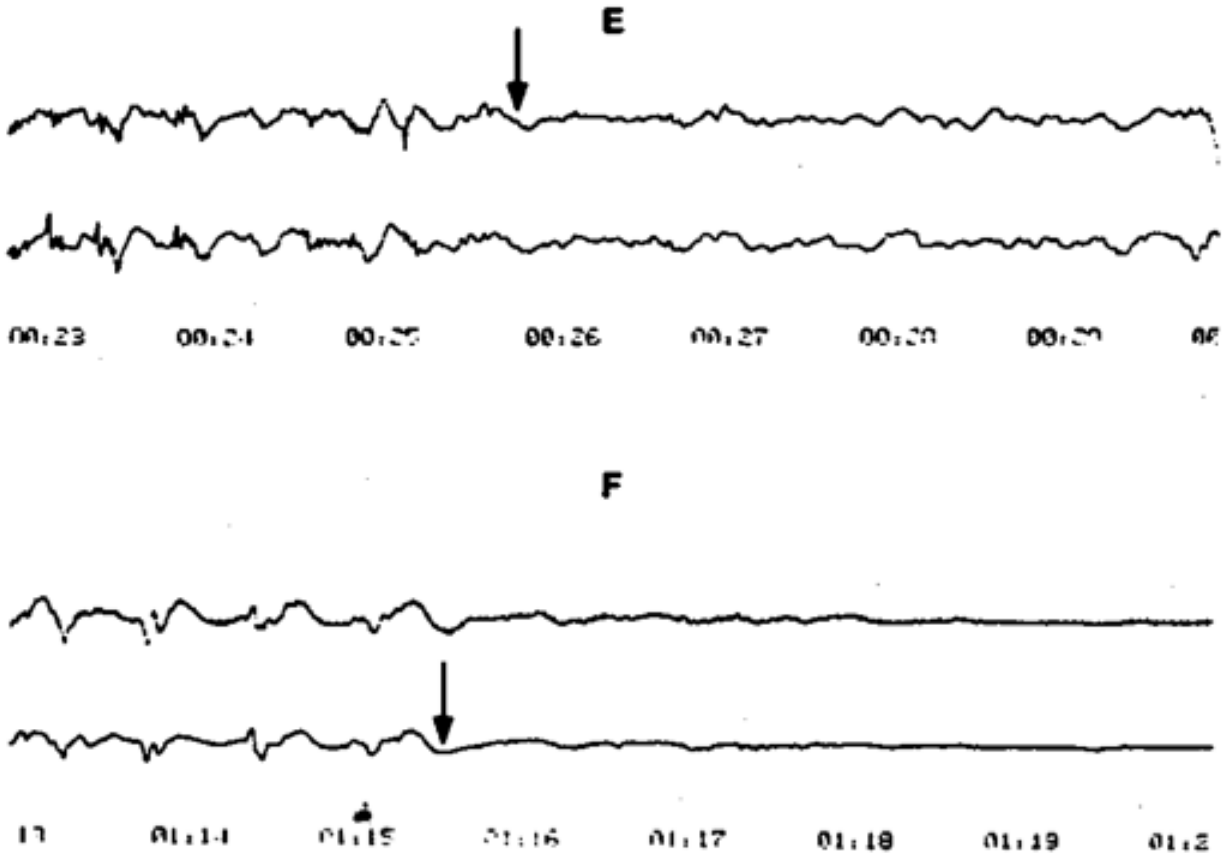
	Low dose unilateral (n = 15)		High dose unilateral (n = 14)		Low dose bilateral (n = 15)		High dose bilateral (n = 19)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Right Hemisphere								
Duration of polyspike phase (sec)	10.29[a]	6.17	5.60[b]	2.01	6.78[b]	2.42	5.58[b]	3.54
Duration of slow-wave phase (sec)	40.60[a]	13.75	52.23[b]	19.76	44.44[b]	10.38	45.37[b]	12.65
Total duration (sec)	50.89	13.89	57.83	19.06	51.22	11.48	50.95	12.32
Peak slow-wave amplitude (μv)	550.83[a]	166.24	526.07[a]	158.02	466.77[a]	127.84	633.73[b]	171.88
Overall strength	1.28[a]	0.58	1.50[a,b]	0.69	1.23[a]	0.41	1.63[b]	0.60
Overall pattern	1.38[a]	0.67	1.78[b]	0.62	1.51[a,b]	0.49	1.78[b]	0.50
Postictal suppression	1.09[a]	0.67	1.64[b]	0.93	1.95[b]	0.43	1.78[b]	0.77
Left Hemisphere								
Total duration (sec)	53.67	12.70	58.37	19.27	52.88	13.02	51.09	12.51
Peak slow-wave amplitude (μv)	515.33[a]	209.92	548.91[a]	168.96	457.34[a]	157.11	598.95[b]	201.99
Overall symmetry	+0.19	0.89	+0.29	0.90	+0.38	0.74	+0.70	1.17

*Groups with differing superscripts (e.g., *a* versus *b*) differed in pair-wise *t*-tests on least-squares adjusted means at trend or significant levels (all p's < 0.1, two-tailed).

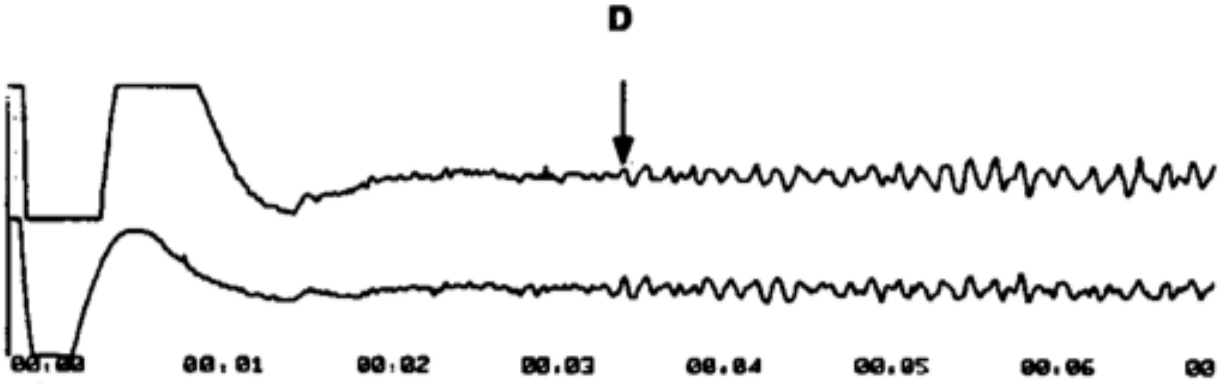
Différente amplitude



Différente terminaison



Apparition de la phase clonique



Les autres études

The Journal of ECT
16(3):211–228 © 2000 Lippincott Williams & Wilkins, Inc., Philadelphia

Quantitative EEG During Seizures Induced by Electroconvulsive Therapy: Relations to Treatment Modality and Clinical Features. I. Global Analyses

Mitchell S. Nobler, M.D., Bruce Luber, Ph.D., James R. Moeller, Ph.D., Gary P. Katzman, B.A., Joan Prudic, M.D., *D. P. Devanand, M.D., Gabriel S. Dichter, B.A., and †Harold A. Sackeim, Ph.D.

62 patients, UL & BL

Régularité et stérotypie : faible predicteur
Suppression post ictale: plus robuste

Les études de Krystal et al. Duke University

The Effects of ECT Stimulus Dose and Electrode Placement on the Ictal Electroencephalogram: An Intraindividual Crossover Study

Andrew D. Krystal, Richard D. Weiner, W. Vaughn McCall, Frank E. Shelp, Rebecca Arias, and Pamela Smith

J Neuropsychiatry Clin Neurosci. 1995 Summer;7(3):295-303.

The ictal EEG as a marker of adequate stimulus intensity with unilateral ECT.

Krystal AD[1], Weiner RD, Coffey CE.

BIOL PSYCHIATRY 1992;31:617–621

EEG Evidence of More "Intense" Seizure Activity with Bilateral ECT

Andrew D. Krystal, Richard D. Weiner, C. Edward Coffey, Pamela Smith, Rebekka Arias, and Eric Moffett

Changes in Seizure Threshold Over the Course of Electroconvulsive Therapy Affect Therapeutic Response and Are Detected by Ictal EEG Ratings

Andrew D. Krystal, M.D., M.S.
C. Edward Coffey, M.D.
Richard D. Weiner, M.D., Ph.D.
Tracey Holsinger, M.D.

Les études de Krystal et al. Duke University

BIOL PSYCHIATRY 1992;31:617–621

EEG Evidence of More "Intense" Seizure Activity with Bilateral ECT

Andrew D. Krystal, Richard D. Weiner, C. Edward Coffey, Pamela Smith, Rebekka Arias, and Eric Moffett

Manual Analysis. Manual ratings of EEGs recorded on paper during the ECT seizures were made by EM and included (1) *maximum peak-to-peak amplitude* of the seizure (mean values over 3 contiguous spike-and-wave complexes), (2) *immediate postictal amplitude* (mean value over first 5 sec following the end of the seizure), and qualitative estimates of both (3) *seizure symmetry* (7-point ordinal scale, −3 to +3, and 0 = symmetrical), and (4) *seizure regularity* (7-point ordinal scale, 0 to 7).

+ QUANTITATIVE ANALYSIS

Analyse spectrale : amplitude ondes lentes et suppression post ictale

Analyse de cohérence

La durée de la crise n'influe pas

BIOL PSYCHIATRY 617
1992;31:617–621

EEG Evidence of More "Intense" Seizure Activity with Bilateral ECT

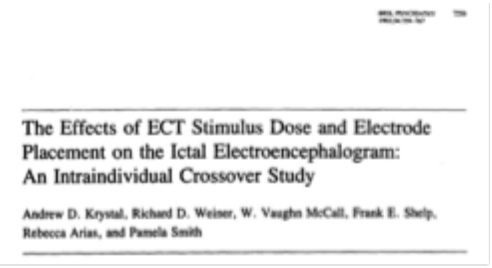
Andrew D. Krystal, Richard D. Weiner, C. Edward Coffey, Pamela Smith, Rebekka Arias, and Eric Moffett

UL (4)	**BL** (5)

La durée des crises ne diffèrent pas

MAIS : les critères qualitatifs et quantitatifs diffèrent

Les études de Krystal et al. Duke University



The Effects of ECT Stimulus Dose and Electrode Placement on the Ictal Electroencephalogram: An Intraindividual Crossover Study

Andrew D. Krystal, Richard D. Weiner, W. Vaughn McCall, Frank E. Shelp, Rebecca Arias, and Pamela Smith

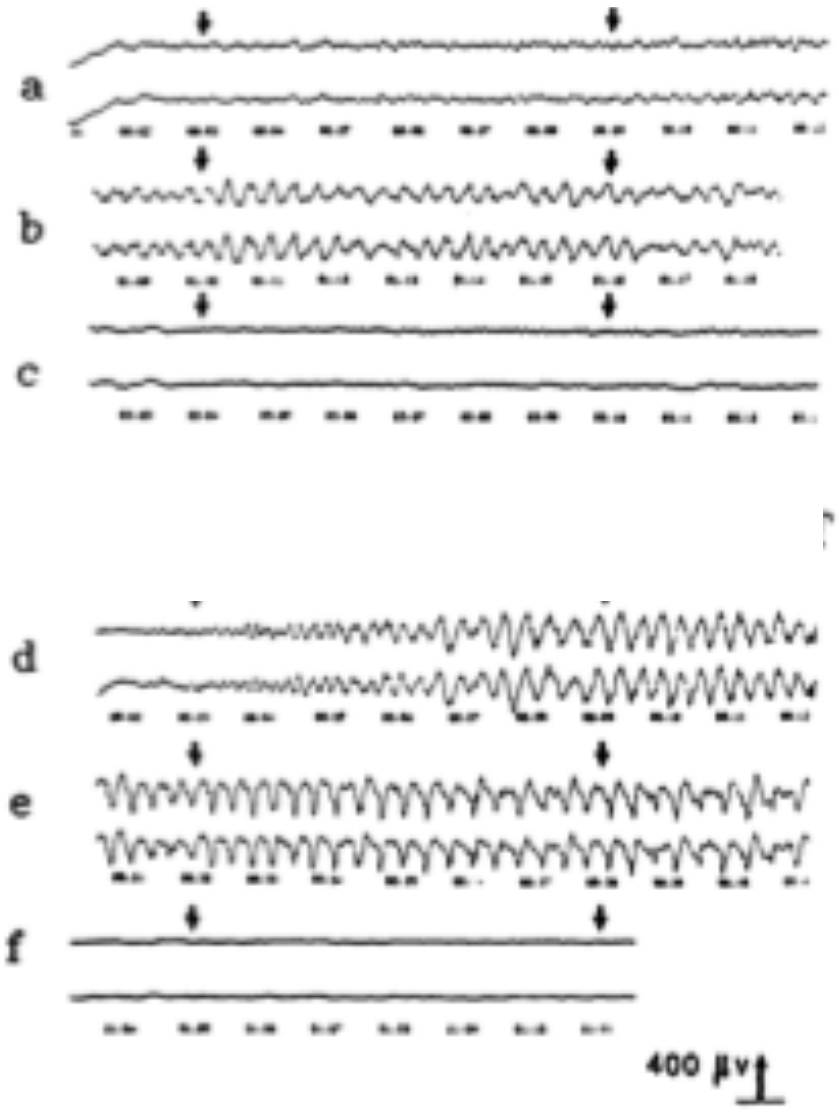
UL (9)		**BL** (10)	
Faible dose	Forte dose	Faible dose	Forte dose

La durée des crises ne diffèrent pas

MAIS : les critères qualitatifs et quantitatifs diffèrent

Attention : la durée de crise diminue en augmentant la dose en BL

Les études de Krystal et al. Duke University



Les études de Krystal et al. Duke University

Changes in Seizure Threshold Over the Course of Electroconvulsive Therapy Affect Therapeutic Response and Are Detected by Ictal EEG Ratings

Andrew D. Krystal, M.D., M.S.
C. Edward Coffey, M.D.
Richard D. Weiner, M.D., Ph.D.
Tracey Holsinger, M.D.

UL (37)	**BL** (10)

Le seuil épileptogène augmente

En UL : le critères qualitatifs prédisent cette augmentation

Et prédisent la réponse à 6 séances

Les autres études

ELSEVIER

Journal of Affective Disorders 41 (1996) 55–58

JOURNAL OF AFFECTIVE DISORDERS

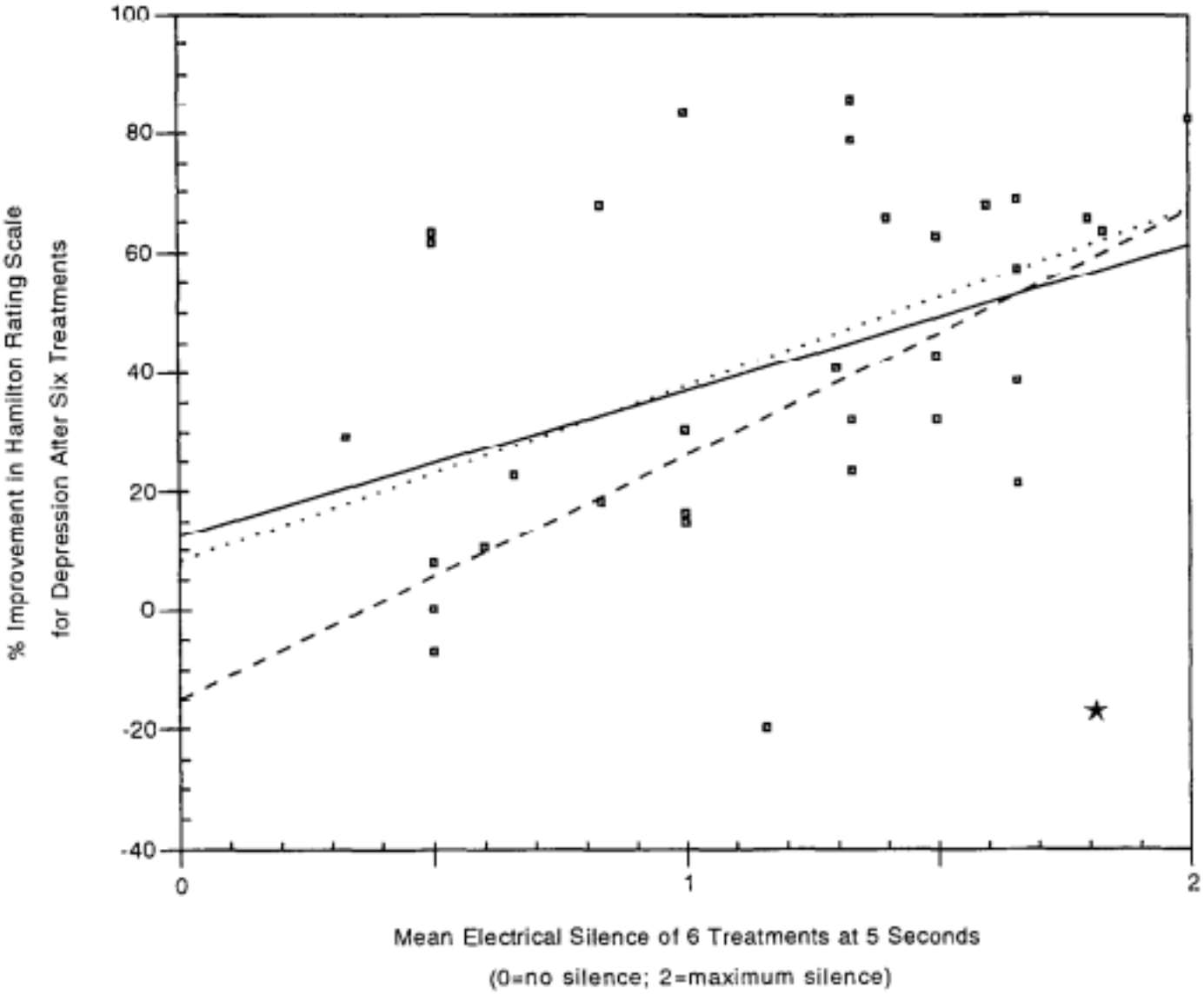
Research report

Is postictal electrical silence a predictor of response to electroconvulsive therapy?

Trisha Suppes [a,*], Andrew Webb [a], Thomas Carmody [a], Eunice Gordon [b], Rolando Gutierrez-Esteinou [c], James I. Hudson [d], Harrison G. Pope Jr. [d]

33 patients, UL ou BL

Les autres études



Les autres études

Eur Arch Psychiatry Clin Neurosci (1996) 246 : 155–164

ORIGINAL PAPER

Here Folkerts

The ictal electroencephalogram as a marker for the efficacy of electroconvulsive therapy

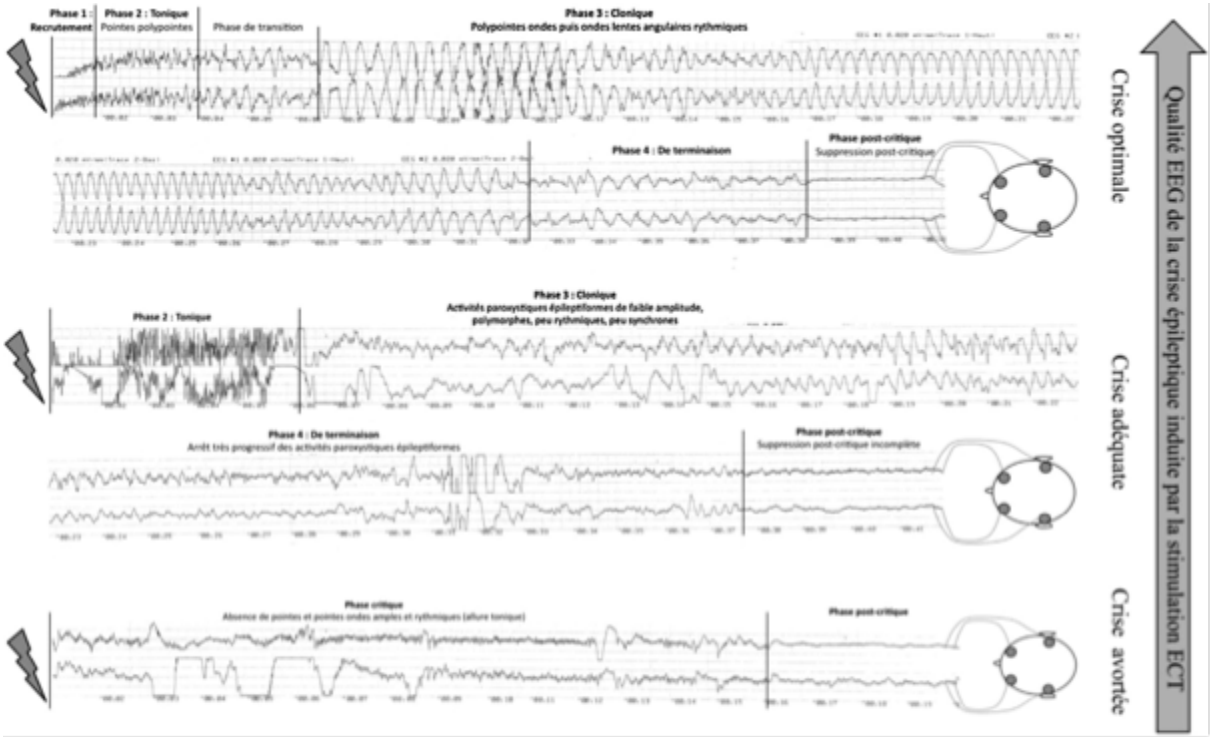
40 patients, UL

Régularité et stérotypie

En résumé

université de BORDEAUX

Aide mémoire



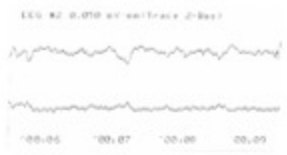

Comment surveiller une crise épileptique induite par ECT ?
Surveillance :
- Clinique (signes de convulsion)
- EEG (2 dérivations : hémisphère droit et gauche)
Durée de la crise EEG ?
Durée EEG = 0s
Absence de crise
Durée EEG < 15s
Crise avortée (courte)
Durée EEG = 15s-20s
Durée EEG = 20s-180s
Crise adéquate
Durée EEG > 180s
Crise prolongée
Attendre 15s-20s
Crise retardée ?
Signes cliniques ?
Crise optimale ?
Arrêter pharmacologiquement la crise épileptique
Arrêt ?
Non
Non
Oui
Oui
Non
Après 60s :
2ème stimulation à une charge supérieure
(Voir 3ème stimulation si nécessaire et si l'anesthésie le permet)
Poursuivre les séances de stimulation afin d'obtenir des crises adéquates
État de Mal Épileptique EME
Prise en charge de réanimation
Si échec traitement pharmacologique
ECT pour EME pharmaco résistant ?
Crise adéquate ?
Oui
Réponse clinique à la cure ECT?
Satisfaisante
Non satisfaisante
Oui
Crise optimale ?
Non
Non
Oui
Aux prochaines séances :
- Arrêter les psychotropes anti épileptiques,
- Préférer étomidate,
- Augmenter la charge de stimulation,
- Préférer stimulation bilatérale,
- Hyperventilation O2 avant stimulation,
- Discuter adjonction clozapine
Discuter les stratégies d'optimisation de la cure ECT
(Charge de stimulation, Placement des électrodes, Largeur d'impulsion, Adjonction pharmacologique: kétamine, etc...)
Aux prochaines séances :
- Rechercher facteurs favorisants,
- Refaire une titration pour déterminer une charge adéquate

Critère 3 : Régularité de la crise

Seizure regularity

(0 – 6)

Critère adapté de Weiner & Krystal, 1993



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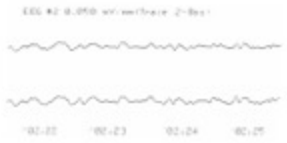
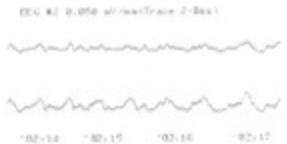


1



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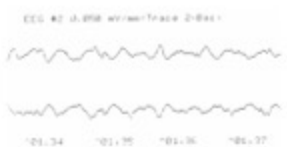

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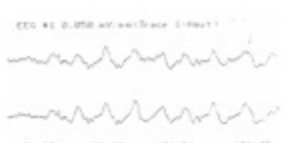

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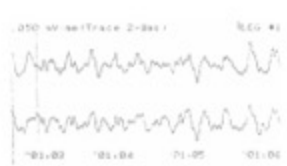

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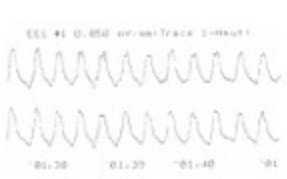

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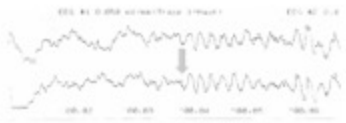
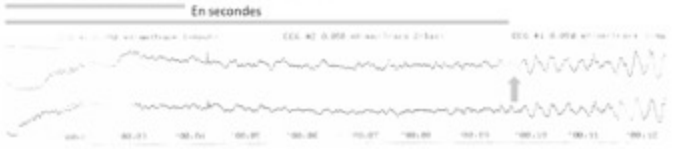
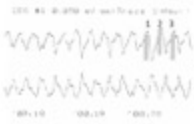


Critère 1 : Durée avant le ralentissement

Time to onset slowing – TSLOW

Durée depuis la fin de la stimulation électrique ECT jusqu'au début du ralentissement EEG ≤ 5 Hz

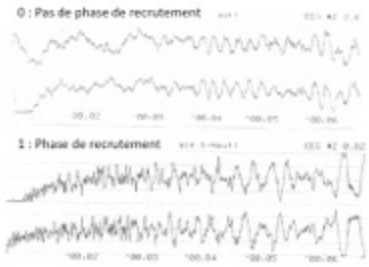




Critère 2 : Amplitude pic à pic en milieu de la phase clonique

Peak mid-ictal amplitude

Amplitudes de 3 ondes consécutives représentatives de la phase clonique la plus ample



Critère 4 : Stéréotypie de la crise

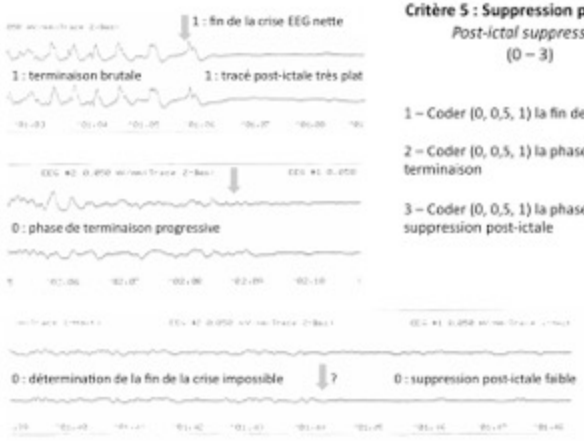
Seizure stereotypy

(0 – 3)

1 – Coder (0, 0,5, 1) la présence d'une phase de recrutement vers la phase clonique

2 – Coder (0, 0,5, 1) la qualité de la morphologie des ondes lentes / pointes-ondes et la réapparition de polypointes chaotiques

3 – Coder (0, 0,5, 1) la variabilité en amplitude des ondes lentes / pointes-ondes de la phase clonique



Critère 5 : Suppression post-ictale

Post-ictal suppression

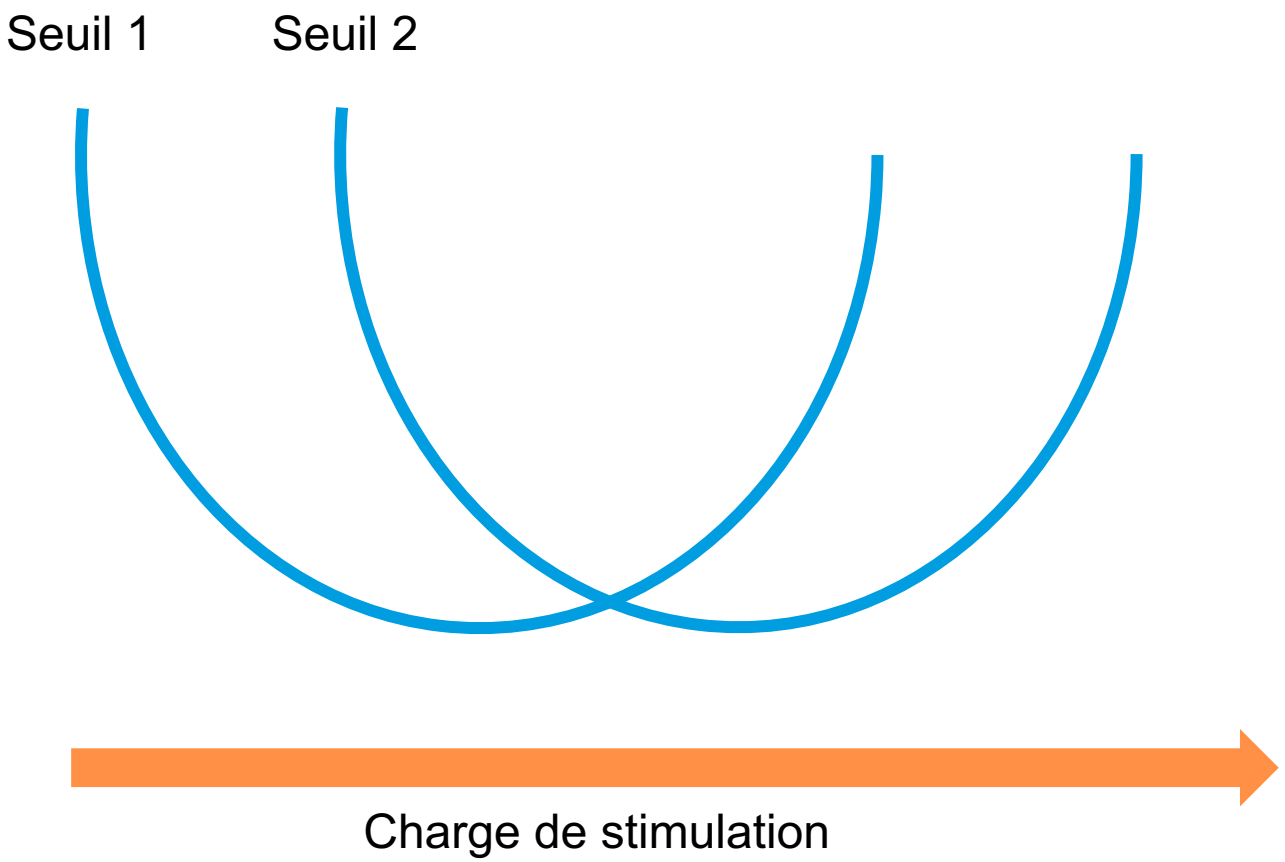
(0 – 3)

1 – Coder (0, 0,5, 1) la fin de la crise

2 – Coder (0, 0,5, 1) la phase de terminaison

3 – Coder (0, 0,5, 1) la phase de suppression post-ictale

Take home message

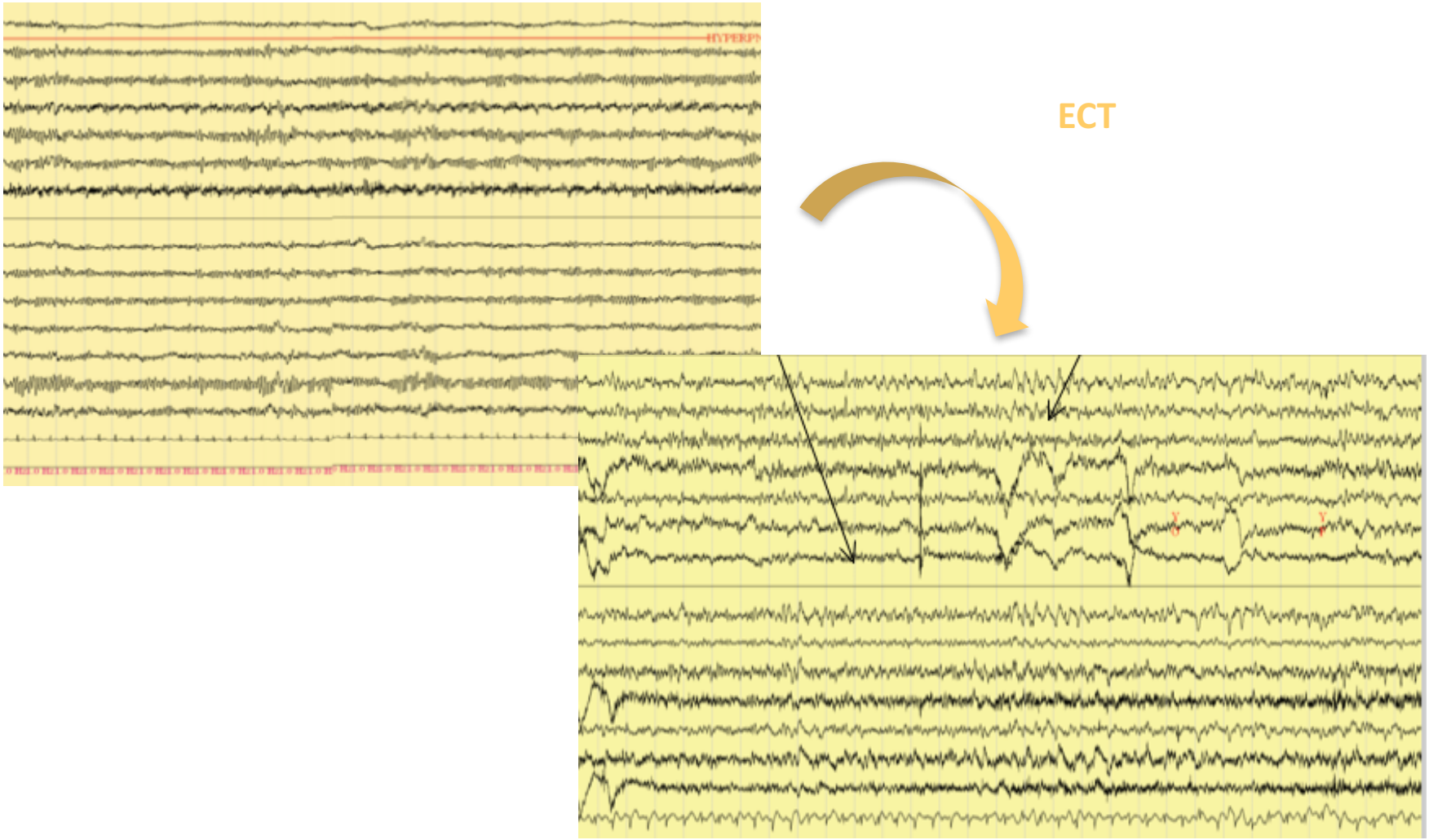


En inter critique

université de BORDEAUX

EEG conventionnel et ECT

Modification EEG post ECT



Crise épileptique indésirable

Pas de surveillance EEG systématique

Les modifications EEG sont reliées à une meilleure réponse thérapeutique aux ECT

Crise épileptique indésirable / Etat de mal épileptique indésirable

Pas de rôle prédicateur de l'EEG de base

Facteurs favorisants:

- ATCD de crises prolongées
- Première séance ECT
- ATCD de pathologies neurologiques (crise épileptique, maladie de parkinson)
- TRT abaissant seuil épileptogéne, arrêt TRT AE

Risque de récidive (discuter TRT AE)

EEG devant toute confusion post ECT pour éliminer état de mal épileptique indésirable

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