

# 4° CORSO RESIDENZIALE EEG e POTENZIALI EVOCATI

22 – 27 NOVEMBRE 2021

Con il Patrocinio di



**Neuromonitoraggio in area critica**

**A.Amantini - A.Grippo  
(Firenze)**



# Assenza di conflitto di interessi

I sottoscritti **Dr. A. Amantini** e **Dr. A. Grippo** in qualità di relatori  
al 4° Corso residenziale EEG e Potenziali evocati  
Roma - Edizione 2021

«Neuromonitoraggio in area critica»

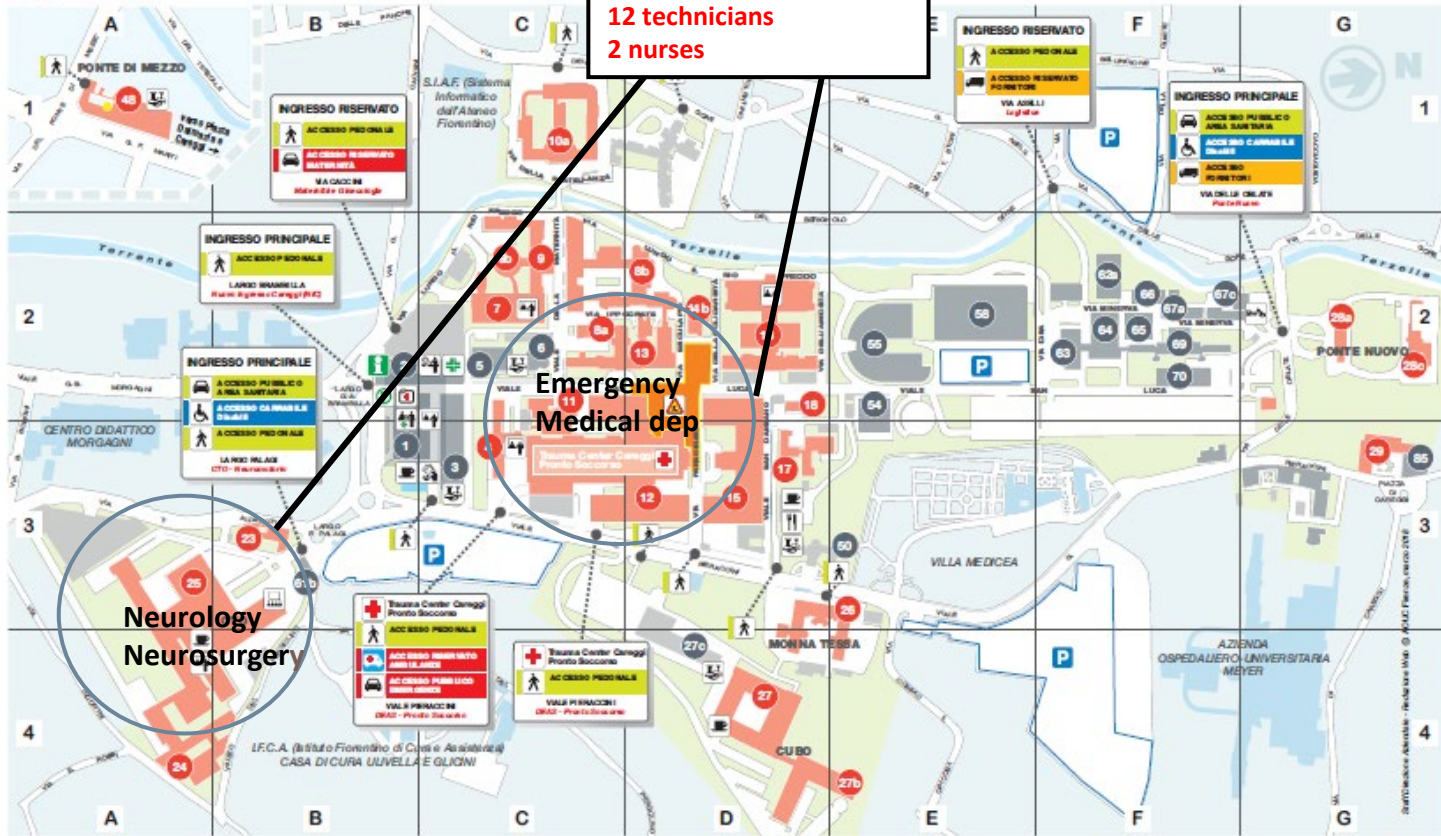
dichiarano l'assenza di conflitto di interessi ovvero l'assoluta  
autonomia dei contenuti scientifici del proprio intervento ed  
indipendenza da interessi economici commerciali con possibili  
aziende sponsorizzatrici.



# NEUROMUSCULAR Dept - UNIT of Clinicl Neurophysiology

Azienda  
Ospedaliero  
Universitaria  
Careggi

**StAFF**  
6 neuophysiolgists  
3 neurosonologists  
12 technicians  
2 nurses



# 7 different ICU areas



Azienda  
Ospedaliera  
Universitaria  
Careggi

**NICU**

**ICU:**

**cardiological/cardiosurgical  
general+trauma center**

**surgical/oncological**

**pneumological**

**neonatal**

**90 beds overall**

**3121 EEGs/year in ICU (gennaio-dic 2018)**

**1129 SEPs/year in ICU**

# Fase acuta

# Fase transizionale

# Fase protratta

DANNO CEREBRALE ACUTO

COMA

COMA cronico?

MORTE ENCEFALICA

RECUPERO

STATO VEGETATIVO

STATO DI MINIMA COSCIENZA (MCS)

RECUPERO COSCIENZA

MCS "CRONICO"

According to behavioral criteria:

stato di *"unarousable unresponsiveness"*

assenza di vigilanza (occhi chiusi) e pertanto di coscienza.

Plumm e Posner (1966) e non GCS<9

According to temporal criteria:

< 28 dd

Giacino et al. 2018

# Utilità prognosi precoce

- French law (the Léonetti Act N.2005-370 of April 22, 2005, concerning patients' rights and end of life care), states that “the acts of prevention, investigation or treatment must not be continued with unreasonable obstinacy, when they seem useless, disproportionate or to have no other effect than solely the artificial preservation of life”
- In this difficult context, electrophysiological recordings, i.e. electroencephalogram (EEG) and evoked potentials (EPs), are useful to take a collective decision.....

Ottimizzazione percorsi assistenziali  
alla dimissione

# Valutazione diagnostica/prognostica precoce D.O.C.



*Presidenza  
del Consiglio dei Ministri*  
CONFERENZA UNIFICATA

**Oggetto:** Accordo tra il Governo, le Regioni e le Province autonome e gli Enti locali sul documento recante "Linee di indirizzo per l'assistenza alle persone in Stato Vegetativo e Stato di Minima Coscienza".

*Accordo ai sensi dell'articolo 9 del decreto legislativo 28 agosto 1997, n. 281.*

A seguito della riunione tecnica svoltasi il 28 aprile u.s., il Ministero della salute, con nota in data 29 aprile 2011, ha inviato la versione definitiva del documento indicato in oggetto che recepisce le modifiche concordate nella predetta riunione tecnica .



# “coma to community”

## 4 fasi

Fase critica/acuta (terapie intensive)

Fase subacuta (unità subintensiva/semintensiva)

Fase post-acuta (riabilitazione intensiva)

Fase degli esiti (strutture territoriali)

*In parallelo:*

*prev compl/stabilizzazione*

*approfondimento diagnostico DOC e*

*valutazione continua indicatori prognostici*

# 1°- 2° anello del percorso (fase acuta-sub-acuta)

Percorso di cura orientato sulla base di indicatori  
prognostici precoci:

età

anamnesi

danni associati

**indicatori neurofisiologici**

# Metodiche applicabili in UTI

**Table I.** Main neurophysiological tools available in the ICU.

<i>Neurophysiological tool</i>	<i>Components</i>	<i>Normal latency range (ms)</i>	<i>Corresponding central or peripheral nervous structures</i>
<b>EEG</b>			Cerebral cortex, brain-stem modulation
<b>Cognitive EPs</b>	MMN	< 200	Auditory cortex
	P300	> 300	Associative cortex, brain-stem modulation
Visual EPs	peak I	< 60	Retina
Flash	peak III	< 100	Occipital cortex
	peak VII	150 – 250	Associative cortex, brain-stem modulation
	RAD	> 250	Occipital cortex, brain-stem modulation
<b>Somatosensory EPs</b>	Erb's point	< 12	Peripheral nerve
<b>Median nerve</b>	N13	12–16	Spinal cord (cervical)
	P14	13–18	Medulla
	P14–N20	< 7	Brain-stem + subcortical transmission time
	N20	18–25	Parietal cortex (area 3b)
	N30	28–35	Frontal cortex
Auditory EPs	BAEP I	< 2	Auditory nerve
	BAEP II–V	< 6	Pons
	Middle-latency	< 90	Auditory cortex
	Long-latency	> 100	Associative cortex, brain-stem modulation
<b>EMG</b>			

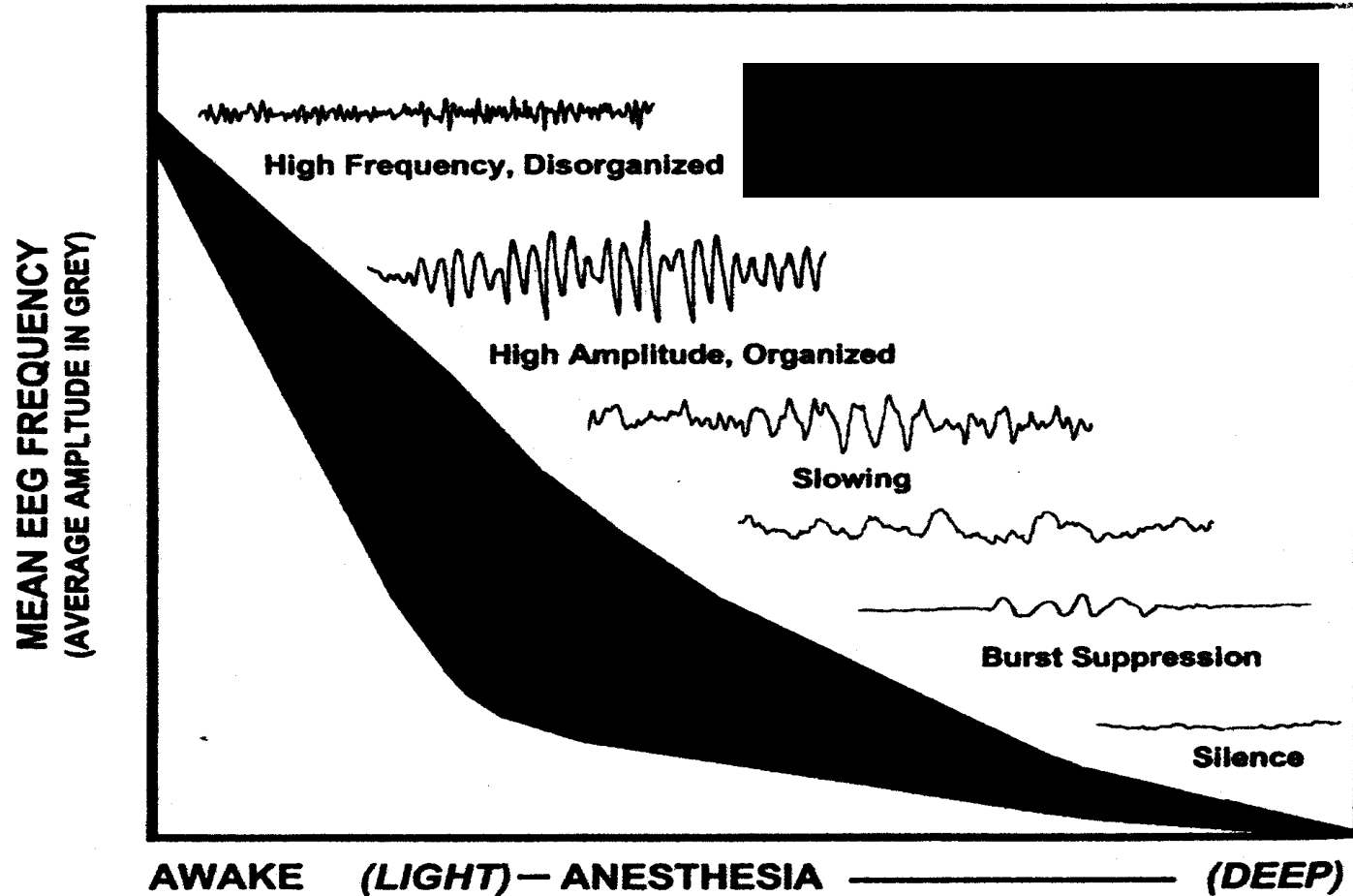
BAEP: brain-stem auditory evoked potential; MMN: mismatch negativity; RAD: rhythmic after-discharge.

# NFC in UTI

- 1) indicatori **prognostici** precoci certi di tipo **sfavorevole** e **favorevole** in funzione dell' etiologia del coma (HIE)
- 2) indicatori **prognostici** con elevato valore predittivo per il recupero dello stato di coscienza e per la disabilità residua (TBI)
- 3) **Diagnosi**: contributo a stabilire l'effettivo stato di coscienza oltre l'evidenza clinica

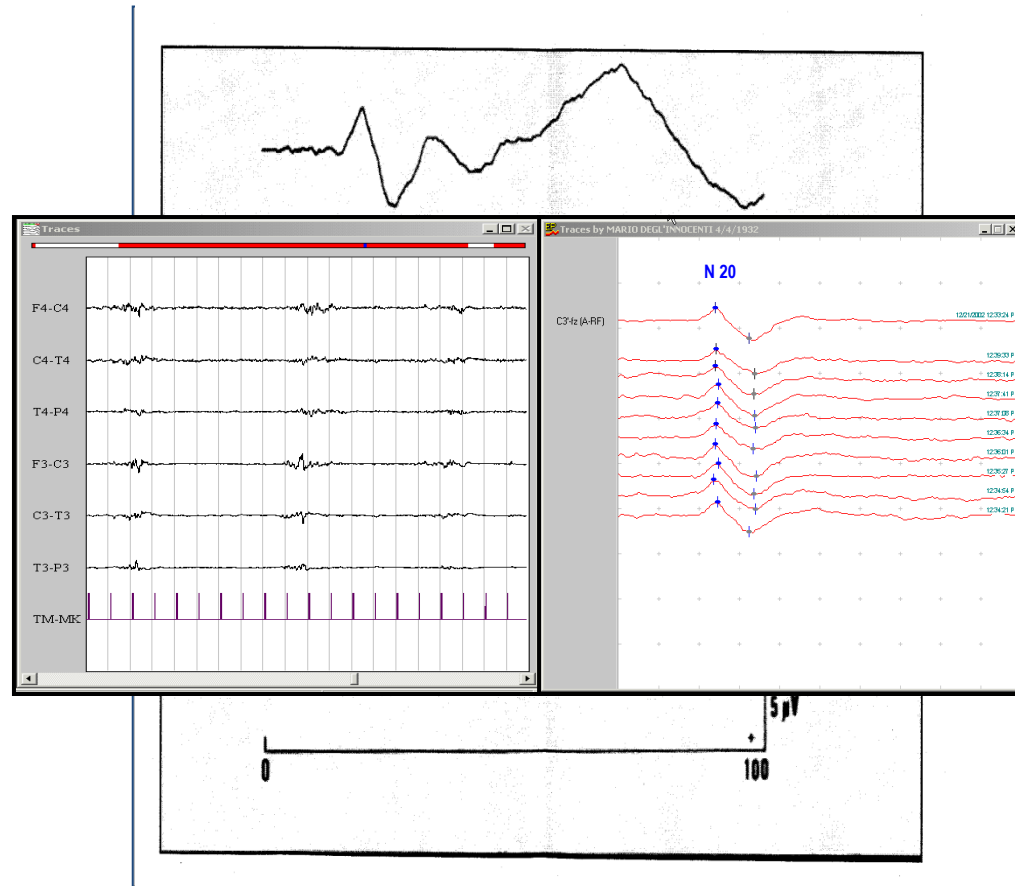
# Effetti sedazione anestesia

## EEG



# Effetti sedazione anestesia SEP

*resistant to sedatives  
and anesthetics*



# Effetti ipotermia

## EEG

< 34°C riduzione d'ampiezza e di frequenza dell'EEG.

Complessi periodici: 29.5°C (+/-3)

Burst-suppression: 24.5°C (+/- 4)

Silenzio elettrico: 22 °C (+/- 4)

## PES

Fino a 30-32°C N20 immutata in ampiezza

N20 scompare : 20.5°C (+/- 4)

P14 scompare : 17.5°C (+ /-2.5)

N13 scompare: 17°C (+/- 3)

*(Stecker et al., 2001)*

# EEG versus PES

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Sensibilità alla  
neurosedazione

Resistenza alla  
neurosedazione

Sensibilità danno  
metabolico

Resistenza danno  
metabolico

Specificità diagnosi  
NCS e SENC

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Sensibilità danno  
strutturale  
ipossi/ischemico

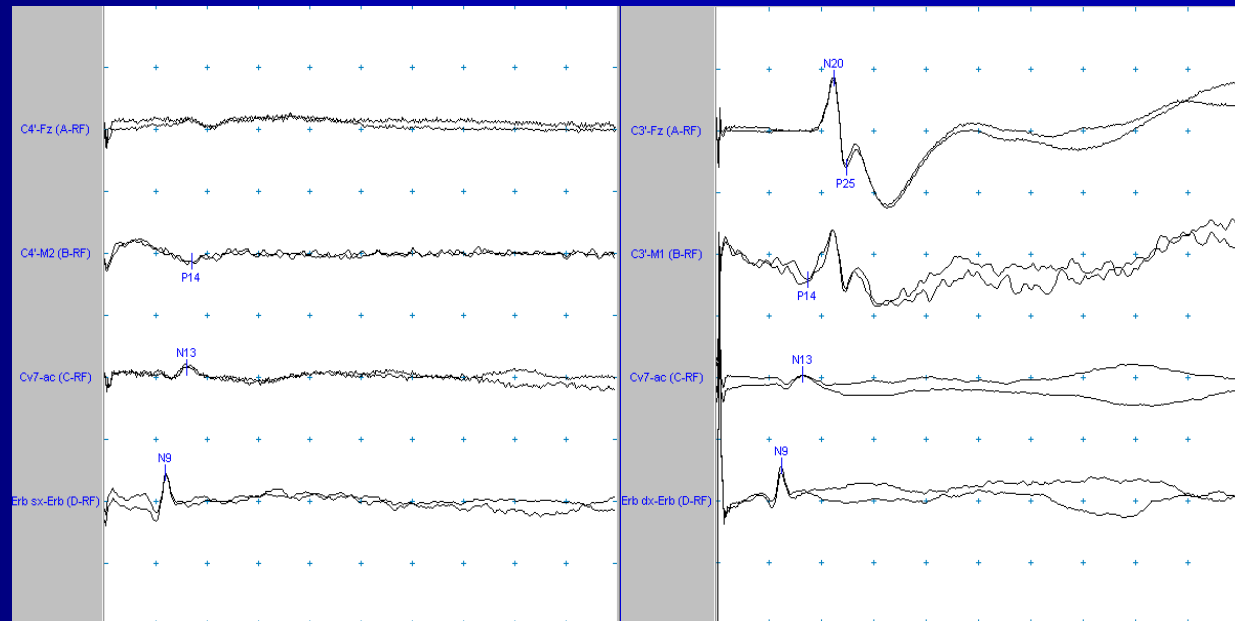
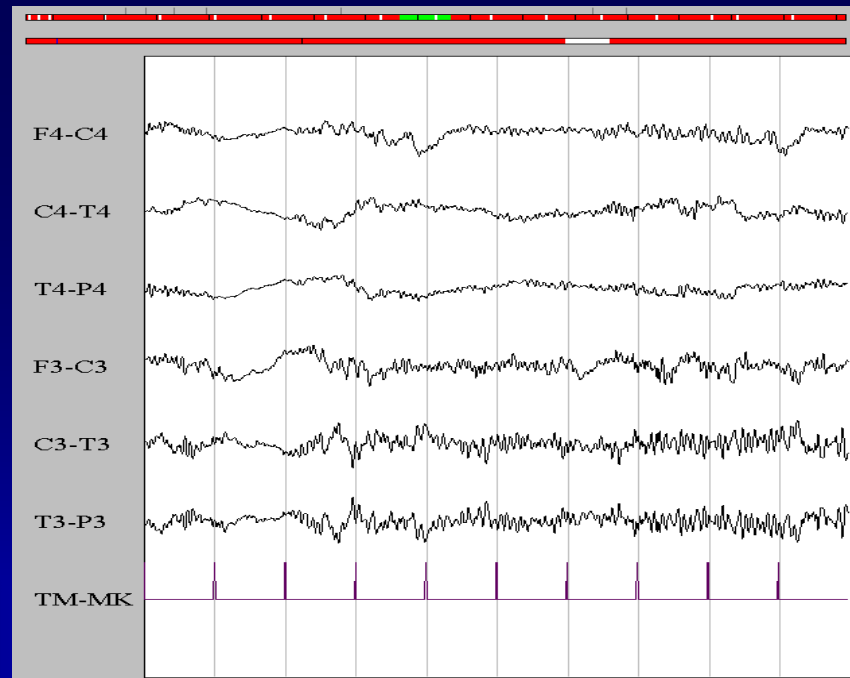
Sensibilità danno  
strutturale  
ipossi/ischemico

Interpretazione  
esperta

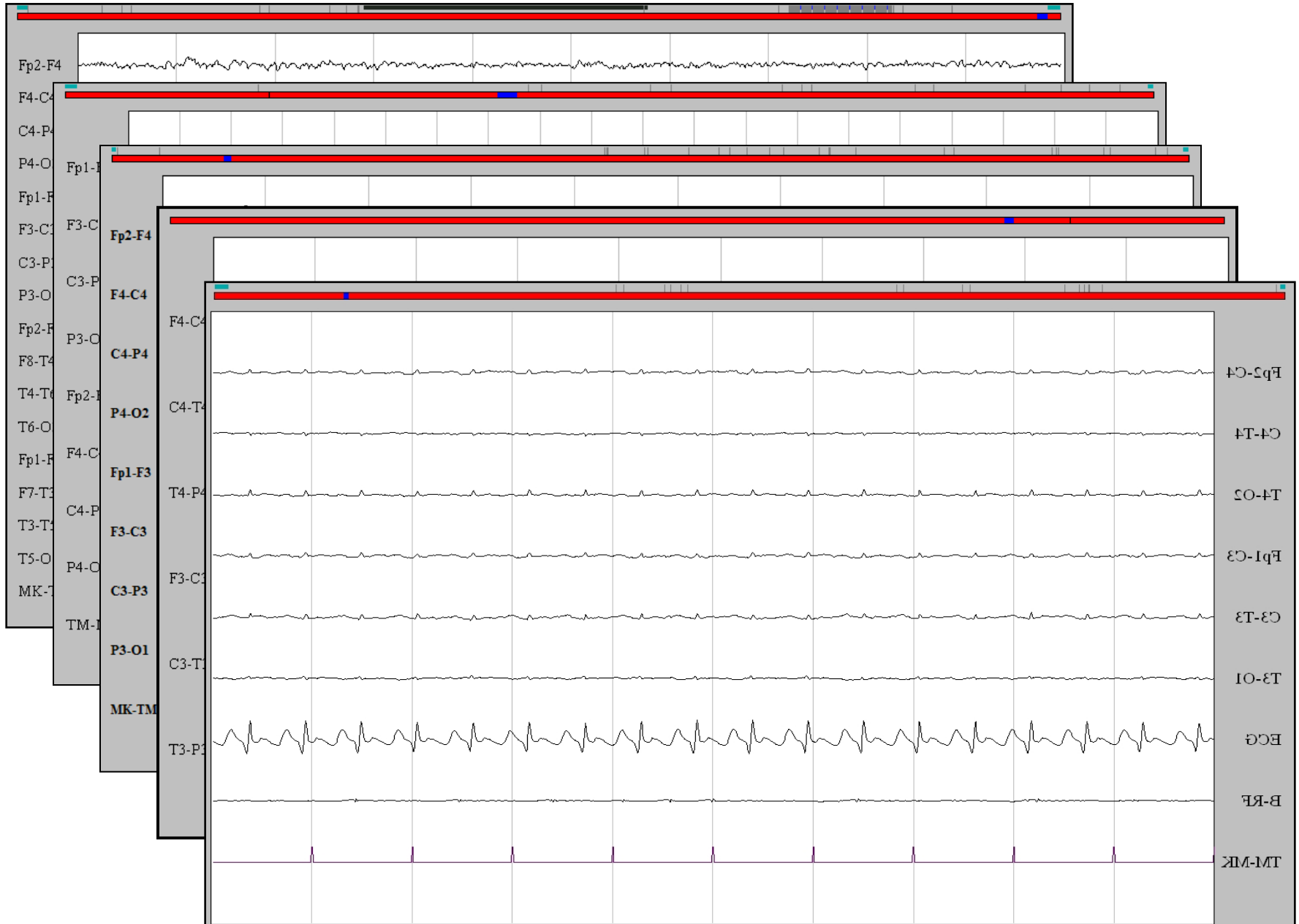
Interpretazione  
semplificata



# ESA: complicanza ischemica da vasospasmo



# Razionale all'impiego dell'EEG



# Scale EEG – Coma

## Hockaday 1965

- **Grade 1:** background alpha with/without scattered theta
- **Grade 2:** theta intermixed with some alpha or some delta
- **Grade 3:** continuous polymorphic delta with little faster frequencies. EEG variability and reactivity
- **Grade 4:** invariant delta activity of relatively small amplitude (<100uV) unresponsive to any stimulation or “suppression burst” pattern
- **Grade 5:** near flat or Electrode Cerebral Inactivity

# Scale EEG – Coma

## Hughes 1976

- EEG INDEX: All EEGs run for 30 min. Determine frequencies present in record. Percentage of time represented by each frequency.
- All studies with <ECS give score of zero. Amplitude 2-10 uV scored x10 of amp max 100.
- For other records, amplitudes disregarded.
- Mean frequency of any range multiplied by incidence for frequency range,

# Prognostic significance of EEG coma patterns (post-traumatic, post-anoxic coma)

Synek, 1988, 1990

*Benign*

*Uncertain*

*Malignant*

<b>Grade 1</b>	<b>Grade 2, non-reactive</b>	<b>Low amplitude, grade 3</b>
<b>Grade 2, reactive</b>	<b>Grade 3, diffuse delta non-reactive</b>	<b>Burst-suppression, grade 4</b>
		<b>Epileptiform discharges grade 4</b>
		<b>Low output, grade 4</b>
		<b>Isoelectric, grade 5</b>
<b>“spindle pattern coma” grade 3</b>	<b>Epileptiform discharges grade 3</b>	<b>“Alpha pattern coma” non-reactive</b>
<b>Frontal rhythmic delta Reactive/non-reactive</b>	<b>“alpha coma”, reactive</b>	<b>“Theta pattern coma”</b>
		<b>BIPLDs, PEDs</b>

# Scale

## Development of a novel

## dict

Alexander D. Rae-Grar

(EEG

Dichotomous rating scale for EEG.

			Weight
<i>Background activity</i>			
'Normal' alpha	Present	Absent	+ 10
WAU/alpha coma	Present	Absent	- 4
Beta	Present	Absent	+ 2
Theta	Present	Absent	+ 1
"Theta coma"	Present	Absent	- 2
Delta (general/frontal)	Present	Absent	+ 1
Delta (focal, non-frontal)	Present	Absent	+ 1
Spindles (symmetric)	Present	Absent	+ 4
Spindles (asym. or abn.)	Present	Absent	- 2
<i>Symmetry, reactivity, variability</i>			
Asymmetry (not posterior)	Present	Absent	- 2
Posterior suppression	Present	Absent	- 2
Reactivity	Present	Absent	+ 3
Variability	Present	Absent	- 3
<i>Additional patterns</i>			
IRDA	Present	Absent	+ 0
Triphasic waves	Present	Absent	+ 0
ELAE	Present	Absent	+ 3
Epileptiform activity	Present	Absent	- 1
Burst suppression	Present	Absent	- 5
Low voltage pattern	Present	Absent	- 6
ECl	Present	Absent	- 10
Dichotomous score:			-



# EEG

## Molteplici classificazioni

*(Hockaday et al., 1965; Hughes et al., 1976; Bricolo et al. 1979;  
Rae-Grant et al., 1991; Syneck, 1988; Young et al., 1997, etc.)*

**Ritmo di fondo**

**Reattività (variabilità)  
pattern speciali**

**Practice Parameter: Prediction of  
outcome in comatose survivors after  
cardiopulmonary resuscitation  
(an evidence-based review)**

**Report of the Quality Standards Subcommittee of the  
American Academy of Neurology**

E.F.M. Wijdicks, MD; A. Hijdra, MD; G.B. Young, MD; C.L. Bassetti, MD; and S. Wiebe, MD



*Which electrophysiologic studies are helpful in determining outcome?*

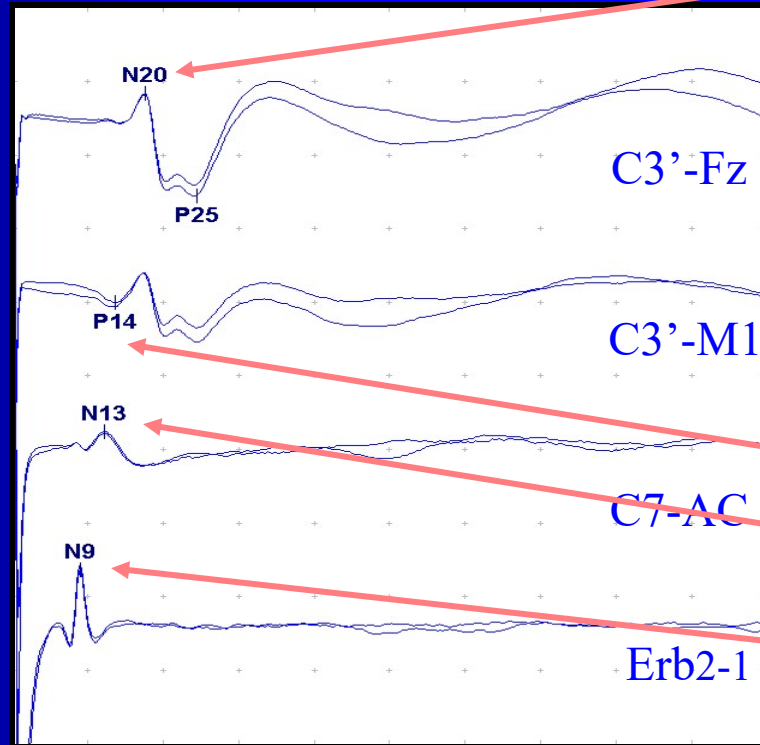
**PES (Potenziali evocati somatosensoriali)**

**a 24 h**

**EEG ?**

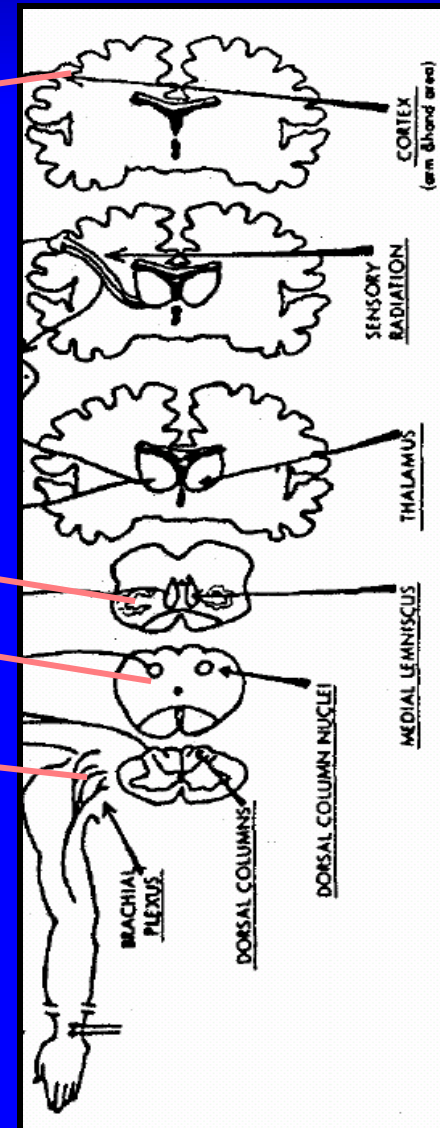
# Razionale all'impiego PES in UTI

## Topografia lesionale



## Indice di funzione cerebrale

*(brainstem, thalamo-cortical and intracortical transmission)*



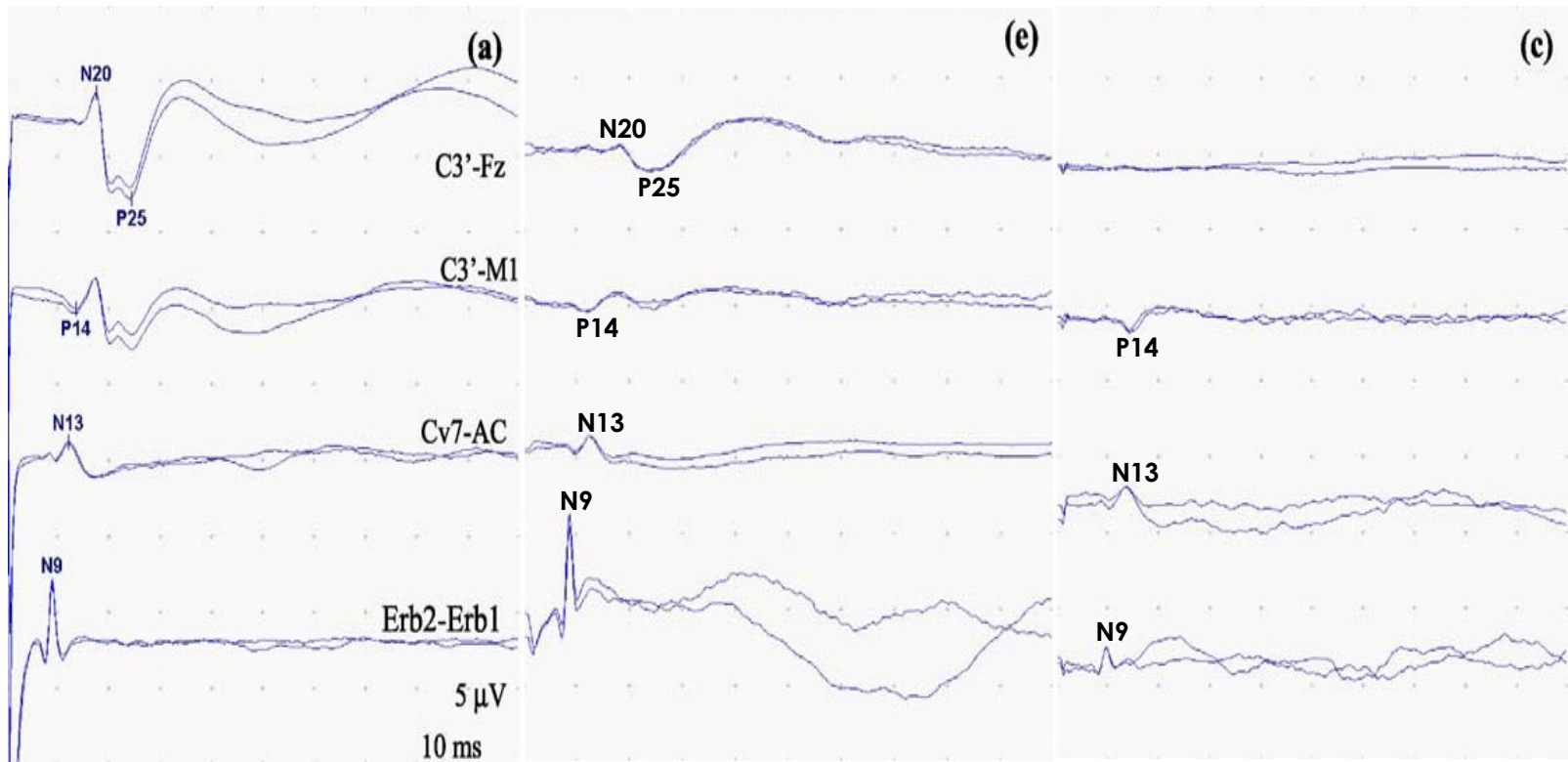
Cortex SMI

Caudal lemniscus

Spinal cord

Brachial plexus

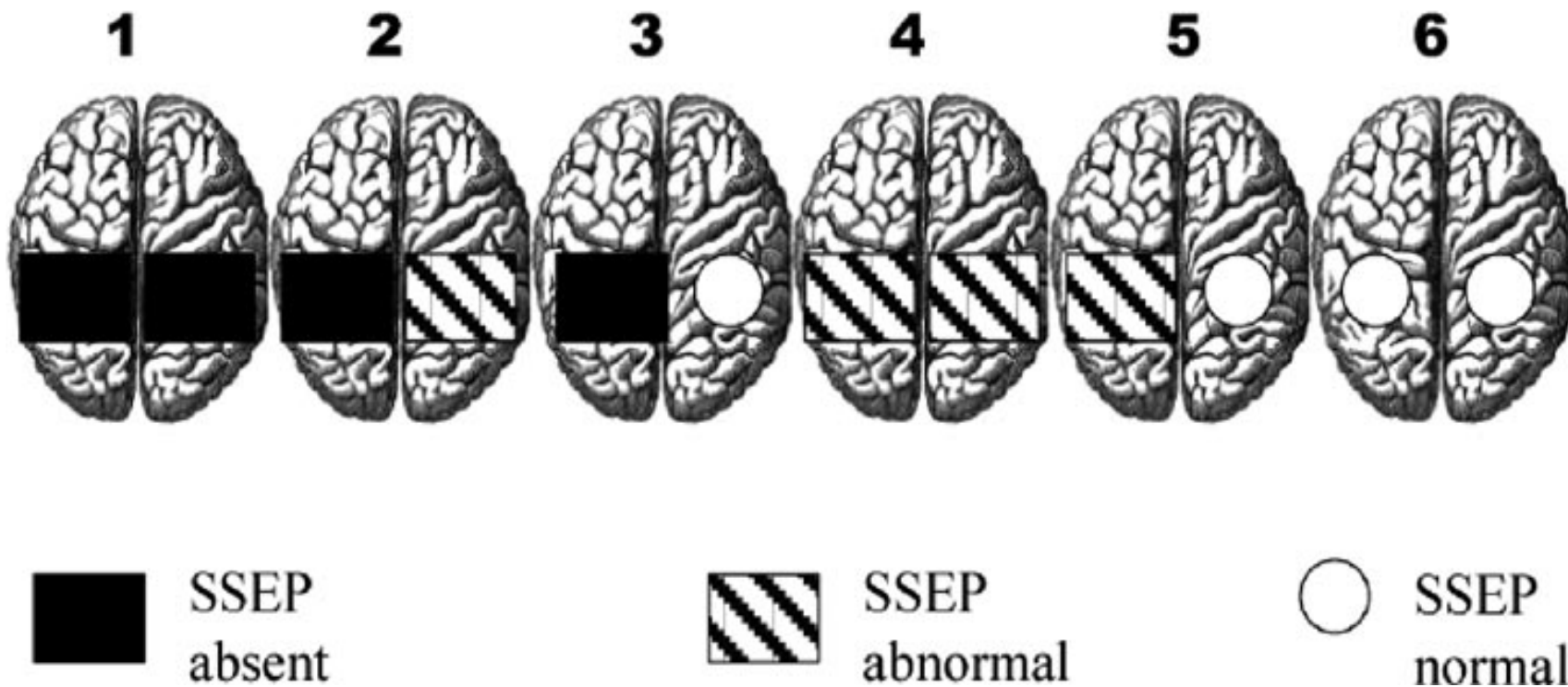
# Classificazione Pattern PES



**6 PATTERN PES: NN-NP-PP-NA-AP-AA**

*(Amantini et al., 2005)*

# Median nerve SSEP grading system

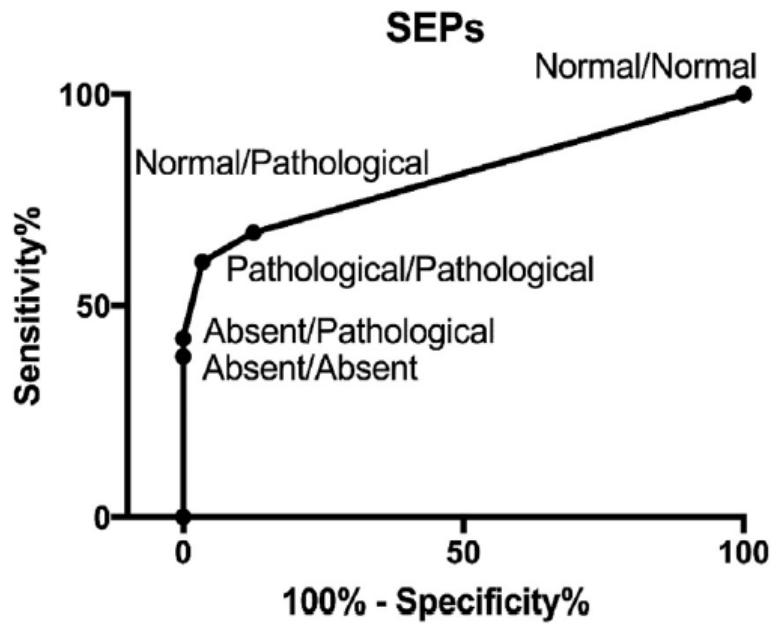


**6 PATTERN PES: NN-NP-PP-NA-AP-AA**

*(Houlden et al.,2010)*

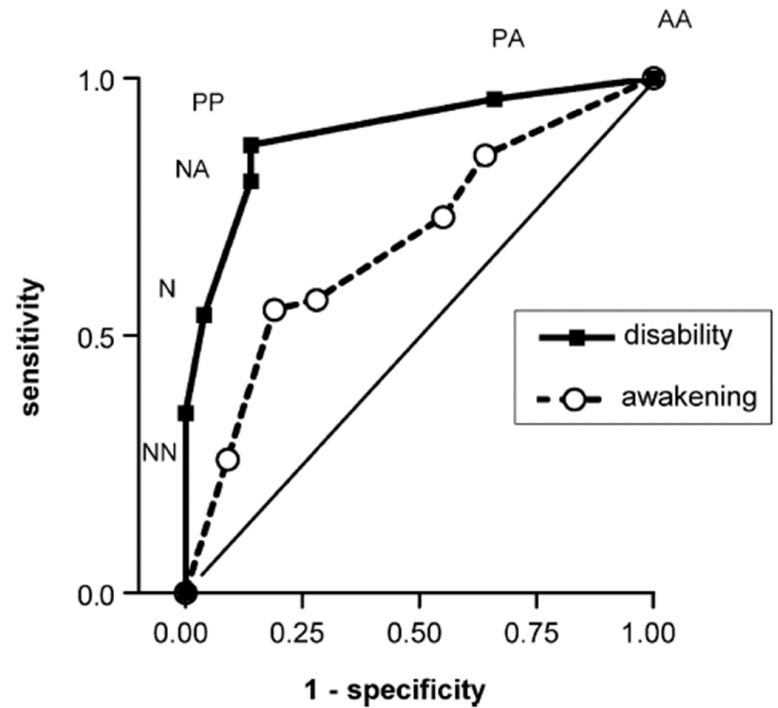
# COMA

## post-anoxic



*(Scarpino et al., 2019)*

## post-traumatic



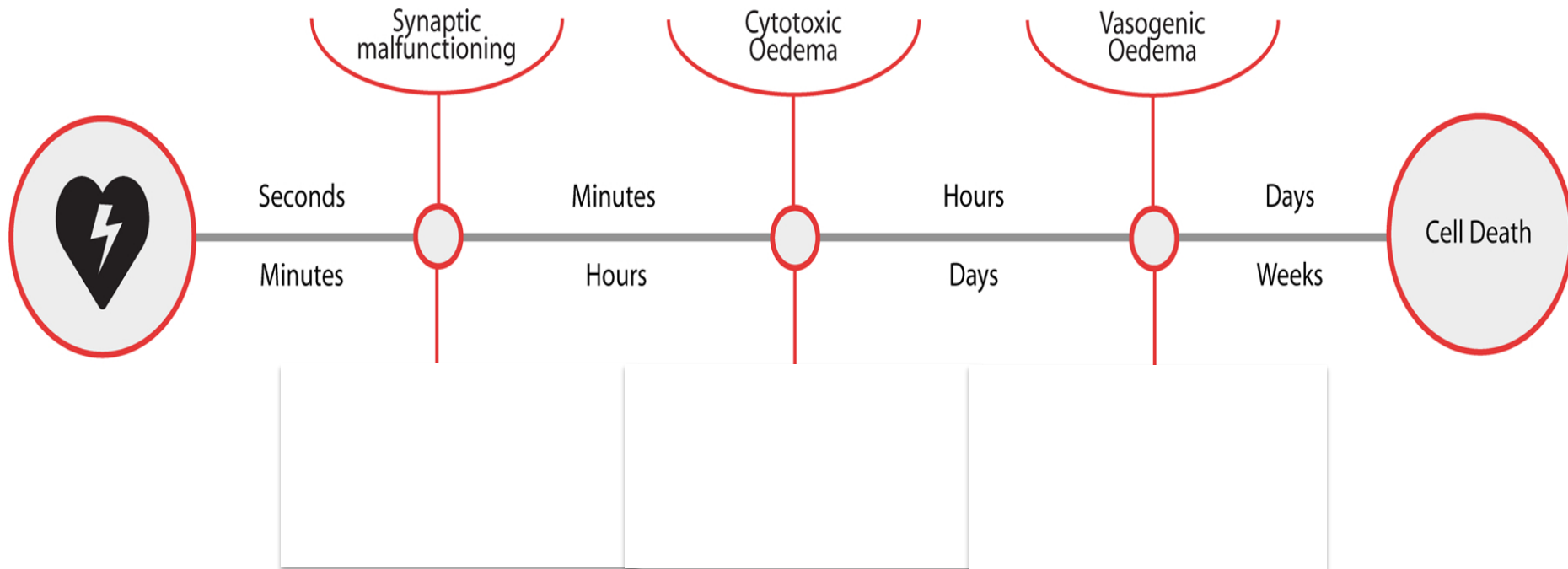
*(Amantini et al., 2005)*



# Eziologia

- Arresto Cardiaco
- Trauma Cranico
- Emorragie Intracraniche
- Stroke ischemico

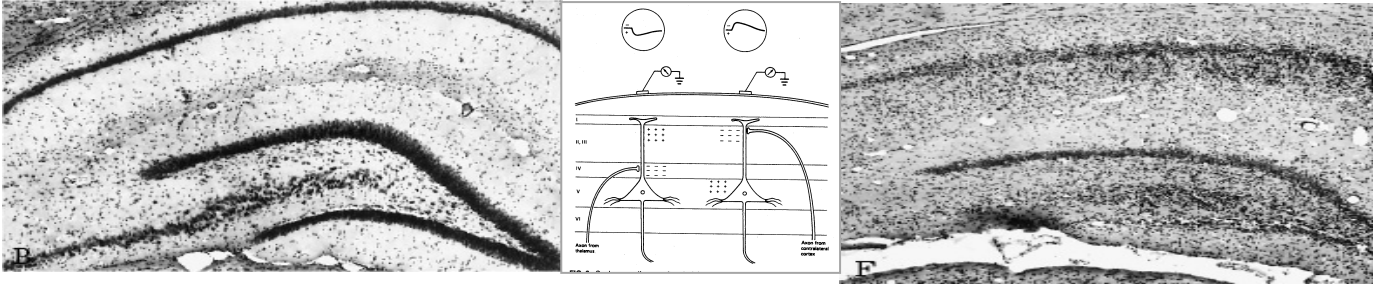
# Timeline of neuronal damage after cardiac arrest and diagnostic measures sensitive to detection of abnormalities for each phase.



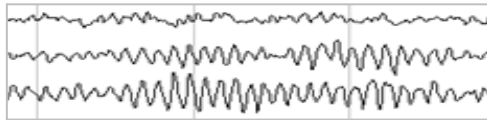


# Istopatology

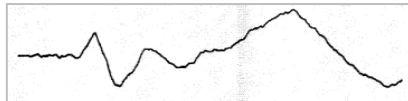
Selective Neuronal death : IV cortical layer, ippocampus, caudatus nuscleus, putamen, thalamus.



EEG

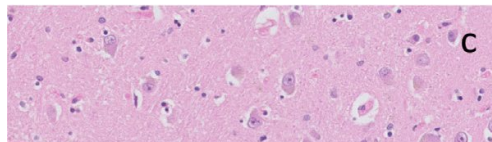
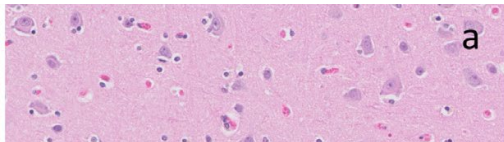


PES



Frontal Cortex

Thalamus

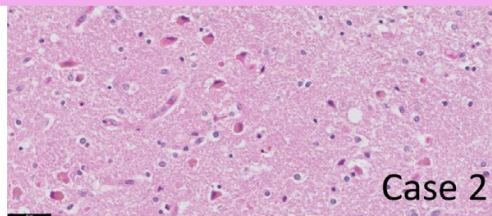


Control

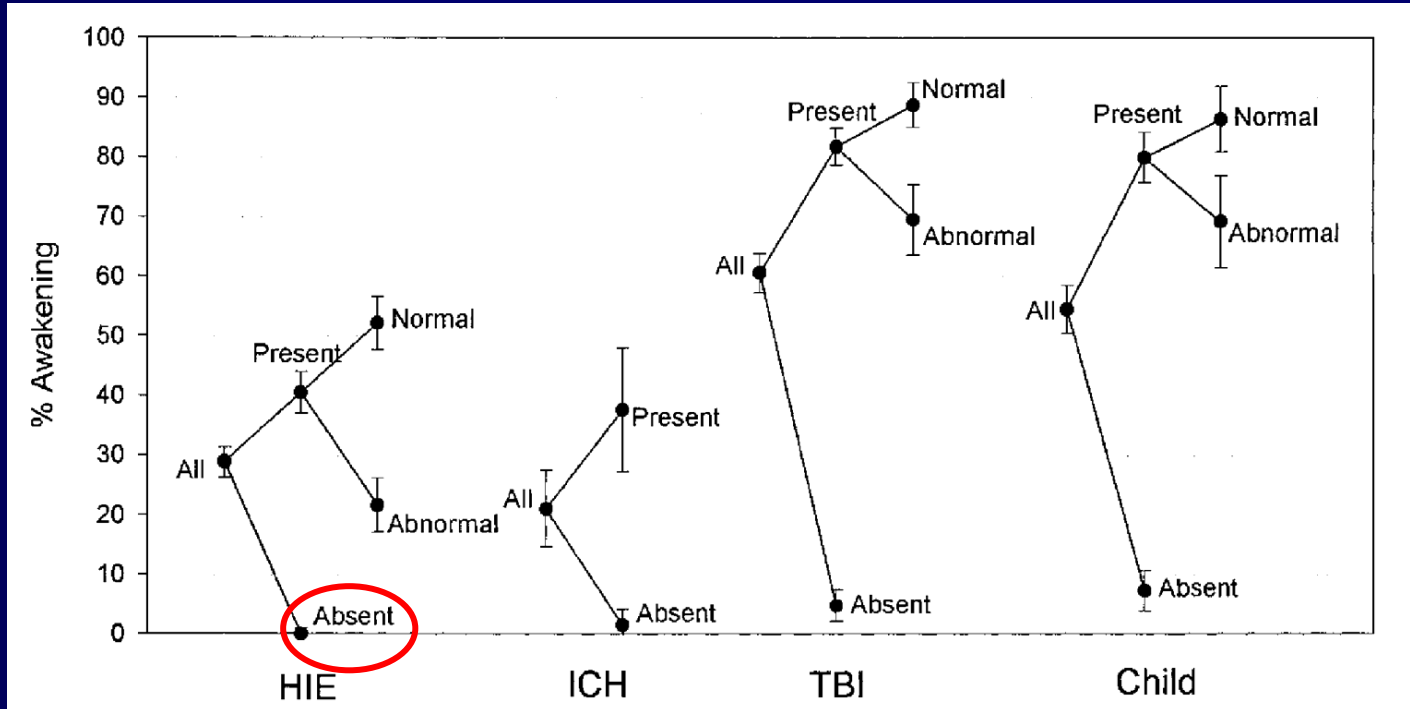
*Electroencephalogr Clin Neurophysiol.* **1987** Jan;66(1):15-24.

**Prognostic value of early cortical somatosensory evoked potentials after resuscitation from cardiac arrest.**

Brunko E, Zegers de Beyl D.



## Valore prognostico PES: coma ipossi-ischemico



*(Robinson et al. 2003)*

## Potenziali Evocati Somatosensoriali

Recommendations (Taccone et al.2017)

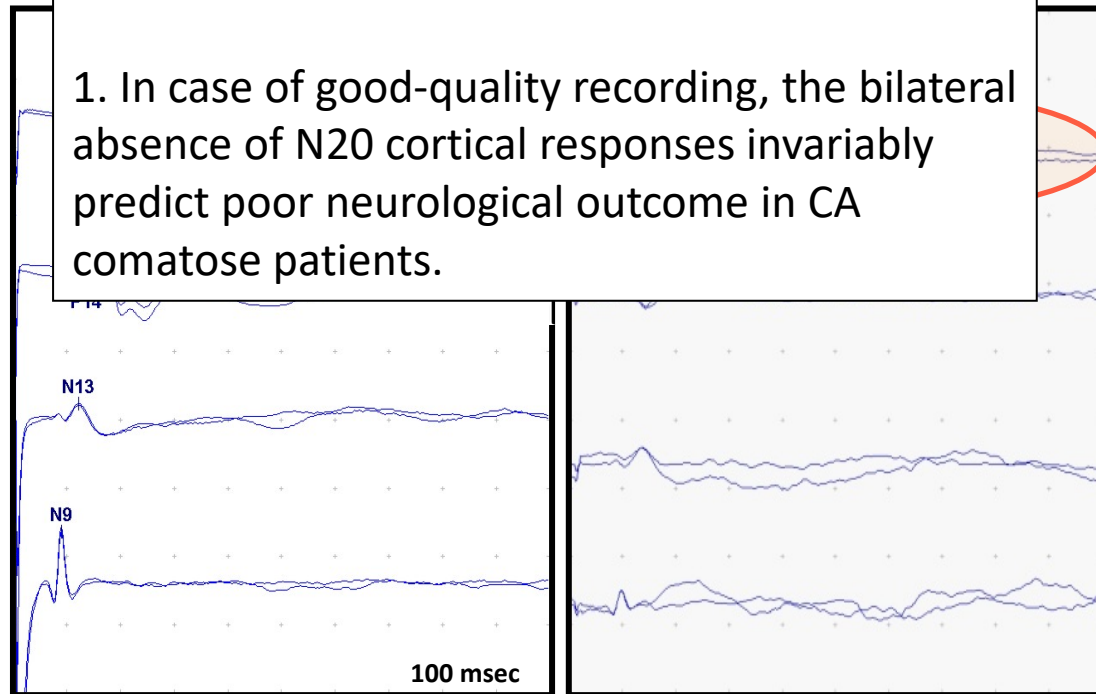
1. In case of good-quality recording, the bilateral absence of N20 cortical responses invariably predict poor neurological outcome in CA comatose patients.

C3'-Fz

C3'-M2

Cv7-AC

Erb-Fz



# valore prognostico assenza PES tempo indipendente

72 ore

24 ore

6-12 ore

< 6 ore?

Neurophysiologie Clinique/Clinical Neurophysiology xxx (xxxx) xxx–xxx



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[www.em-consulte.com/en](http://www.em-consulte.com/en)



ORIGINAL ARTICLE 2021

## Are neurophysiologic tests reliable, ultra-early prognostic indices after cardiac arrest?

Riccardo Carrai<sup>a,b,\*</sup>, Maddalena Spalletti<sup>a,b</sup>,  
Maenia Scarpino<sup>a,b</sup>, Francesco Lolli<sup>c</sup>, Giovanni Lanzo<sup>a</sup>,  
Cesarina Cossu<sup>a</sup>, Manuela Bonizzoli<sup>d</sup>, Filippo Socci<sup>d</sup>,  
Chiara Lazzeri<sup>d</sup>, Aldo Amantini<sup>b</sup>, Antonello Grippo<sup>a,b</sup>

**Practice Parameter: Prediction of  
outcome in comatose survivors after  
cardiopulmonary resuscitation  
(an evidence-based review)**

**Report of the Quality Standards Subcommittee of the  
American Academy of Neurology**

E.F.M. Wijdicks, MD; A. Hijdra, MD; G.B. Young, MD; C.L. Bassetti, MD; and S. Wiebe, MD

# Rivalutazione ruolo EEG nel coma post-anossico

2012

1 - adozione di una terminologia EEG  
standardizzata

2- comprensione della tempo dipendenza del  
significato prognostico dei pattern EEG

# TERMINOLOGIA EEG STANDARDIZZATA

American Clinical Neurophysiology Society's Standardized Critical Care EEG Terminology:  
2012 version

**Hirsch LJ, LaRoche SM, Gaspard N, Gerard E, Svoronos A, Herman ST, Mani R, Arif H, Jette N, Minazad Y, Kerrigan JF, Vespa P, Hantus S, Claassen J, Young GB, So E, Kaplan PW, Nuwer MR, Fountain NB and Drislane FW.**

**Objective:** To standardize terminology of periodic and rhythmic EEG patterns in the critically ill in order to aid future research involving such patterns. Our goal is to avoid terms with clinical connotations and to define terms thoroughly enough to ensure adequate inter-rater reliability.



# American Clinical Neurophysiology Society's Standardized Critical Care EEG Terminology: 2012 Version

*Hirsch, L. J.; LaRoche, S. M.; Gaspard, N.; Gerard, E.; Svoronos, A.; Herman, S. T.; Mani, R.; Arif, H.; Jette, N.; Minazad, Y.; Kerrigan, J. F.; Vespa, P.; Hantus, S.; Claassen, J.; Young, G. B.; So, E.; Kaplan, P. W.; Nuwer, M. R.; Fountain, N. B.; Drislane, F. W.*

*J. Clin. Neurophysiol:* [2013](#)

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# American Clinical Neurophysiology Society's Standardized Critical Care EEG Terminology: 2021 Version

*Hirsch, Lawrence J.\*; Fong, Michael W.K.†; Leitinger, Markus‡; LaRoche, Suzette M.§; Beniczky, Sandor||; Abend, Nicholas S.¶; Lee, Jong Woo#; Wusthoff, Courtney J.\*\*; Hahn, Cecil D.††; Westover, M. Brandon‡‡; Gerard, Elizabeth E.§§; Herman, Susan T.||||; Haider, Hiba Arif§; Osman, Gamaleldin¶¶; Rodriguez-Ruiz, Andres§; Maciel, Carolina B.##; Gilmore, Emily J.\*; Fernandez, Andres\*\*\*; Rosenthal, Eric S.†††; Claassen, Jan‡‡‡; Husain, Aatif M.§§§; Yoo, Ji Yeoun|||||; So, Elson L.¶¶¶; Kaplan, Peter W.###; Nuwer, Marc R.\*\*\*\*; van Putten, Michel††††; Sutter, Raoul††††; Drislane, Frank W.§§§§; Trinkka, Eugen‡; Gaspard, Nicolas*

*J.Clin. Neurophysiol:* [2021](#)



# Concetto di tempo-dipendenza EEG nella encefalopatia ipossi-ischemica

*tempo-dipendenza per:*

*comparsa/scomparsa di patterns*

*significato prognostico dei patterns*

Continuous electroencephalography monitoring for early prediction of neurological outcome in postanoxic patients after cardiac arrest:  
A prospective cohort study

Marleen C. Cloostermans, MSc; Fokke B. van Meulen, MSc; Carin J. Eertman, RNT; Harold W. Hom, MD;  
Michel J. A. M. van Putten, MD, PhD

(Crit Care Med 2012; 40:0-0)

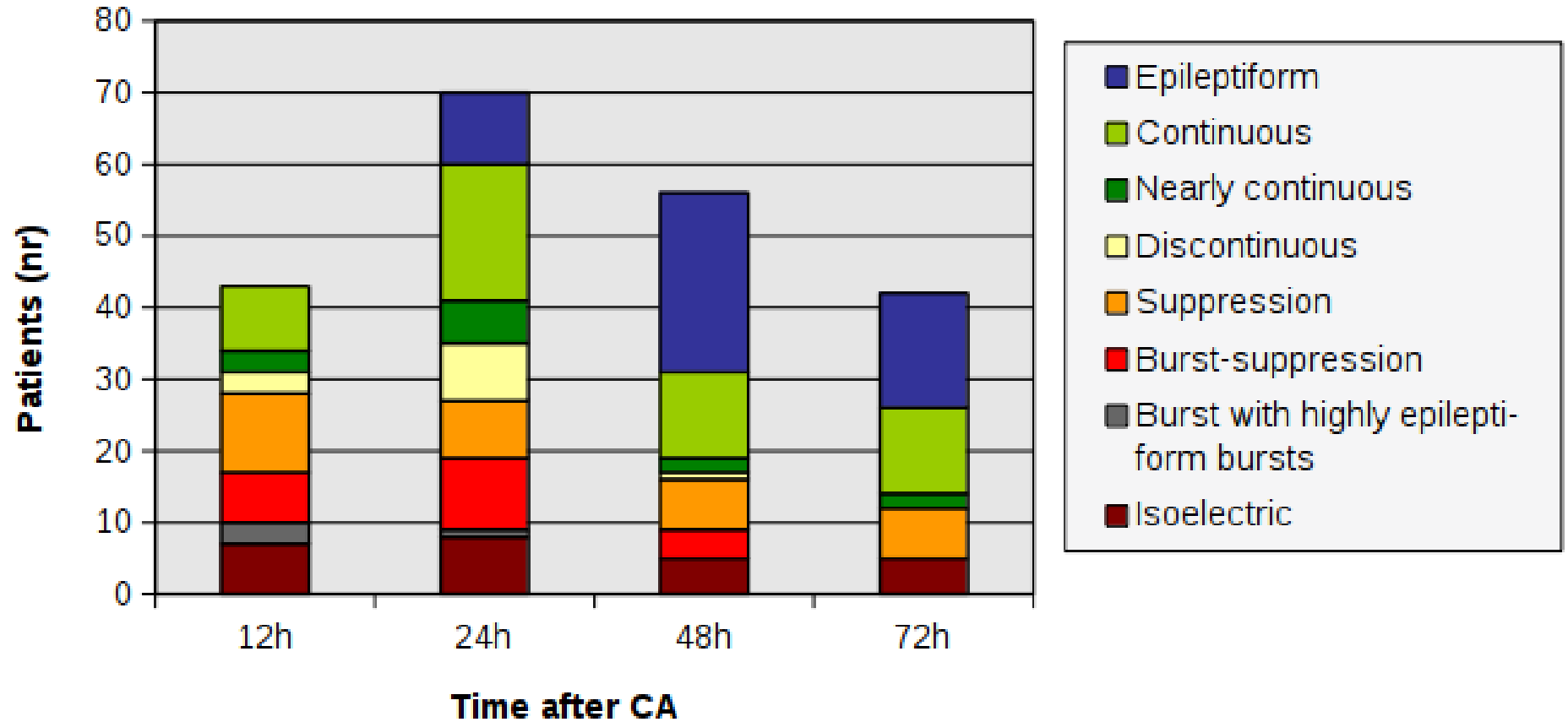
Table 2. Somatosensory evoked potential results and electroencephalogram patterns for patients 12 and 24 hrs after resuscitation

	Time After Resuscitation (hrs)	Poor Neurological Outcome (Cerebral Performance Category Score 3–5)	Good Neurological Outcome (Cerebral Performance Category Score 1–2)
A: SSEP: bilateral absent N20 vs. present N20			
SSEP N20 absent	<24	7	0
SSEP N20 present	<24	22	27
B: EEG after 12 hrs: isoelectric, low-voltage, or burst-suppression EEG vs. continuous EEG patterns <sup>a</sup>			
EEG isoelectric or low voltage or burst suppression	12	26	13
EEG continuous	12	0	10
C: EEG after 24 hrs: isoelectric or low-voltage EEG vs. burst-suppression or continuous EEG <sup>b</sup>			
EEG isoelectric or low voltage	24	8	0
EEG burst suppression or continuous	24	12	26
D: EEG after 24 hrs: isoelectric, low-voltage, or burst-suppression EEG vs. continuous EEG pattern <sup>b</sup>			
EEG isoelectric or low voltage or burst suppression	24	19	1
EEG continuous	24	1	25

EEG, electroencephalogram; SSEP, somatosensory evoked potential.



## EEG patterns along time

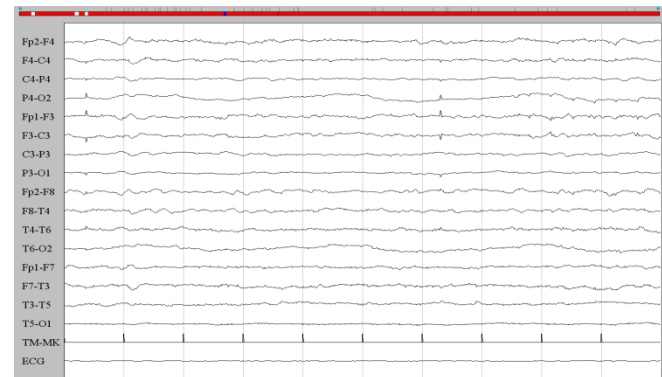
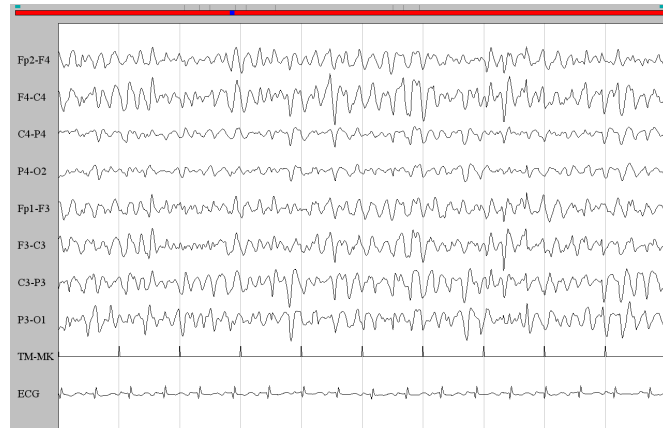
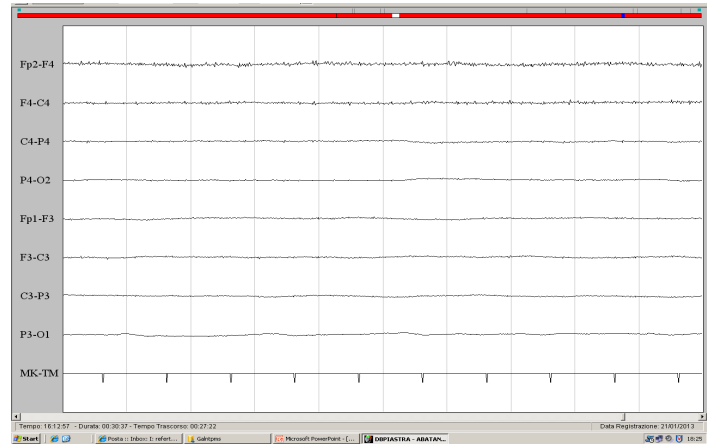
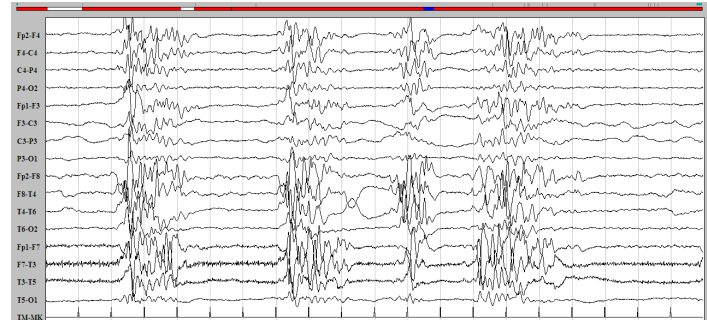
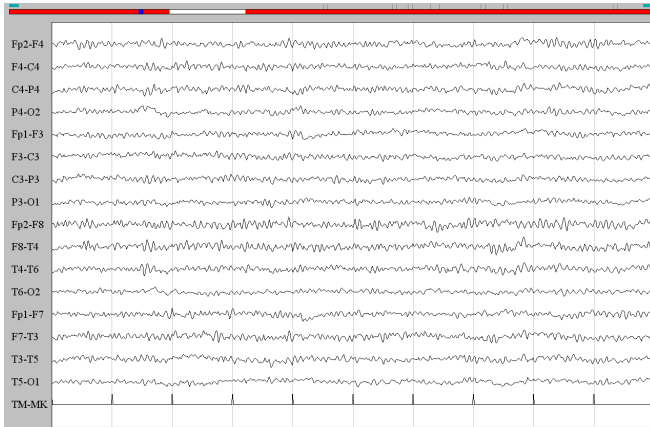


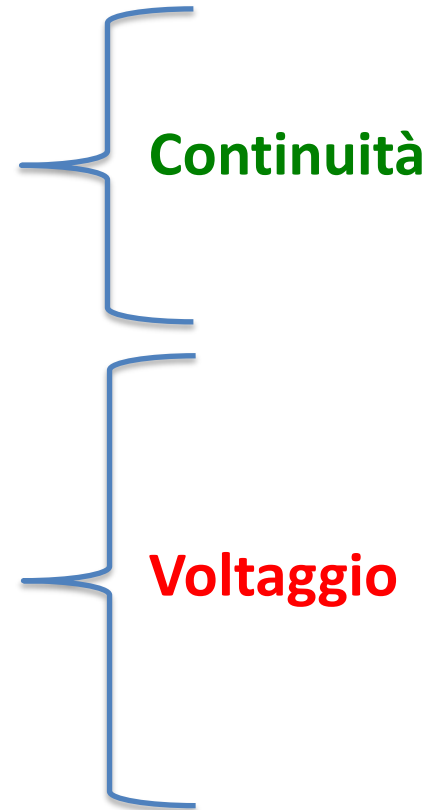
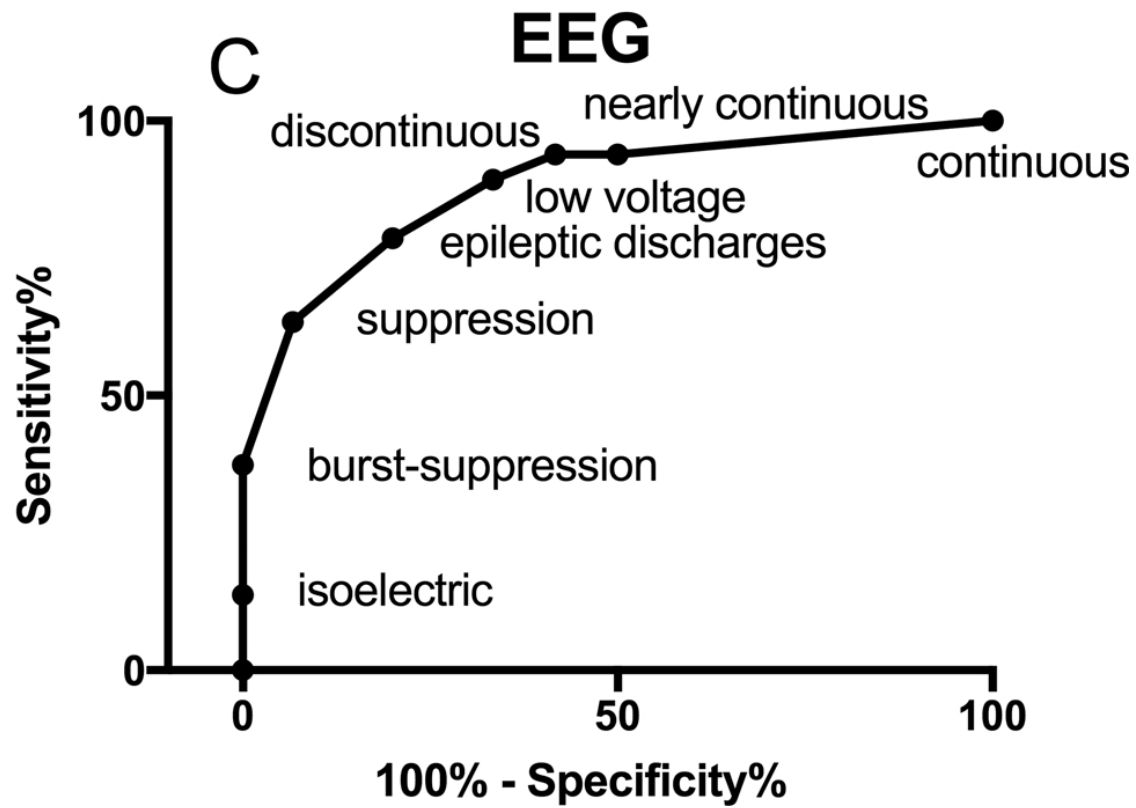
*(Spalletti et al., 2016)*

# continuous

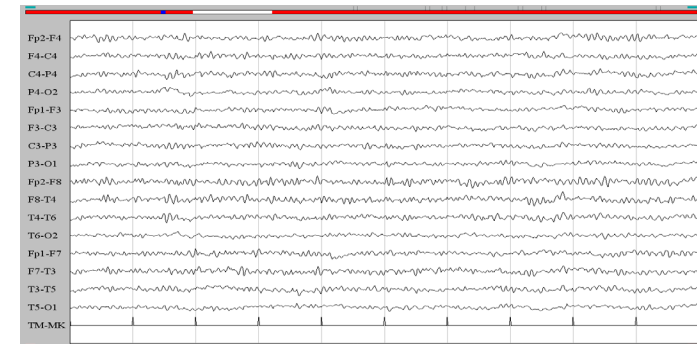
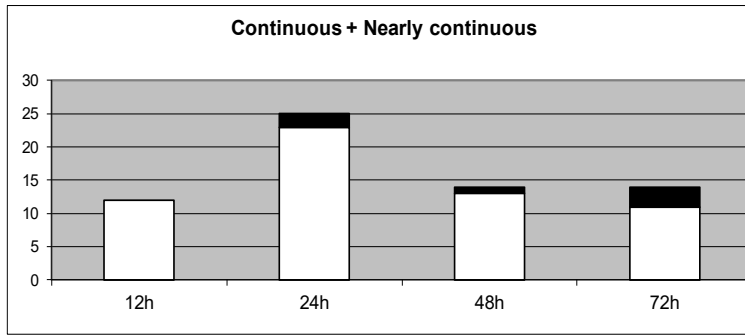
# (EEG)

# non continuous



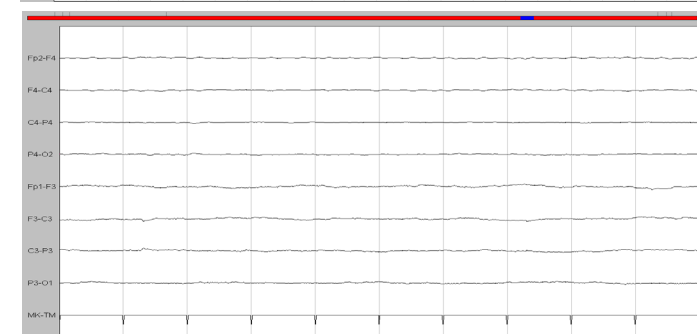
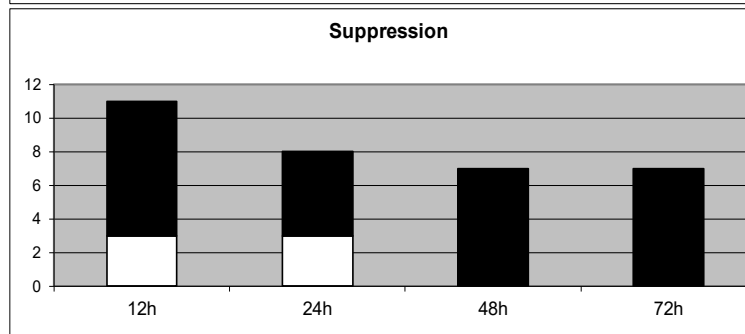
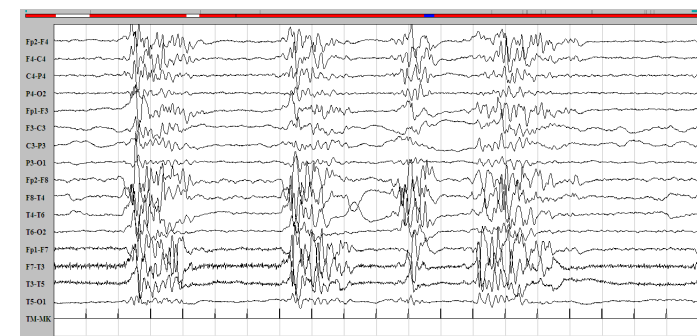
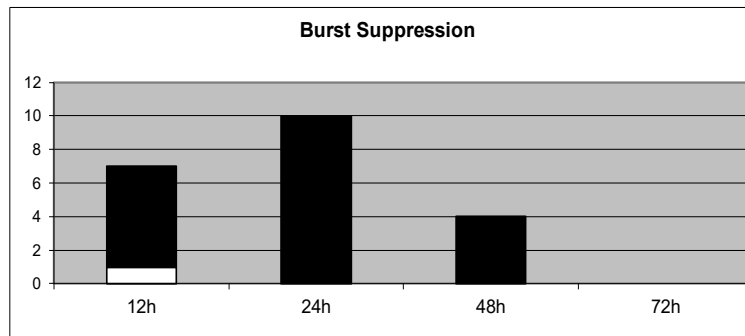
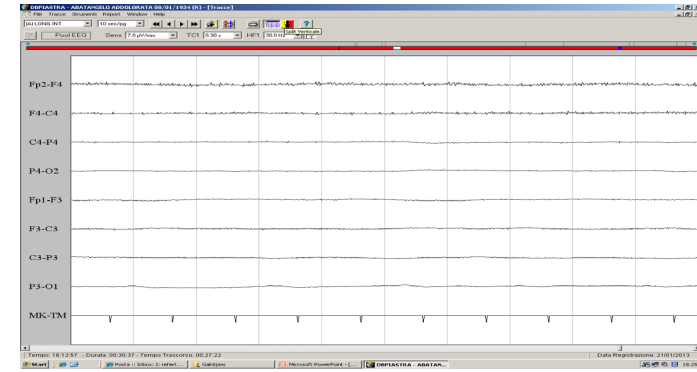
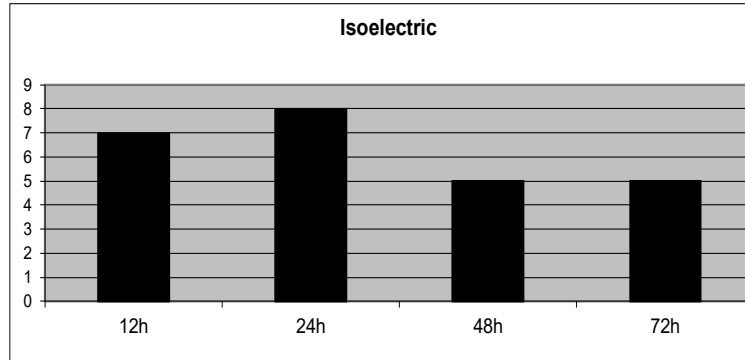


□ Good Outcome



# Tempo dipendenza pattern EEG (specificità 100%)

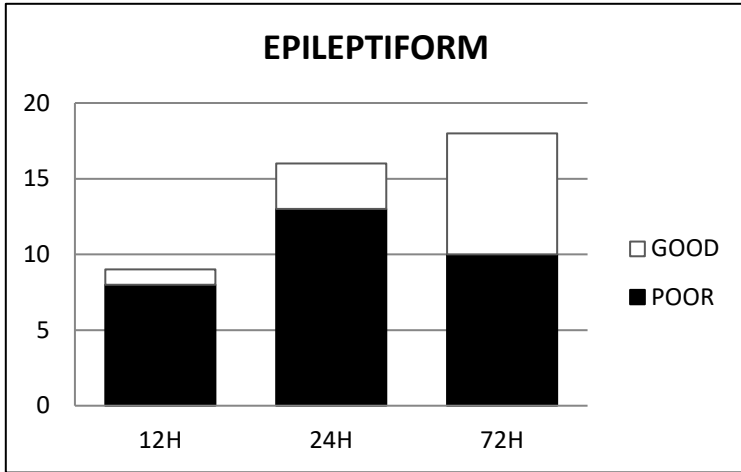
■ Poor Outcome



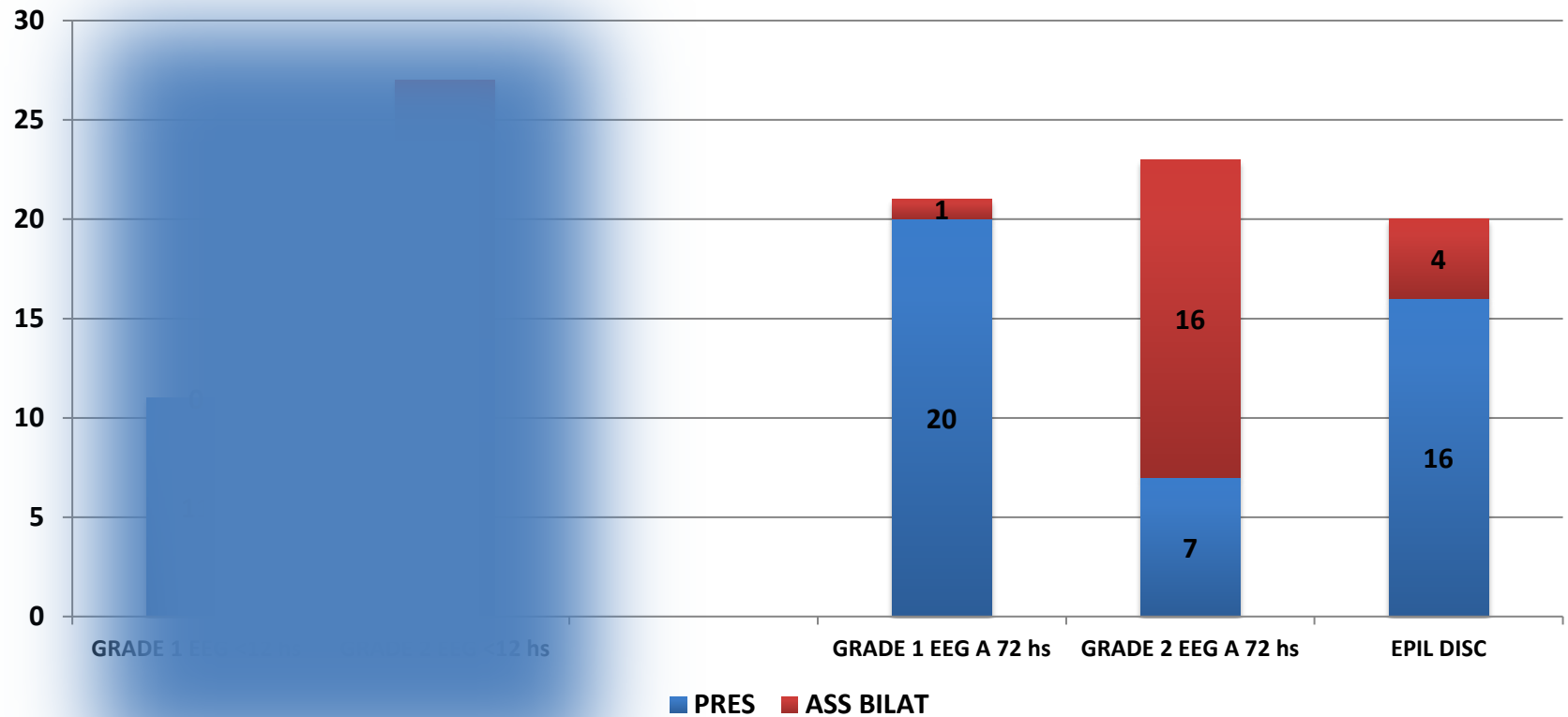


# EPILETTIFORMI

CPC: 1-3 VS 4-5



# EEG/SEP pattern association

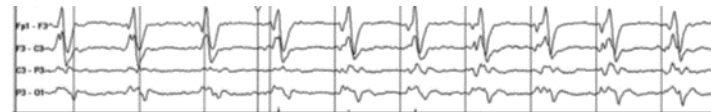
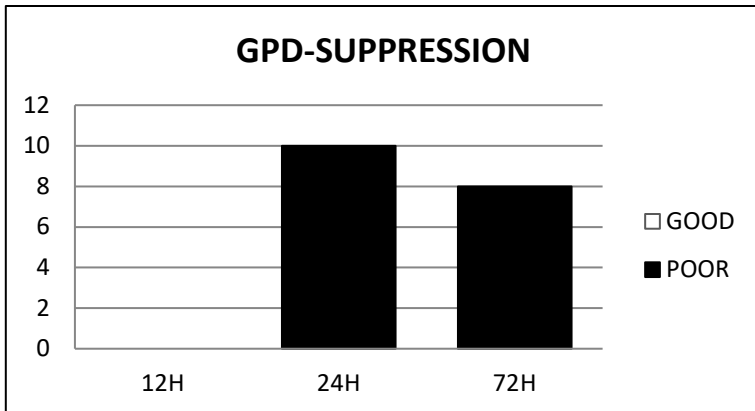
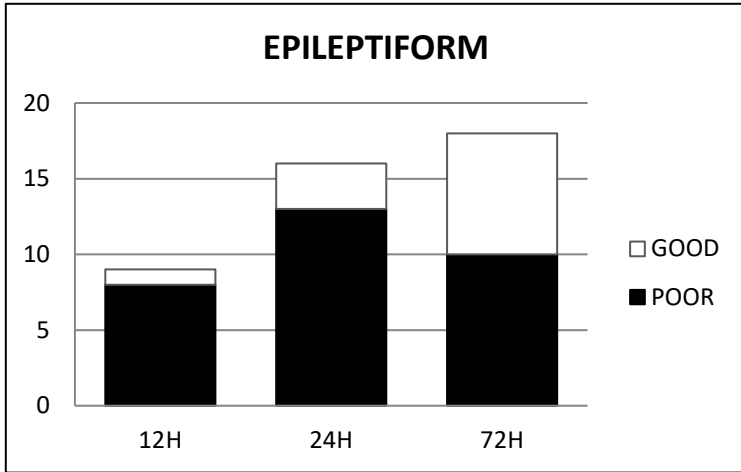


**12h**

**72h**

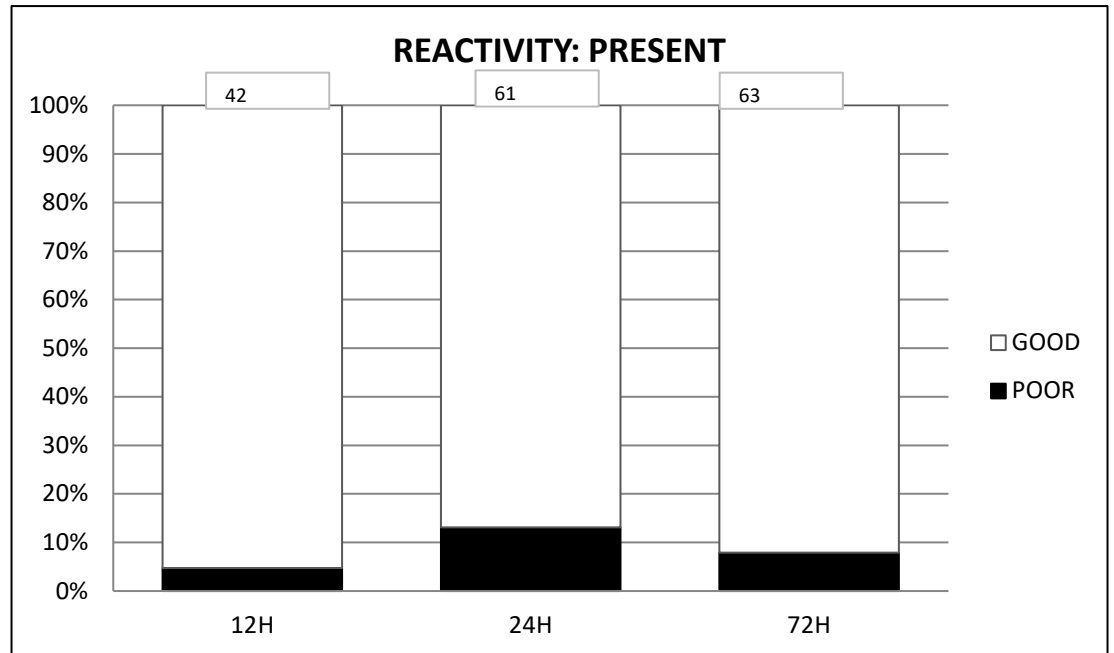
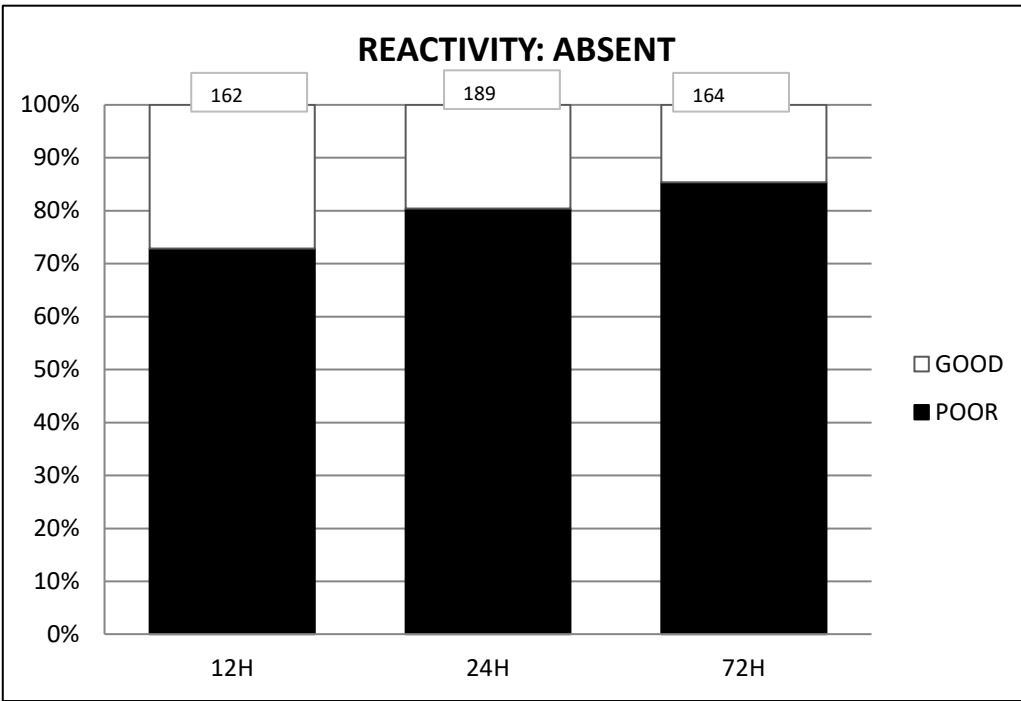
# EPILETTIFORMI

CPC: 1-3 VS 4-5

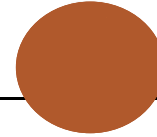


# REATTIVITA'

CPC: 1-3 VS 4-5




# Recommendations



CONSENSUS PAPER AND GUIDELINE

## **Neuroprognostication after adult cardiac arrest treated with targeted temperature management: task force for Belgian recommendations**

Fabio Silvio Taccone<sup>1</sup> · Ingrid Baar<sup>2</sup> · Cathy De Deyne<sup>3</sup> · Patrick Druwe<sup>4</sup> · Benjamin Legros<sup>5</sup>  · Geert Meyfroidt<sup>6</sup> · Michel Osseman<sup>7</sup> · Nicolas Gaspard<sup>5</sup>

1. A multimodal approach incorporating at least 2 or 3 additional tools, including at least EEG in all patients, in addition to clinical examination should be used in comatose CA survivors to predict outcome.

## Neurophysiological prediction of neurological good and poor outcome in post-anoxic coma

A. Grippo<sup>1,2</sup> | R. Carrai<sup>1,2</sup> | M. Scarpino<sup>1,2</sup> | M. Spalletti<sup>1</sup> | G. Lanzo<sup>1</sup> |  
C. Cossu<sup>1</sup> | A. Peris<sup>3</sup> | S. Valente<sup>4</sup> | A. Amantini<sup>1,2</sup>

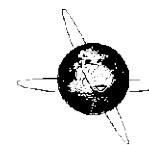
**Significance:** The combination of EEG/SEP findings allows prediction of good and poor outcome (within 12 h after CA) and of poor outcome (after 48–72 h). Recording of EEG and SEPs in the same patients allows always an increase in the number of cases correctly classified, and an increase of the reliability of prognostication in a single patient due to concordance of patterns.



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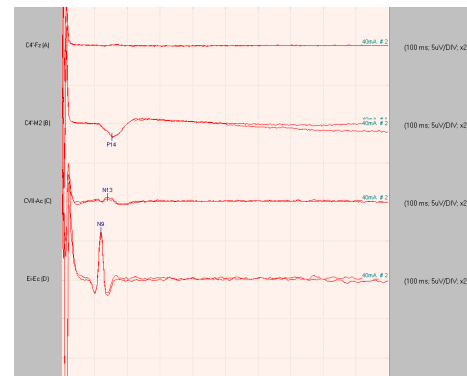
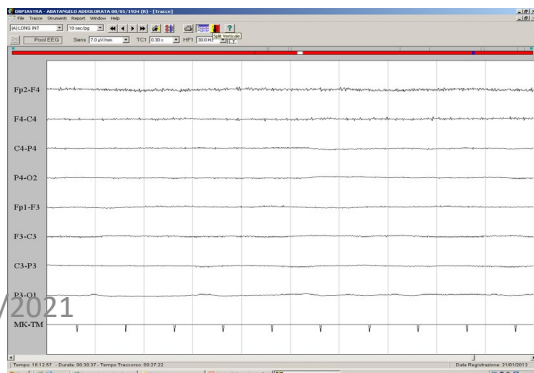
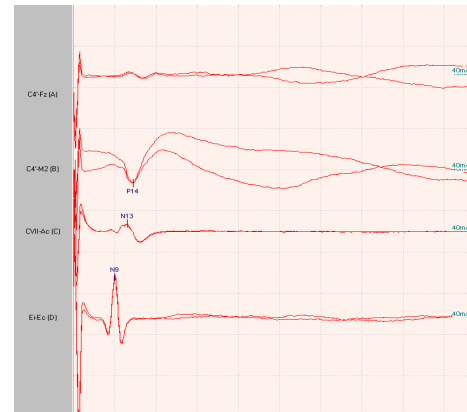
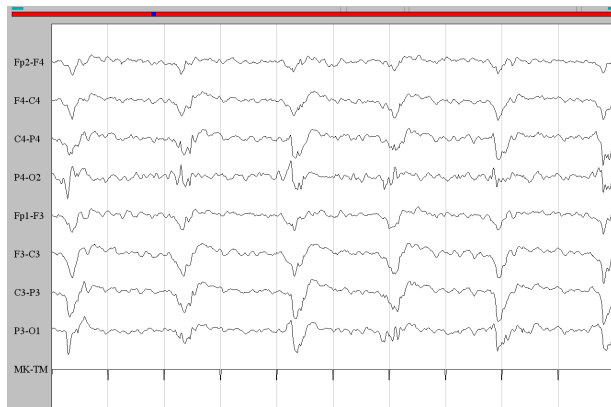
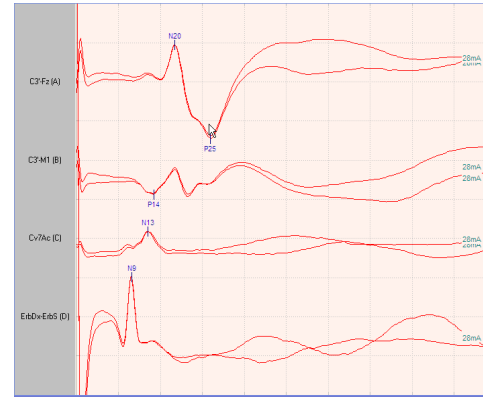
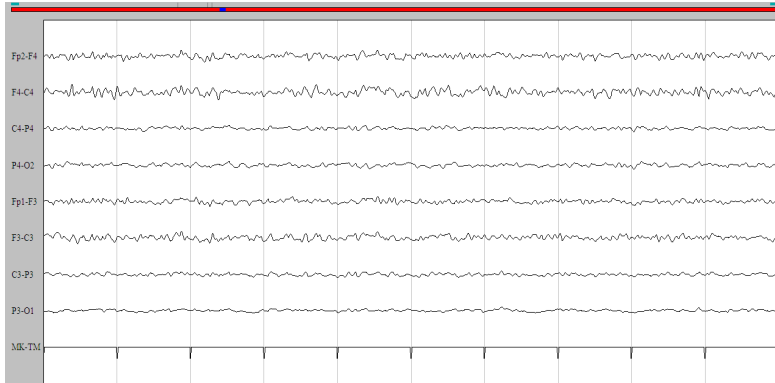
### Association between somatosensory evoked potentials and EEG in comatose patients after cardiac arrest



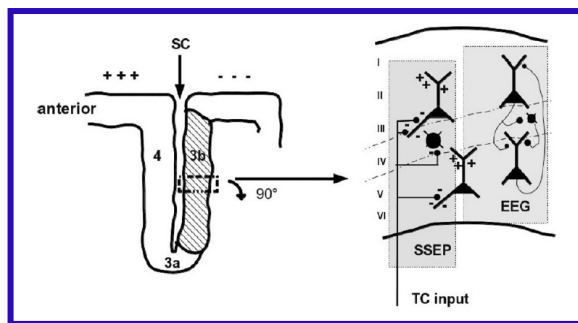
Astrid B. Glimmerveen<sup>a,□</sup>, Barry J. Ruijter<sup>b</sup>, Hanneke M. Keijzer<sup>a,c</sup>, Marleen C. Tjepkema-Cloostermans<sup>b,d</sup>,  
Michel J.A.M. van Putten<sup>b,d</sup>, Jannette Hofmeijer<sup>a,b</sup>

**Significance:** SSEP and EEG together identify more patients with no chance of recovery than one of this alone

# Associazione pattern EEG/PES



# 3 gradi di encefalopatia ipossi-ischemica secondo EEG/PES valutabili in fase precoce <12h



1 **Grado minore:** EEG cont PES presente

2 **Grado intermedio:** EEG non cont PES presente

3 **Grado severo:** EEG non cont PES assente



# ProNeCA

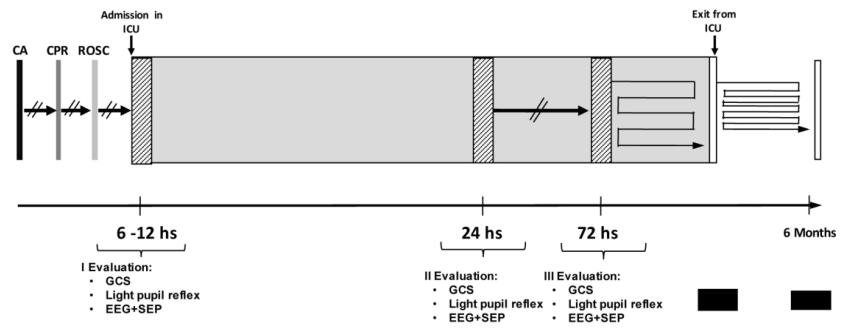


Fig. 1: Course line of ProNeCA study. CA: cardiac arrest; CPR: cardio-respiratory resuscitation; ICU:

**24 CENTRI HANNO DATO ADESIONE**

**12 CENTRI HANNO RECLUTANO PAZIENTI**



**Gruppo di Studio SINC**  
**“Neurofisiologia Clinica Intraoperatoria e dell’Area Critica”**



Available online at [www.sciencedirect.com](http://www.sciencedirect.com) 2020

# Resuscitation

journal homepage: [www.elsevier.com/locate/resuscitation](http://www.elsevier.com/locate/resuscitation)



Clinical paper

## Neurophysiology for predicting good and poor neurological outcome at 12 and 72 h after cardiac arrest: The ProNeCA multicentre prospective study



*Maenia Scarpino<sup>a,b,1</sup>, Riccardo Carrai<sup>a,b,1</sup>, Francesco Lolli<sup>c</sup>, Giovanni Lanzo<sup>b</sup>, Maddalena Spalletti<sup>b</sup>, Franco Valzania<sup>d</sup>, Maria Lombardi<sup>e</sup>, Daniela Audenino<sup>f</sup>, Sara Contardi<sup>g</sup>, Maria Grazia Celani<sup>h</sup>, Alfonso Marrelli<sup>i</sup>, Oriano Mecarelli<sup>j</sup>, Chiara Minardi<sup>k</sup>, Fabio Minicucci<sup>l</sup>, Lucia Politini<sup>m</sup>, Eugenio Vitelli<sup>n</sup>, Adriano Peris<sup>o</sup>, Aldo Amantini<sup>a,b</sup>, Claudio Sandroni<sup>p,\*</sup>, Antonello Grippo<sup>a,b</sup>, for the ProNeCA study group<sup>2</sup>*

# Gray Matter–White Matter De-Differentiation on Brain Computed Tomography Predicts Brain Death Occurrence

C. Vigneron<sup>a</sup>, V. Labeye<sup>b</sup>, M. Cour<sup>a,c</sup>, S. Hannoun<sup>d</sup>, A. Grember<sup>a</sup>, F. Rampon<sup>a</sup>, and F. Cotton<sup>a,d,e,\*</sup>

*Transplantation Proceedings*, 48, 1893–1897 (2016)

Neurophysiologie Clinique/Clinical Neurophysiology (2017) 47, 327–335



Disponible en ligne sur

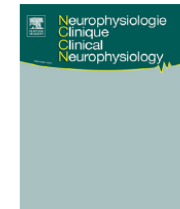
**ScienceDirect**

[www.sciencedirect.com](http://www.sciencedirect.com)

Elsevier Masson France

**EM|consulte**

[www.em-consulte.com/en](http://www.em-consulte.com/en)



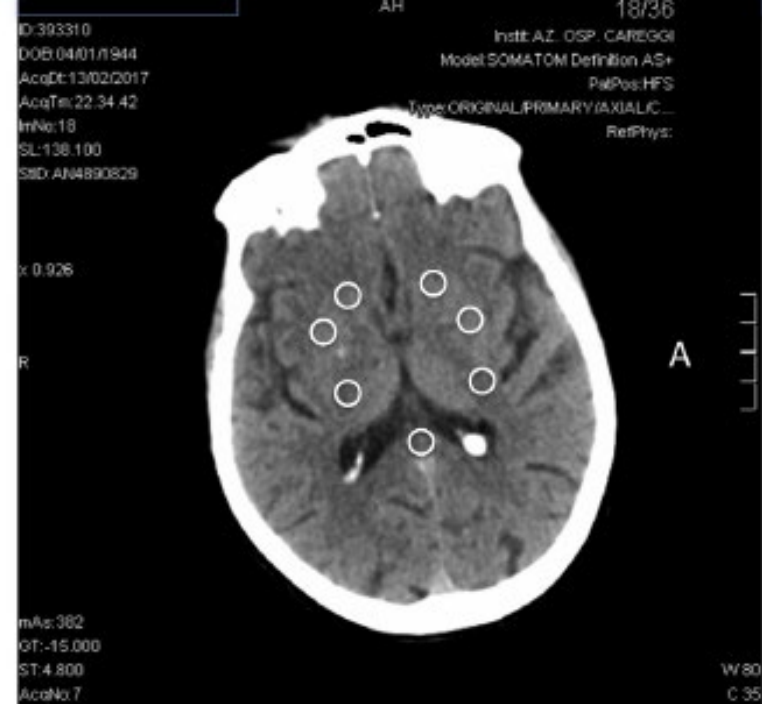
ORIGINAL ARTICLE/ARTICLE ORIGINAL

## Is brain computed tomography combined with somatosensory evoked potentials useful in the prediction of brain death after cardiac arrest?

Maenia Scarpino<sup>a,b</sup>, Giovanni Lanzo<sup>a</sup>, Francesco Lolli<sup>a,c</sup>, Marco Moretti<sup>d</sup>, Riccardo Carrai<sup>a,b</sup>, Maria Luisa Migliaccio<sup>e</sup>, Maddalena Spalletti<sup>a</sup>, Manuela Bonizzoli<sup>e</sup>, Adriano Peris<sup>e</sup>, Aldo Amantini<sup>a,b</sup>, Antonello Grippo<sup>a,b,\*</sup>



# Brain CT



*Slices at the orbito-meatal plan  
circular regions of measurement (0.6 cm<sup>2</sup>)  
were placed over:*

*the caudate nucleus (**CN**), putamen (**PU**)  
posterior limb of the internal capsule (**PIC**), the corpus callosum (**CC**)*

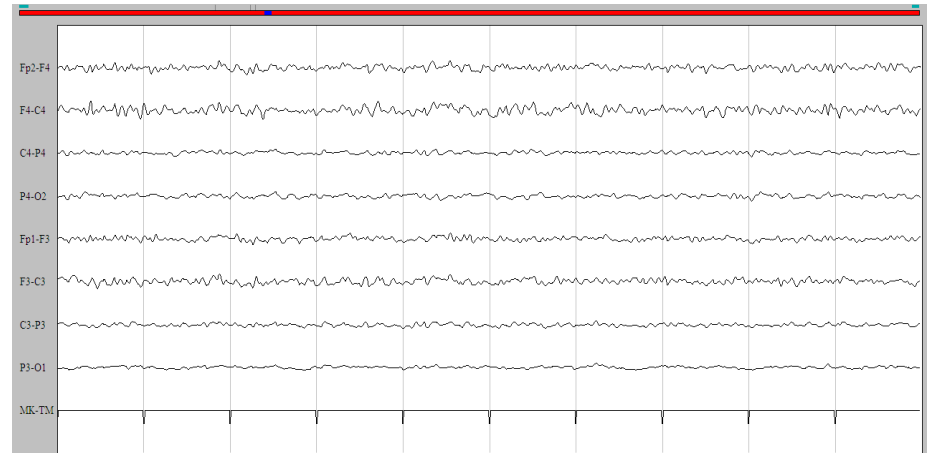
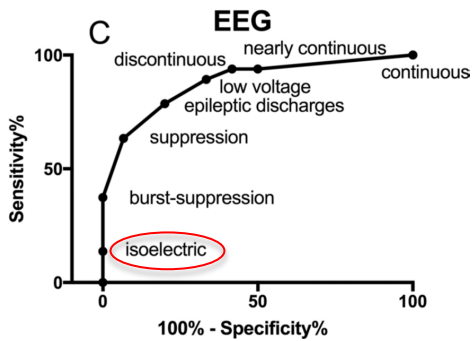
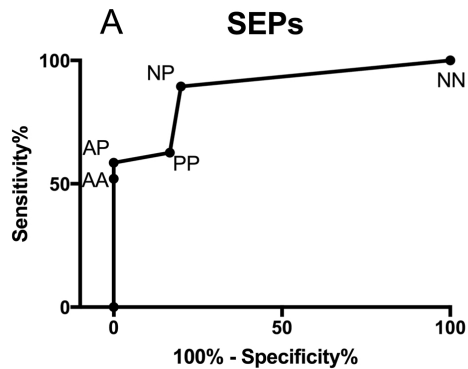
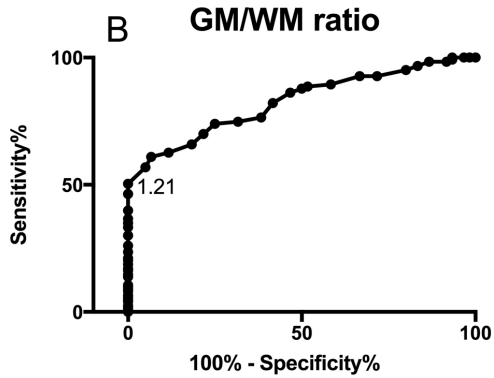
The GM/WM ratio density at the basal ganglia level was calculated as

$$\mathbf{GM/WM\ ratio = (CN + PU) / (CC + PIC).}$$

< 24hs

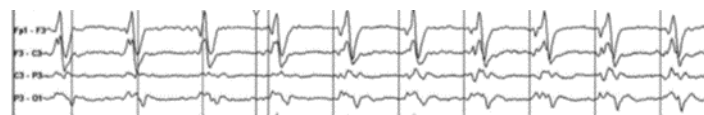
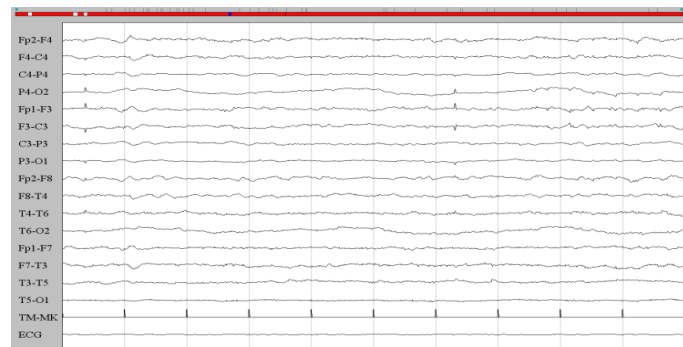
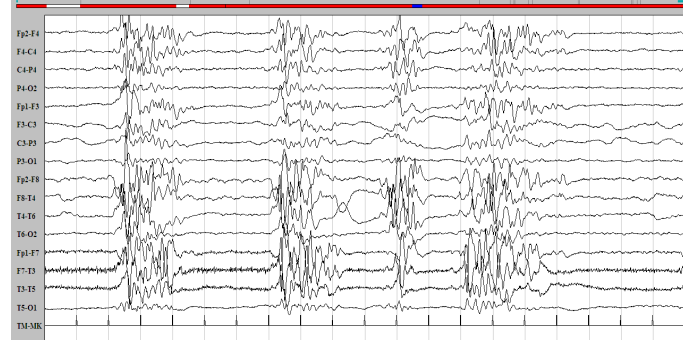
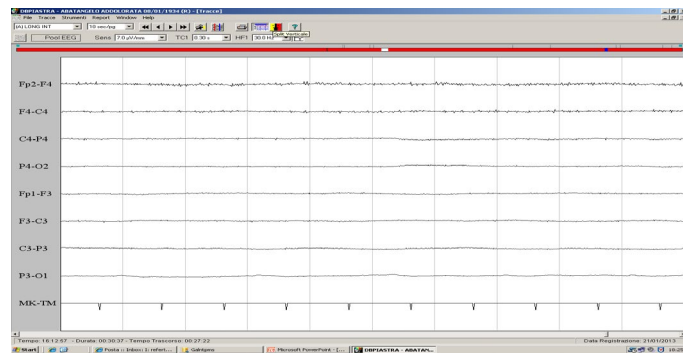
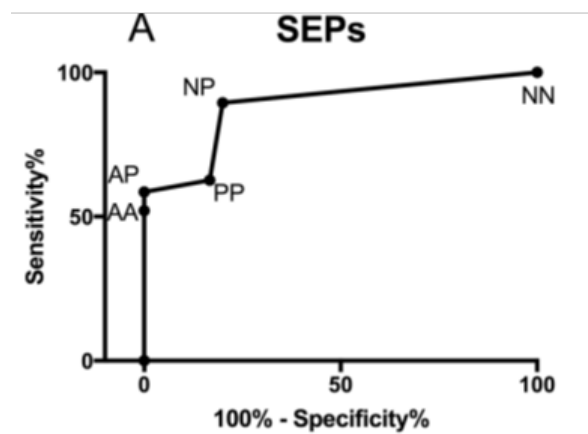
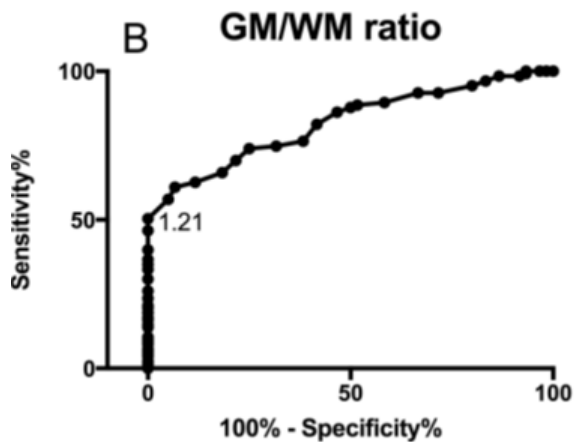
# Poor Prognosis

# Good Prognosis



# > 48-72hs

## Poor Prognosis



CONFERENCE REPORTS AND EXPERT PANEL



# European Resuscitation Council and European Society of Intensive Care Medicine guidelines 2021: post-resuscitation care

Jerry P. Nolan<sup>1,2\*</sup>, Claudio Sandroni<sup>3,4</sup>, Bernd W. Böttiger<sup>5</sup>, Alain Cariou<sup>6</sup>, Tobias Cronberg<sup>7</sup>, Hans Friberg<sup>8</sup>, Cornelia Genbrugge<sup>9,10</sup>, Kirstie Haywood<sup>11</sup>, Gisela Lilja<sup>12</sup>, Véronique R. M. Moolaert<sup>13</sup>, Nikolaos Nikolaou<sup>14</sup>, Theresa Mariero Olasveengen<sup>15</sup>, Markus B. Skrifvars<sup>16</sup>, Fabio Taccone<sup>17</sup> and Jasmeet Soar<sup>18</sup>

© 2021 European Resuscitation Council

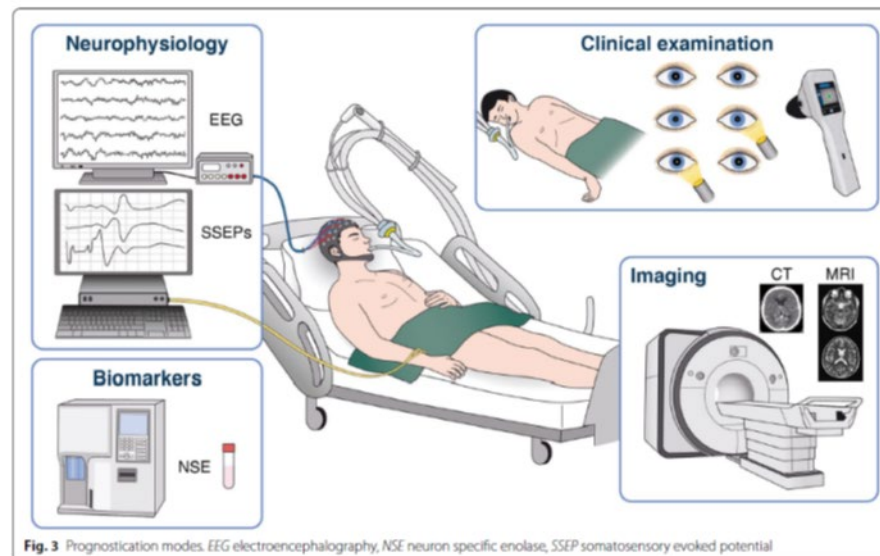


Fig. 3 Prognostication modes. EEG electroencephalography, NSE neuron specific enolase, SSEP somatosensory evoked potential

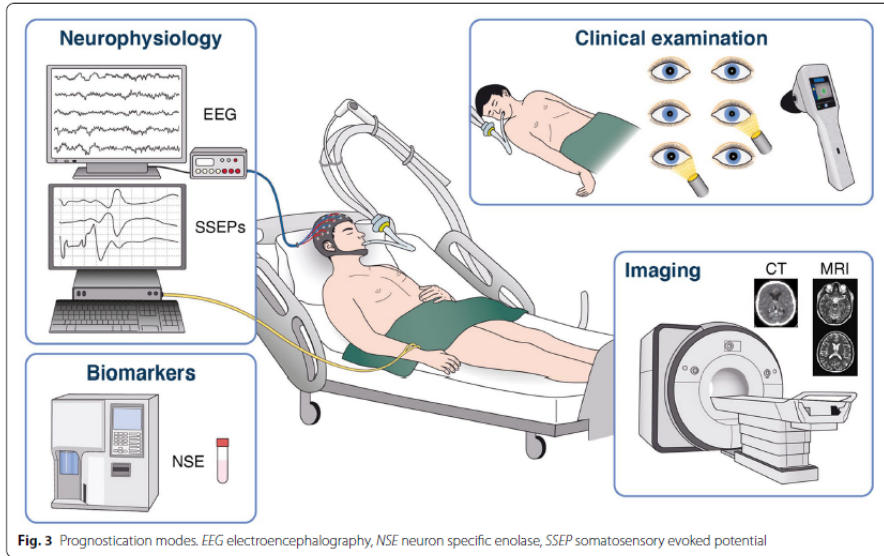


Fig. 3 Prognostication modes. EEG electroencephalography, NSE neuron specific enolase, SSEP somatosensory evoked potential

## PROGNOSTICATION

### 2015 GUIDELINES

The prognostication strategy algorithm is applicable to all patients who remain comatose with an absent or extensor motor response to pain at  $\geq 72$  h from ROSC. Results of earlier prognostic tests are also considered at this time point.

One or both of the following indicate that a poor outcome is very likely (FPR  $< 5\%$ , narrow 95% CIs):

- No pupillary and corneal reflexes
- Bilaterally absent N20 SSEP wave

Two or more of the following indicate that a poor outcome is likely:

- Status myoclonus  $\leq 48$ h after ROSC
- High NSE levels
- Unreactive burst-suppression or status epilepticus on EEG
- Diffuse anoxic injury on brain CT/MRI

### 2021 GUIDELINES

In a comatose patient with  $M \leq 3$  at  $\geq 72$  h from ROSC, in the absence of confounders, poor outcome is likely when two or more of the following predictors are present:

- no pupillary and corneal reflexes at  $\geq 72$  h,
- bilaterally absent N20 SSEP wave at  $\geq 24$  h,
- highly malignant EEG (suppressed background or burst-suppression) at  $> 24$ h,
- NSE  $> 60 \mu\text{g L}^{-1}$  at 48 h and/or 72 h,
- status myoclonus  $\leq 72$  h,
- or a diffuse and extensive anoxic injury on brain CT/MRI.



*There has been a very large amount of data published on prognostication since the 2015 guidelines. A recent systematic review identified 94 studies that included over 30,000 patients, all published since January 2013 [6].*

*The two-stage prognostication algorithm in the 2015 guidelines has been simplified so that a poor outcome is considered likely when two or more of the listed predictors are present. The algorithm is valid for comatose patients with a Glasgow Motor Score  $\leq 3$  (compared with  $\leq 2$  in the 2015 version). A threshold value for NSE is now stated. The EEG patterns suppression and burst-suppression are the most consistent predictors of poor neurological outcome. Conversely, absence of EEG reactivity has been only inconsistently associated with poor neurological outcome in recent studies.*

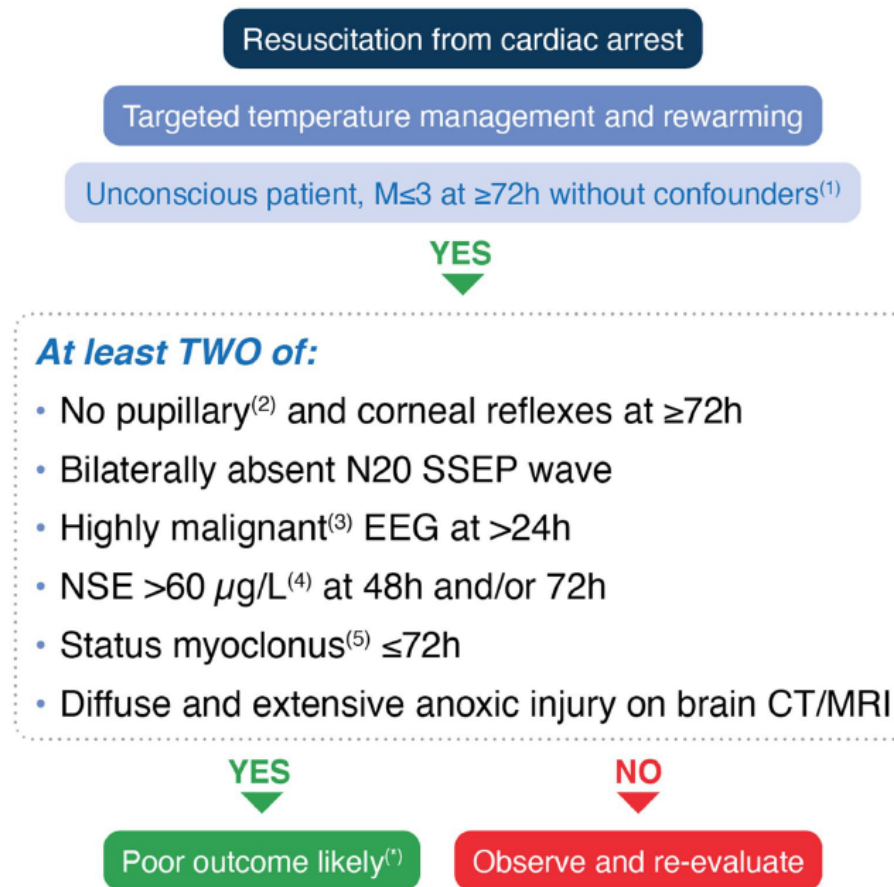
*We suggest using the 2021 ACNS terminology when assessing these patterns for prognostication, to ensure an unequivocal identification.*

2015  
GCS-M $\leq 2$

2021  
GCS-M $\leq 3$

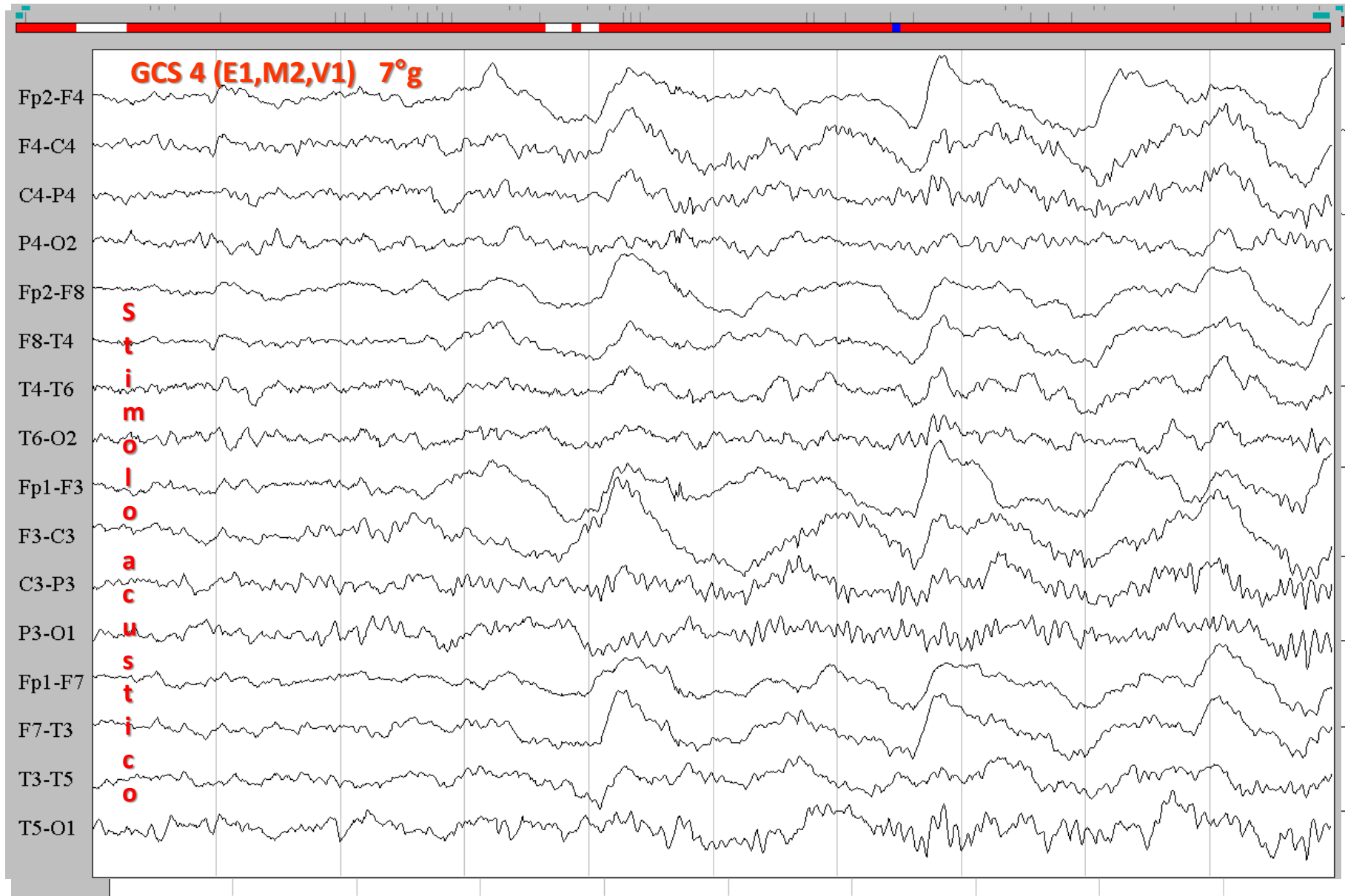


# Multimodal Prognostication



*Most of these signs can be recorded before 72 h from ROSC; however, their results will be evaluated only at the time of clinical prognostic assessment*

# EEG



# Prognostic significance of EEG coma patterns (post-traumatic, post-anoxic coma)

Synek, 1990

*Benign*

*Uncertain*

*Malignant*

<b>Grade 1</b>	<b>Grade 2, non-reactive</b>	<b>Low amplitude, grade 3</b>
<b>Grade 2, reactive</b>	<b>Grade 3, diffuse delta non-reactive</b>	<b>Burst-suppression, grade 4</b>
		<b>Epileptiform discharges grade 4</b>
		<b>Low output, grade 4</b>
		<b>Isoelectric, grade 5</b>
<b>“spindle pattern coma” grade 3</b>	<b>Epileptiform discharges grade 3</b>	<b>“Alpha pattern coma” non-reactive</b>
<b>Frontal rhythmic delta Reactive/non-reactive</b>	<b>“alpha coma”, reactive</b>	<b>“Theta pattern coma”</b>
		<b>BIPLDs, PEDs</b>

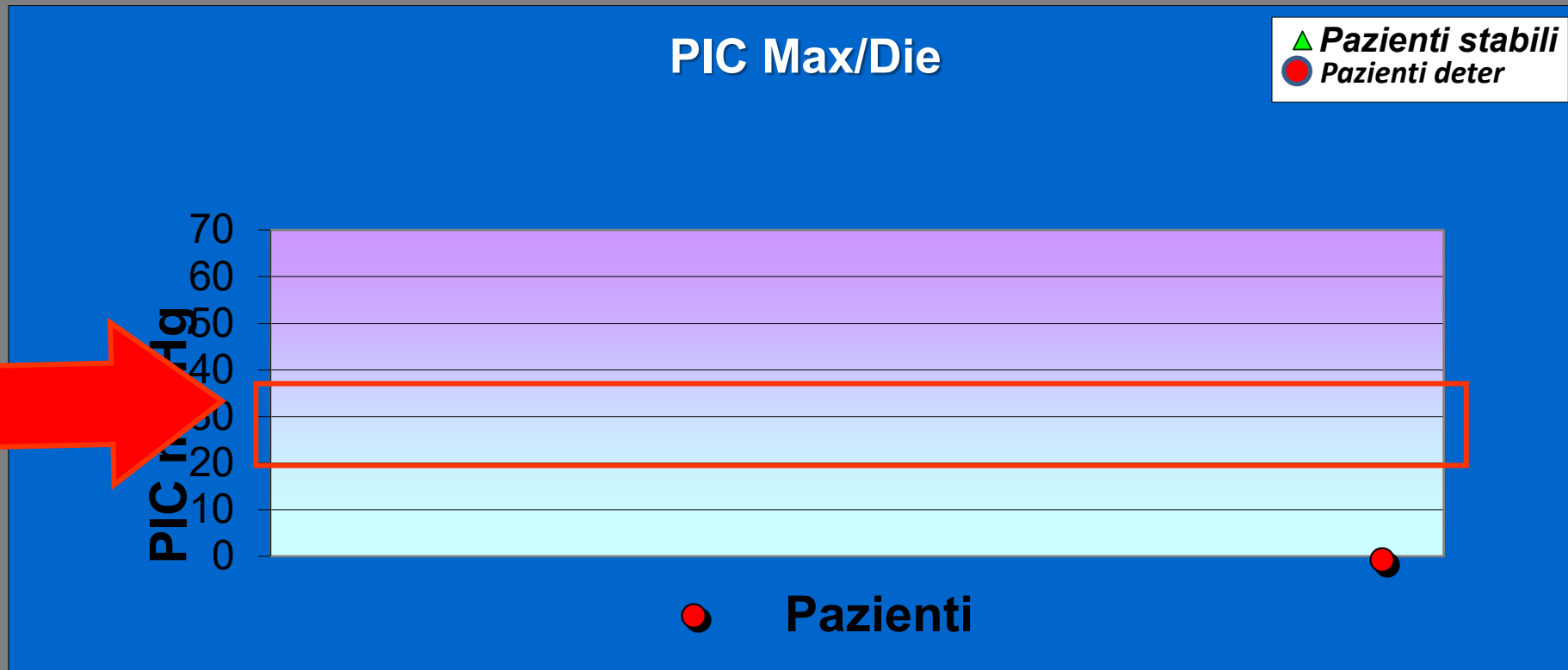
# **Prognosi coma post-traumatico**

**fase precoce (< 7gg)**

Valutazione clinica/EEG: sedazione

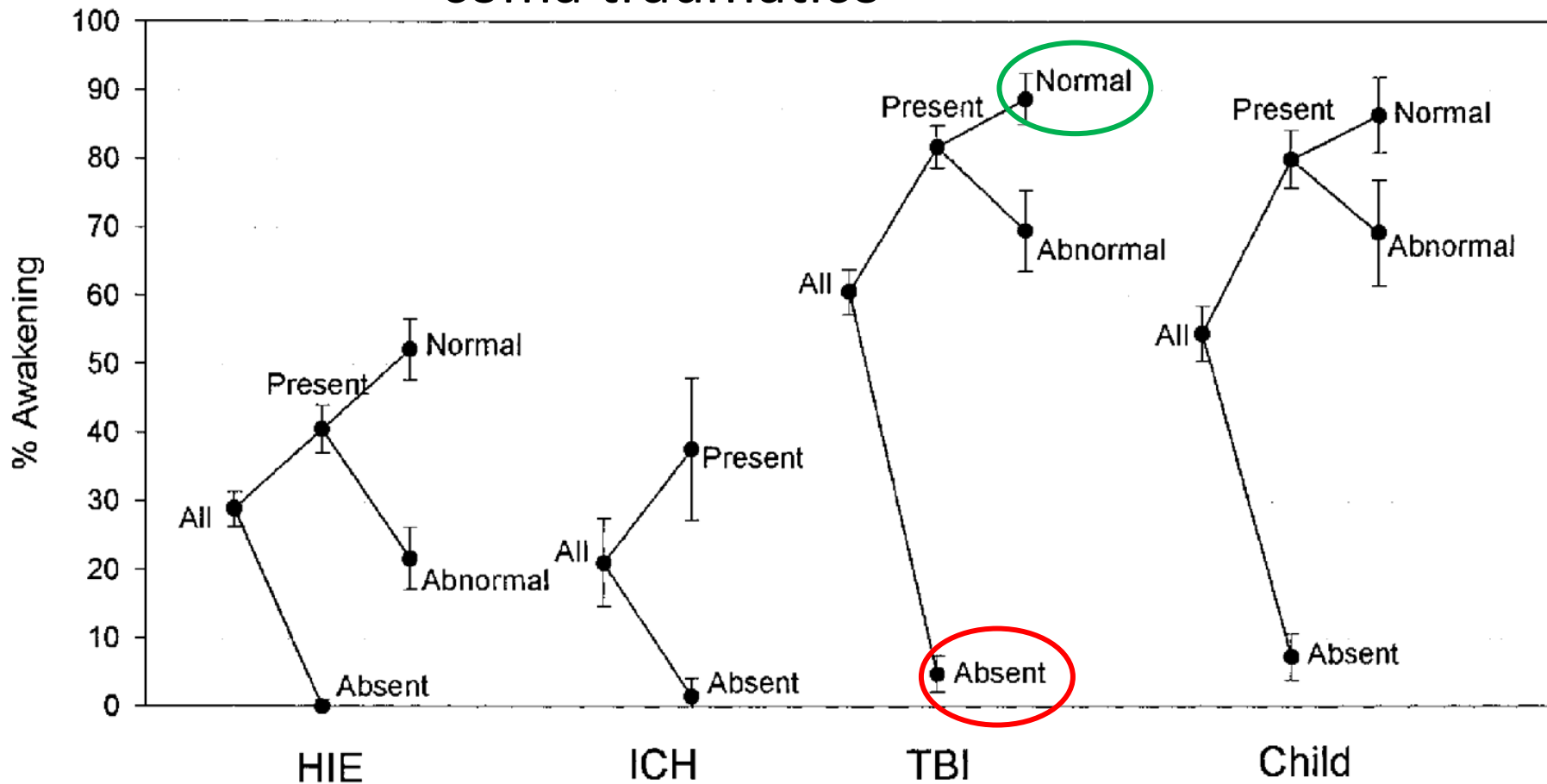
Monitoraggio ICP

# PES, PIC & evoluzione clinica



# Valore prognostico PES:

## coma traumatico



(Robinson et al. 2003)

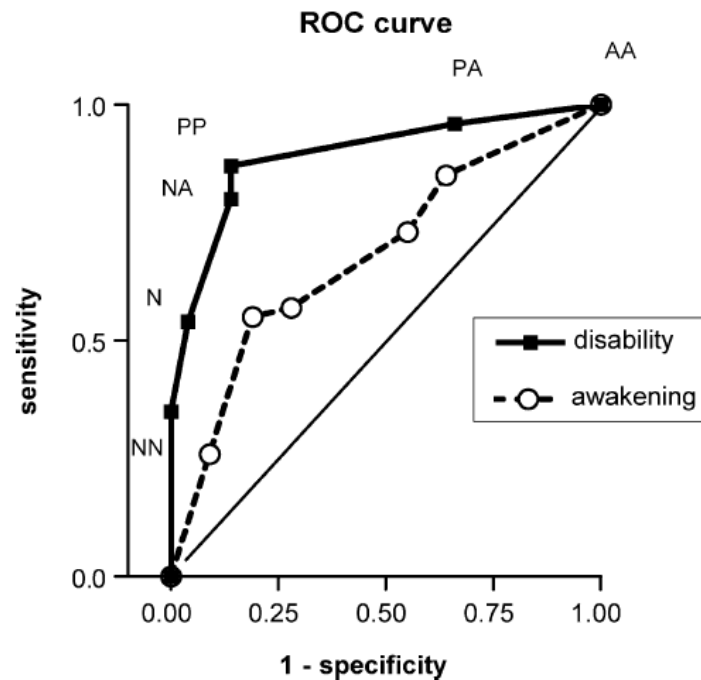
## Prediction of ‘awakening’ and outcome in prolonged acute coma from severe traumatic brain injury: evidence for validity of short latency SEPs

Aldo Amantini<sup>a,\*</sup>, Antonello Grippo<sup>a</sup>, Selvaggia Fossi<sup>a</sup>, Chiara Cesaretti<sup>a</sup>, Anna Piccioli<sup>b</sup>,  
Adriano Peris<sup>b</sup>, Aldo Ragazzoni<sup>c</sup>, Francesco Pinto<sup>a</sup>

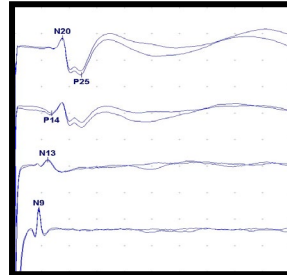
<sup>a</sup>Department of Neurological and Psychiatric Sciences, University of Florence, Az. Ospedaliera Careggi, V. le Morgagni 85, Firenze 50134, Italy

<sup>b</sup>Intensive Care Unit I, Az. Ospedaliera Careggi, Florence, Italy

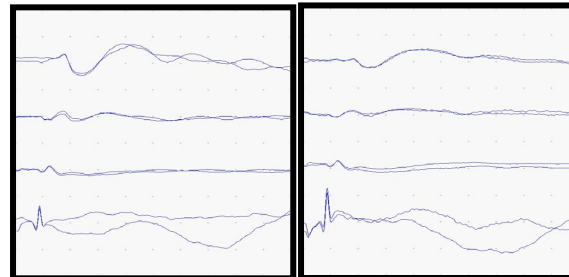
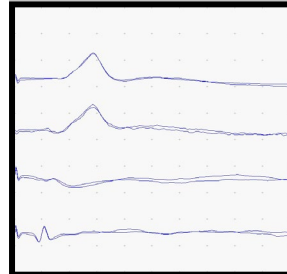
<sup>c</sup>Service of Neurology, Ospedale S. Giovanni di Dio, Florence, Italy



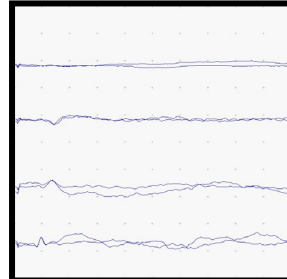
**Normal**



**Pathological**



**Absent**



Grado 1 (NN,NP)	<i>Normal</i>
Grado 2 (NA,PP,PA)	<i>Present</i>
Grado 3 (AA)	<i>Absent</i>



# Coma post-traumatico

**Grado 1 (NN, NP)**      *Normale*

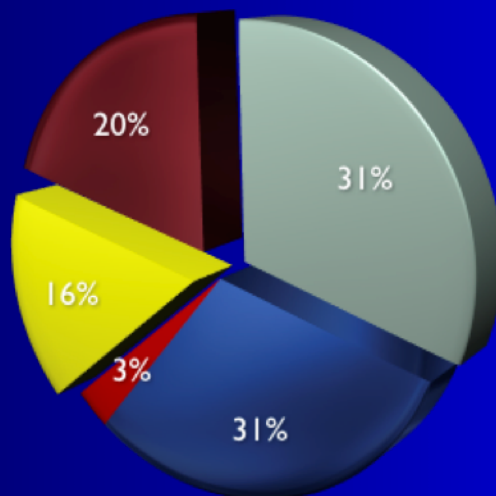
**VPP: risveglio  $\geq 90\%$   
rec funz  $\geq 80\%$**

**Grado 2 (NA, PP, PA)**      *Preservato*

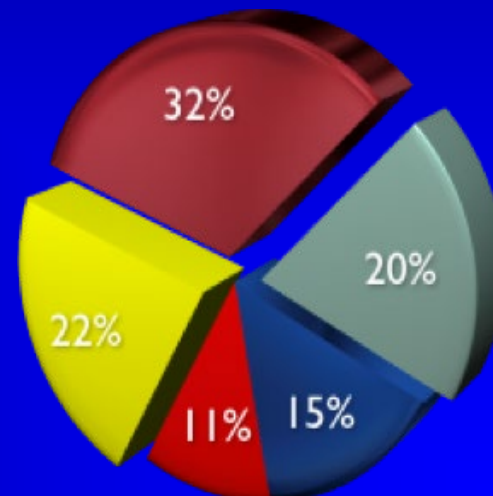
**Grado 3 (AA)**      *Assente*

**VPP: risveglio  $< 10\%$   
grave disab  $\sim 100\%$**

- GOS 1 - Decesso
- GOS 2 - Stato Vegetativo
- GOS 3 - Grave Disabilità
- GOS 4 - Moderata Disabilità
- GOS 5 - Buon Recupero



*(Murray et al 1999)*

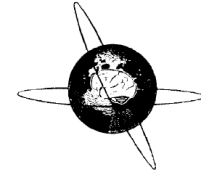


*(Casistica personale n=120)*



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## Prediction of ‘awakening’ and outcome in prolonged acute coma from severe traumatic brain injury: evidence for validity of short latency SEPs

Aldo Amantini<sup>a,\*</sup>, Antonello Grippo<sup>a</sup>, Selvaggia Fossi<sup>a</sup>, Chiara Cesaretti<sup>a</sup>, Anna Piccioli<sup>b</sup>,  
Adriano Peris<sup>b</sup>, Aldo Ragazzoni<sup>c</sup>, Francesco Pinto<sup>a</sup>

<sup>a</sup>*Department of Neurological and Psychiatric Sciences, University of Florence, Az. Ospedaliera Careggi, V. le Morgagni 85, Firenze 50134, Italy*

<sup>b</sup>*Intensive Care Unit 1, Az. Ospedaliera Careggi, Florence, Italy*

<sup>c</sup>*Service of Neurology, Ospedale S. Giovanni di Dio, Florence, Italy*

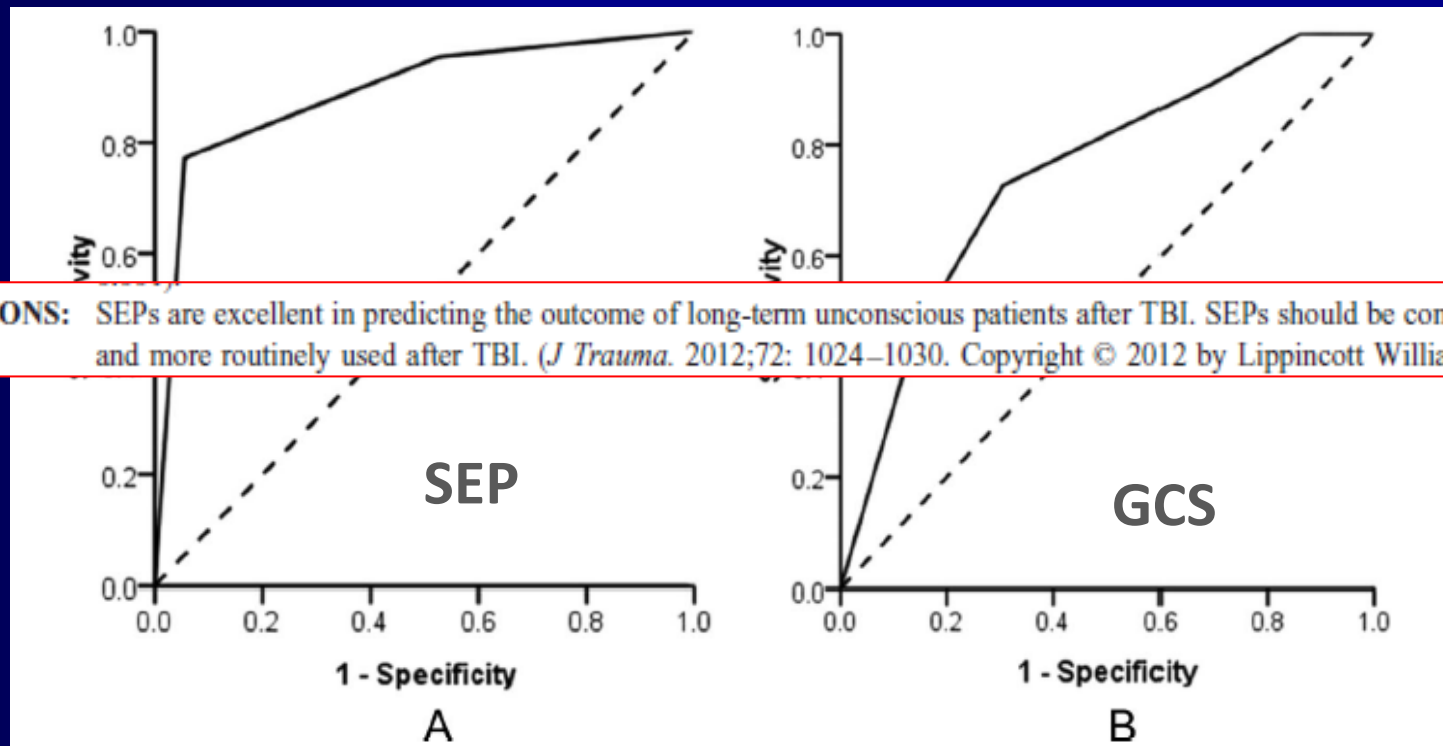
## Early somatosensory evoked potential grades in comatose traumatic brain injury patients predict cognitive and functional outcome\*

David A. Houlden, PhD; Amanda B. Taylor, MD; Anthony Feinstein, MD; Rajiv Midha, MD;  
Allison J. Bethune, BSc; Craig P. Stewart, MA; Michael L. Schwartz, MD

Crit Care Med 2010 Vol. 38, No. 1

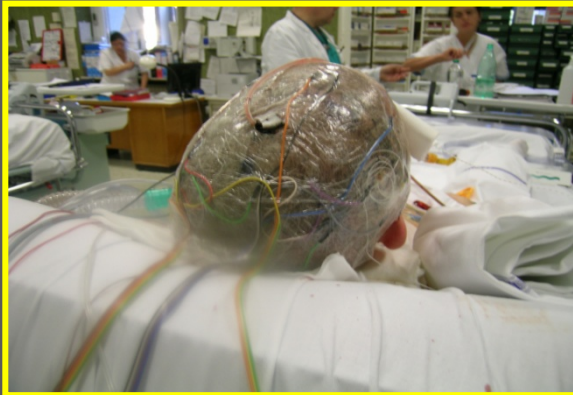
# Prediction of minimally conscious state with somatosensory evoked potentials in long-term unconscious patients after traumatic brain injury

Weiwei Xu, PhD, Gengsi Jiang, MSc, Yanwei Chen, MSc, Xiangyu Wang, MD, PhD,  
and Xiaodan Jiang, PhD, Guangdong, China



**CONCLUSIONS:** SEPs are excellent in predicting the outcome of long-term unconscious patients after TBI. SEPs should be considered more often and more routinely used after TBI. (*J Trauma*. 2012;72: 1024–1030. Copyright © 2012 by Lippincott Williams & Wilkins)

# Utilità registrazione prognostica precoce



**Grave  
Trauma  
cranico**

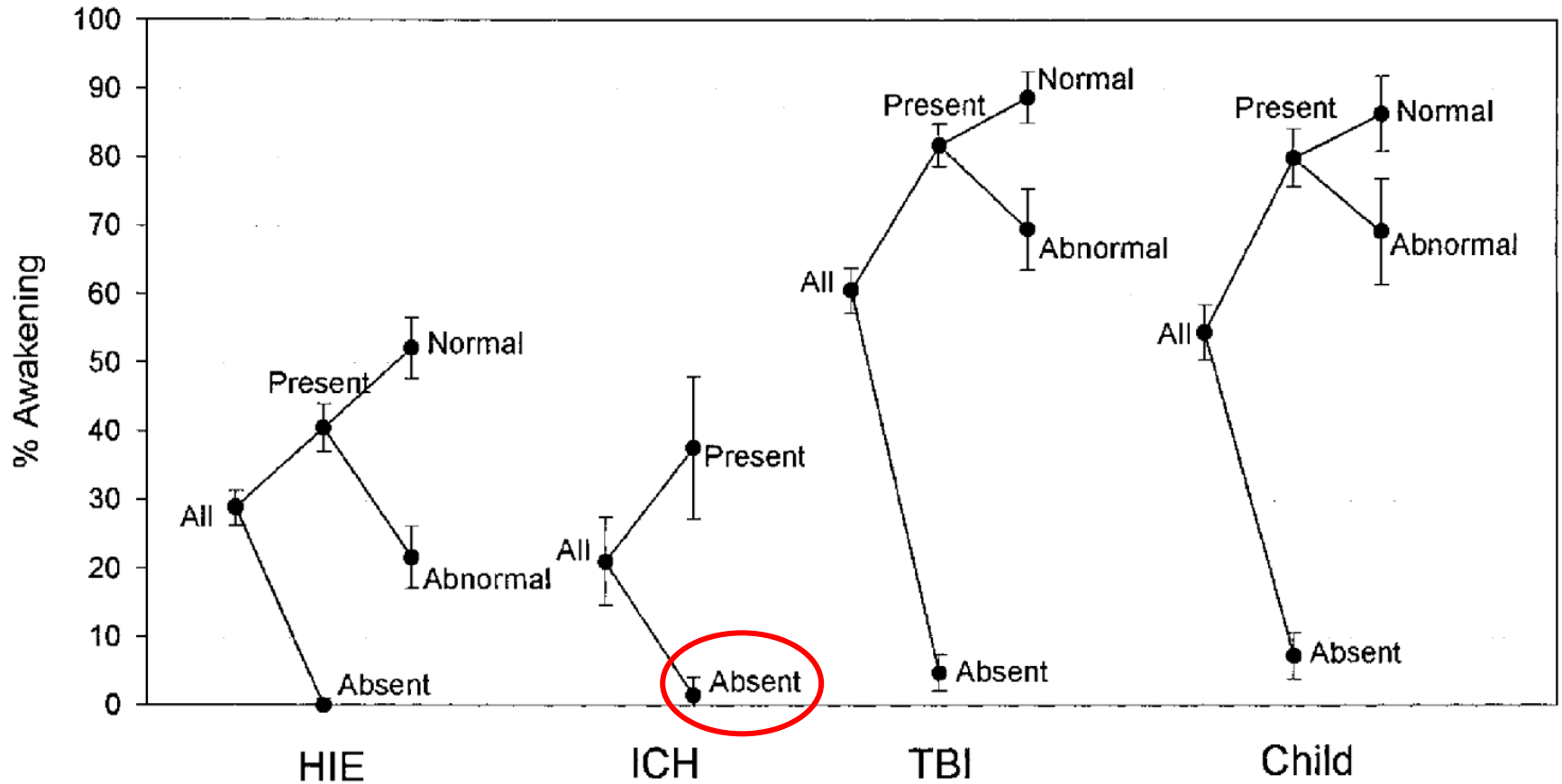


**PES Normale**

**PES Assente**

(ICU long stay  
Tracheostomy  
Very long rehab)

# Valore prognostico PES coma emorragia intracranica



*(Robinson et al. 2003)*

# Emorragie intracraniche (ESA e EIP)

Gennaio 2004-Agosto 2008

**357 pz. ammessi in T.I. (219 ESA, 138 EIP);**

**155 pz. non studiati per GCS>9 (116 ESA; 39 EIP)**

**165 pz. inclusi nella casistica ( 88 ESA; 77 EIP)**

**20 esclusi per CAM prima valutazione (11 ESA; 9 EIP)**

**14 pz. non studiati con GCS<9 (3 ESA; 11 EIP)**

# Pattern PES e GOS

Pat

Use of somatosensory evoked potentials for preoperative assessment in patients with severe aneurysmal subarachnoid hemorrhage before surgical or interventional treatment: a prospective observational cohort study.

[Article in Chinese] 2018

[Zhao J](#)<sup>1</sup>, [Luo X](#), [Zhang Z](#), [Chen K](#), [Shi G](#), [Zhou J](#).

## CONCLUSIONS:

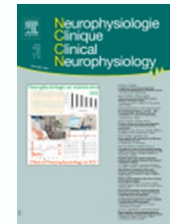
In comparison with WFNS grade and the modified Fisher scale, **SLSEP** seems **more accurate in the prediction of long-term outcome** of severe aSAH prior to surgical or interventional treatment, and thus may be applied as an effective aid in preoperative assessment.



## Predictive patterns of sensory evoked potentials in comatose brain injured patients evolving to brain death

*Scarpino M, Lanzo G, Carrai R, Lolli F, Migliaccio ML, Spalletti M, Peris A, Amantini A, Grippo A*

*February, 2017*



November 2014 – October 2015  
ABI (ICH, TBI, ischemic stroke, HIE)

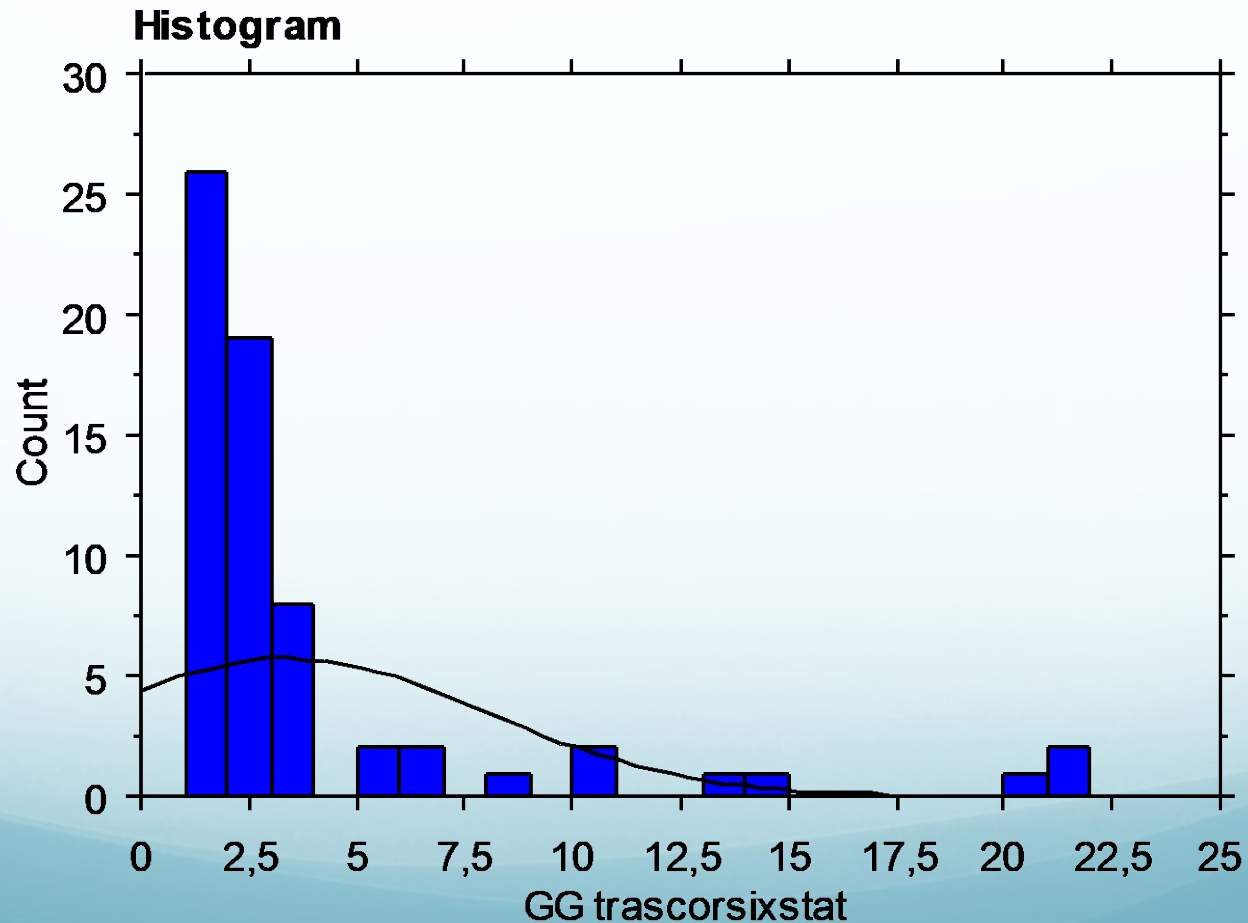
**203pts/70 (34%)** evolving to BD

SEP recorded  $\leq 24$ h ICU admission

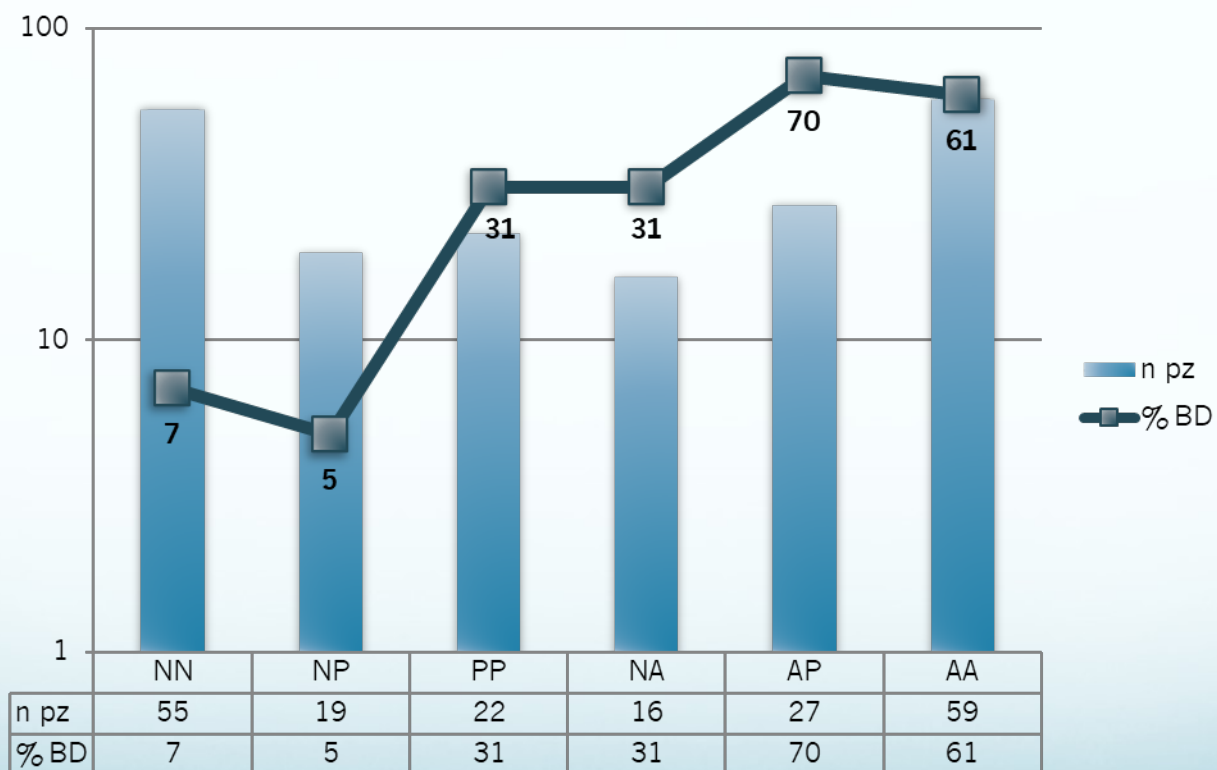


# Distribuzione gg da ammissione ICU a CAM

- 58/70 (82%) entro le 72 ore dall'ammissione in ICU



## N° pts according to SEPpattern and % pts deteriorating to BD





**CASI CLINICI**

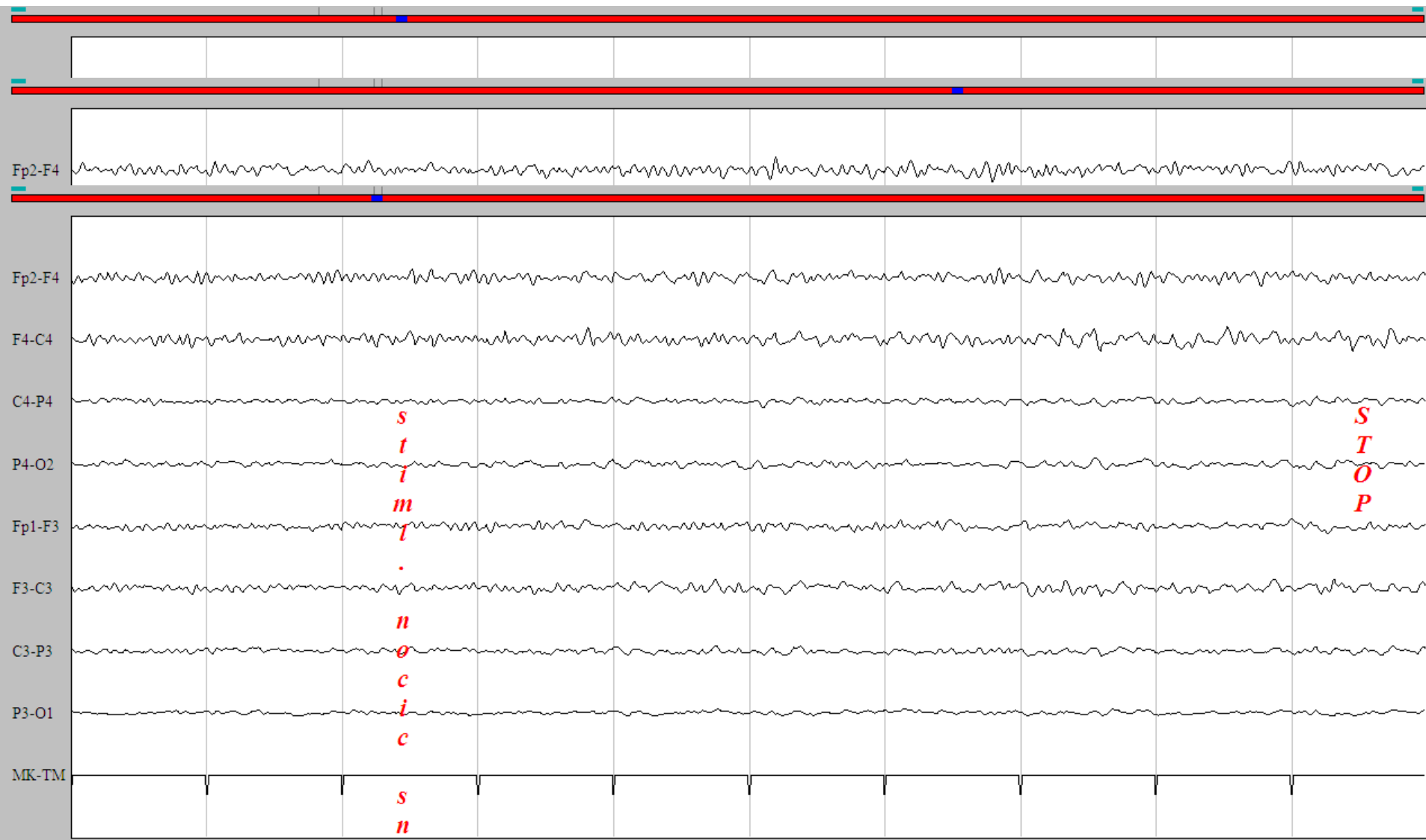
Sig...LR...Data nascita...4-9-1958.....Età...52.....Sesso: M



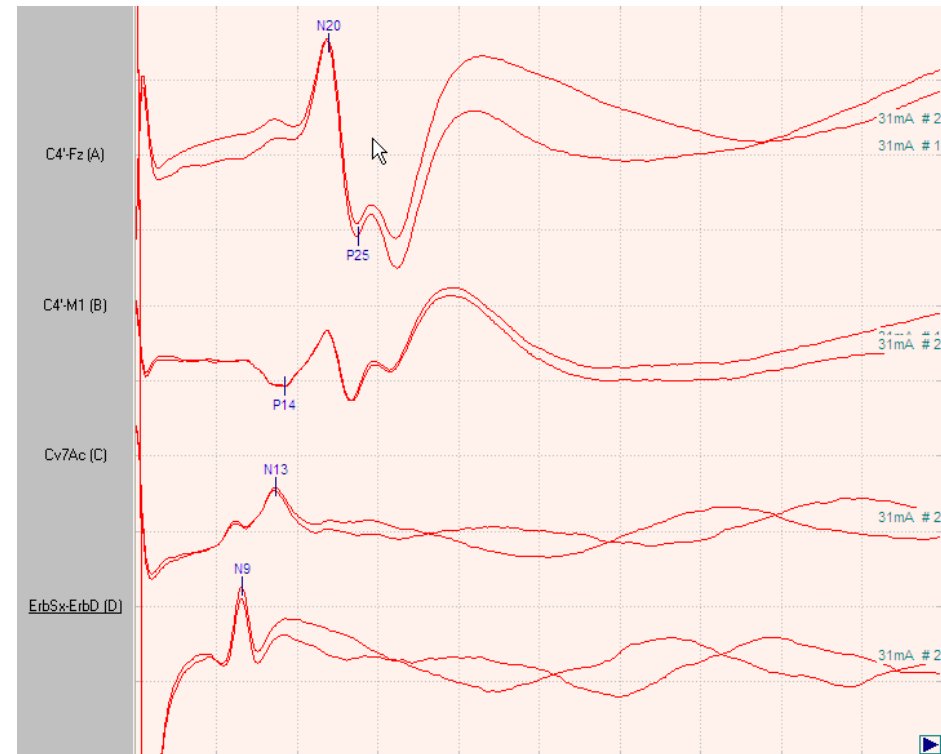
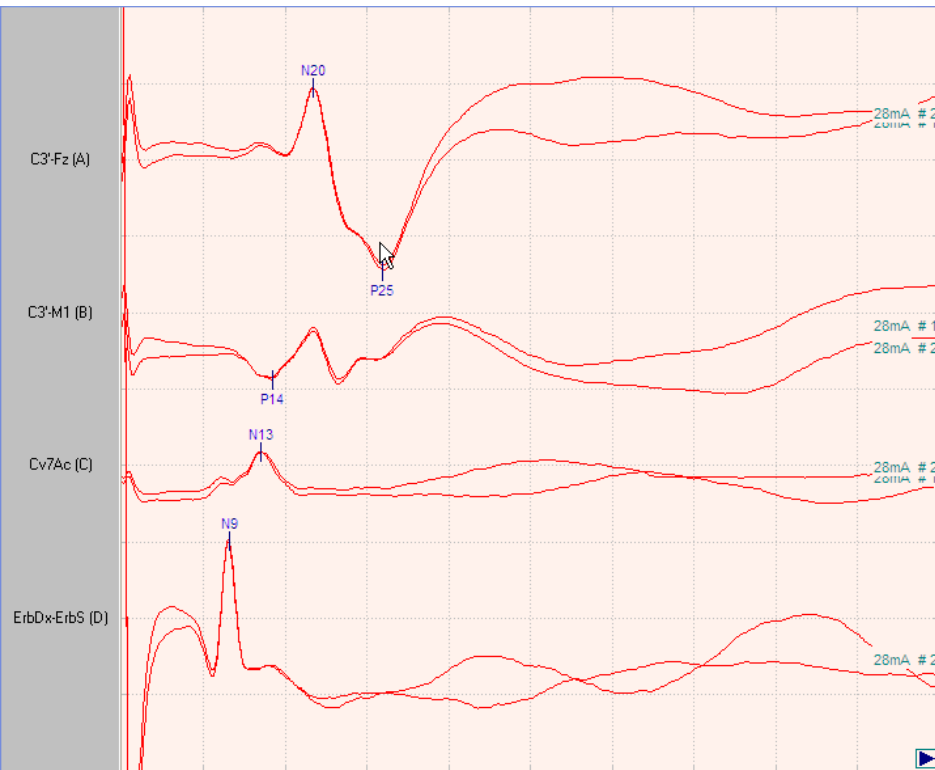
## Scheda Valutazione Coma Post-Anossico

TIPO	DATI			
DATA ACR	12-12-2010	Ora ACR	12.00	
LUOGO ACR			EXTRAOSP	
CAUSA ACR	TRAUMA	ACIDOSI	ALTRO	
			X	
RITMO ESORDIO	FV/TV	ASISTOLIA	Pulseless Electrical Activity	
	X			
DURATA ARRESTO	2'	TEMPO STIMATO ROS	25'	
GCS INGRESSO 118/PS	E=1	V=1	M=1	Tot:3
GCS INGRESSO ICU	E=1	V=1	M=2	Tot:4
Pupille		Diametro Reattività	X Miotiche SI	media midr NO midriatiche
INIZIO IPOT DA ACR (ore)	3			
DURATA IPOTERMIA (ore)	24			

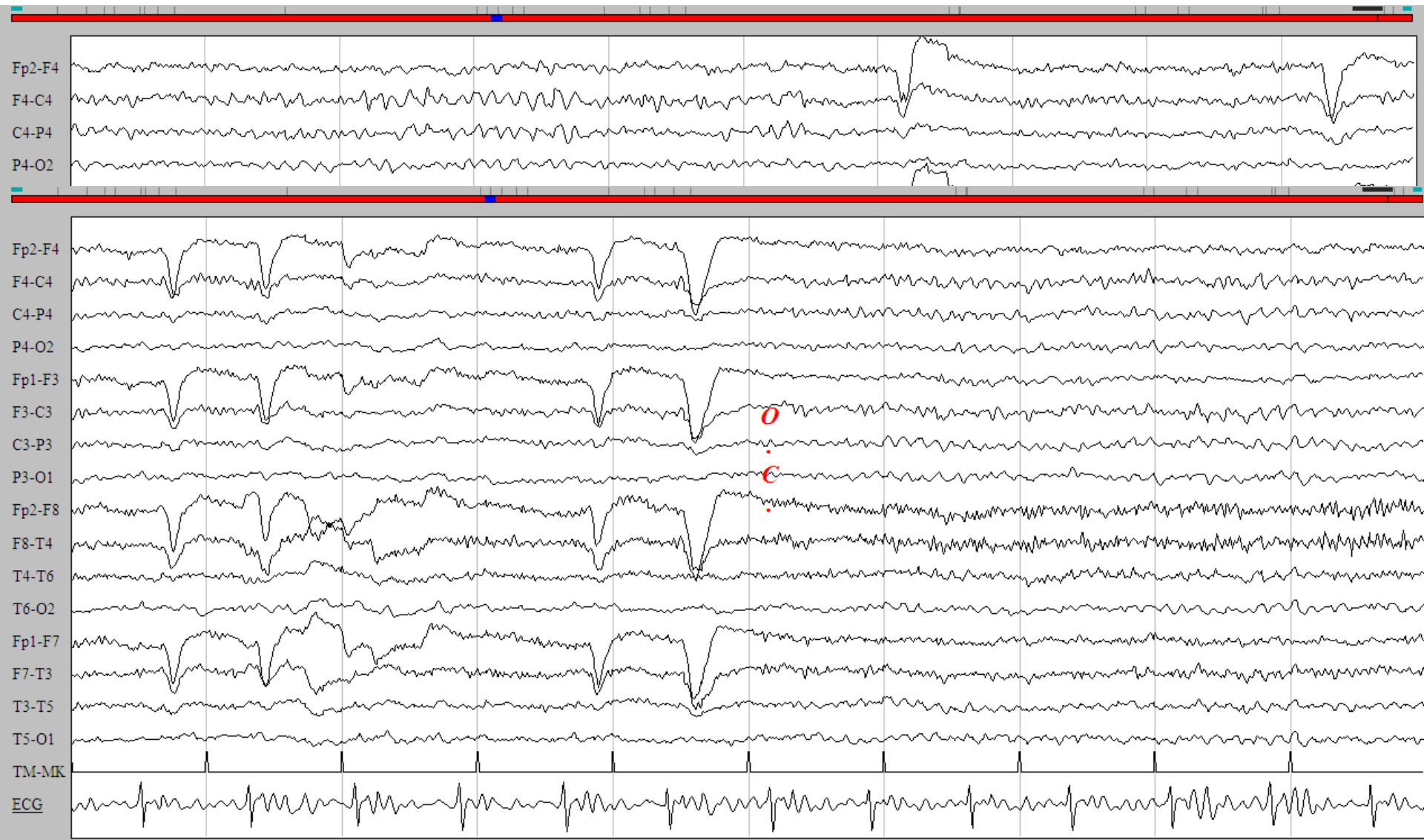
# L.R. – 13.12.2010 (12 ore)



# LR 13.12.2010 (12 ore)



# LR – 15.12.2010 (72 ore)



SEP and EEG recorded at about 12 hours

**Bilaterally present**

SEP

Bilaterally absent

CPC 4-5

- **Continuous**
- **Nearly continuous**
- **Reactive**

EEG

Electrocerebral inactivity (exclude deep sedation)

CPC 4-5

- **Burst-suppression**
- **Suppression**
- **Discontinuous**
- **Epileptiform**
- **Non Reactive**

**CPC 1-2-3**

Undetermined Prognosis





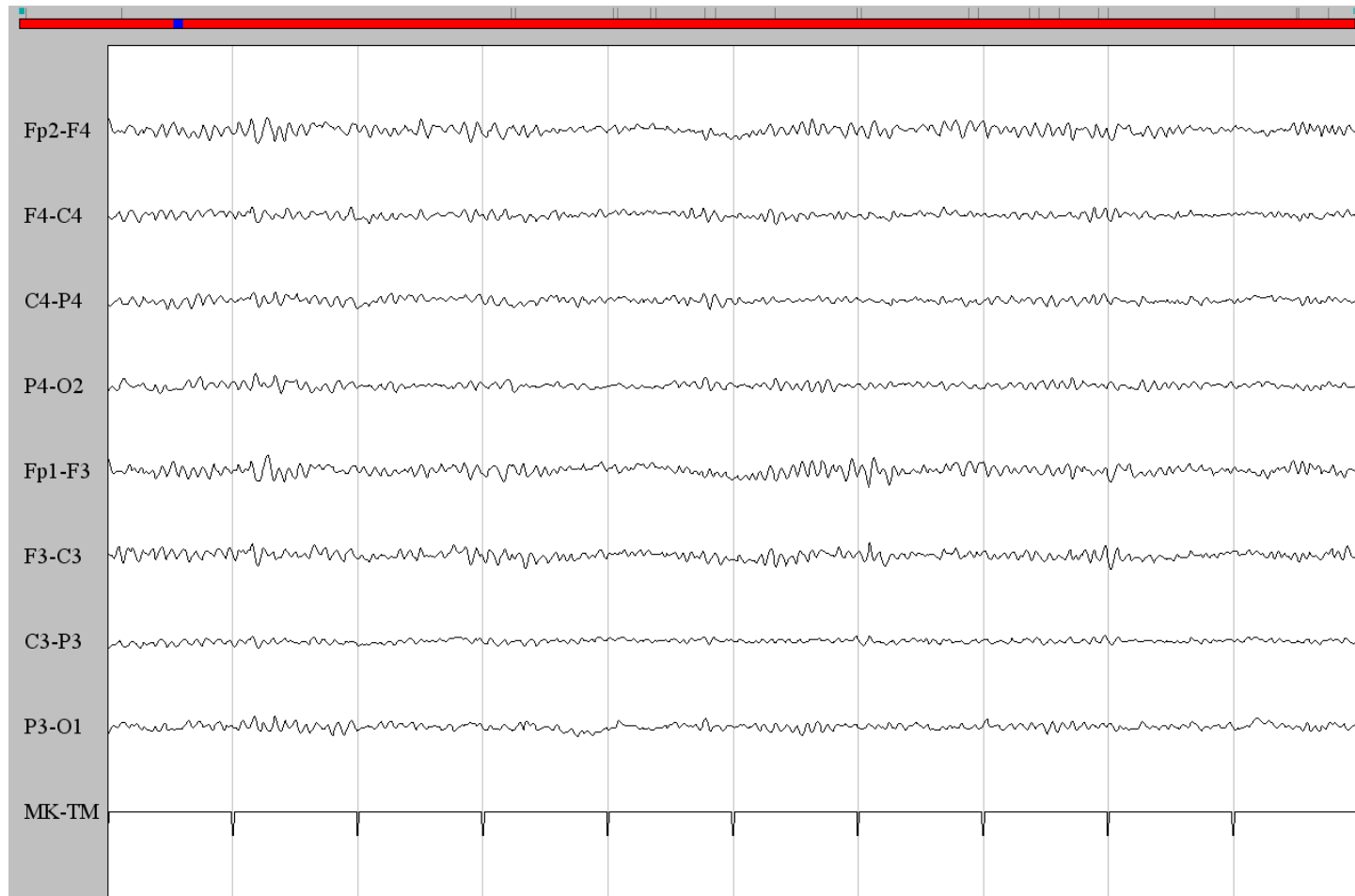
## SCHEDA VALUTAZIONE COMA POST-ANOSSICO

Sig... **FL**.....Data nascita... **21-02-1973**...Età... **39**....Sesso M....

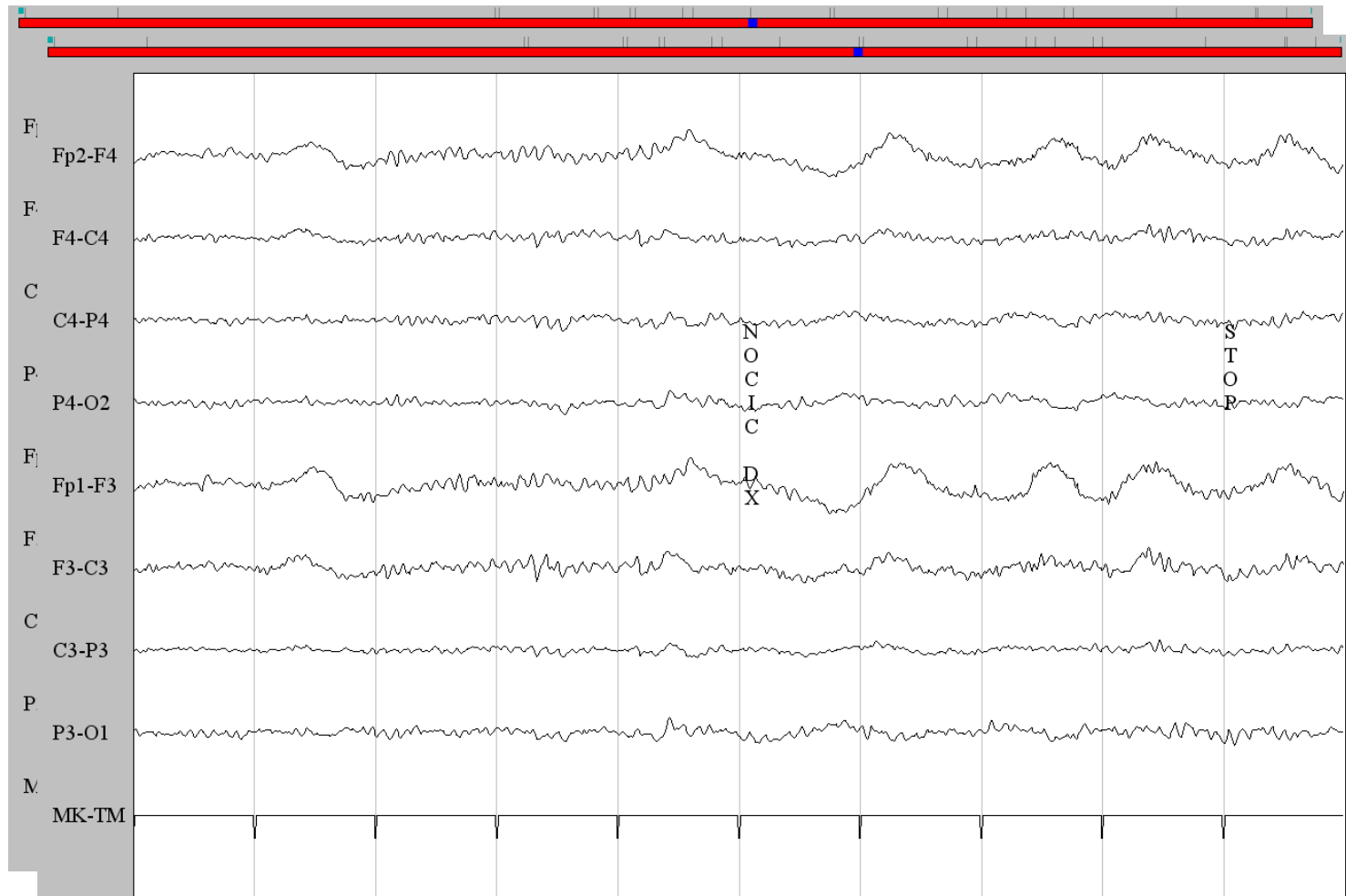
Reparto: **Rianimazione DEA**

TIPO	DATI			
DATA ACR	07-03-2012			
Ora ACR	21.55			
LUOGO ACR	EXTRAOSP			
CAUSA ACR	TRAUMA	ACIDOSI	ALTRO	
			X	
RITMO ESORDIO	FV/TV	ASISTOL	PEA(Pulseless Electrical Activity)	
	X			
DURATA ARRESTO	30'			
TEMPO STIMATO ROS	35'			
GCS INGRESSO 118/PS	E1	V1	M1	Tot: 3
GCS INGRESSO ICU	E1	V1	M1	Tot: 3
Pupille		Diametro Reattività	Miotiche	media midr midriatiche
Episodi ipossia peri - arresto	SI	NO	SI	NO
Episodi ipotensione Protratta (>30')	SI	NO		
INIZIO IPOT DA ACR (ore)	4 h			
DURATA IPOTERMIA (ore)	24 h			

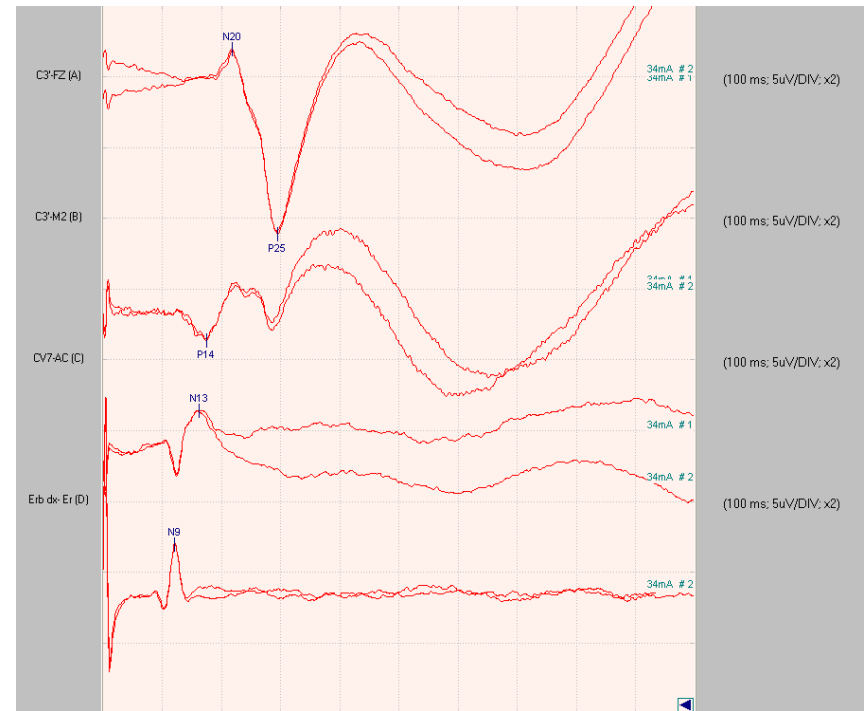
# FL 13 h



# F.L. (reattività)



# FL, 13h





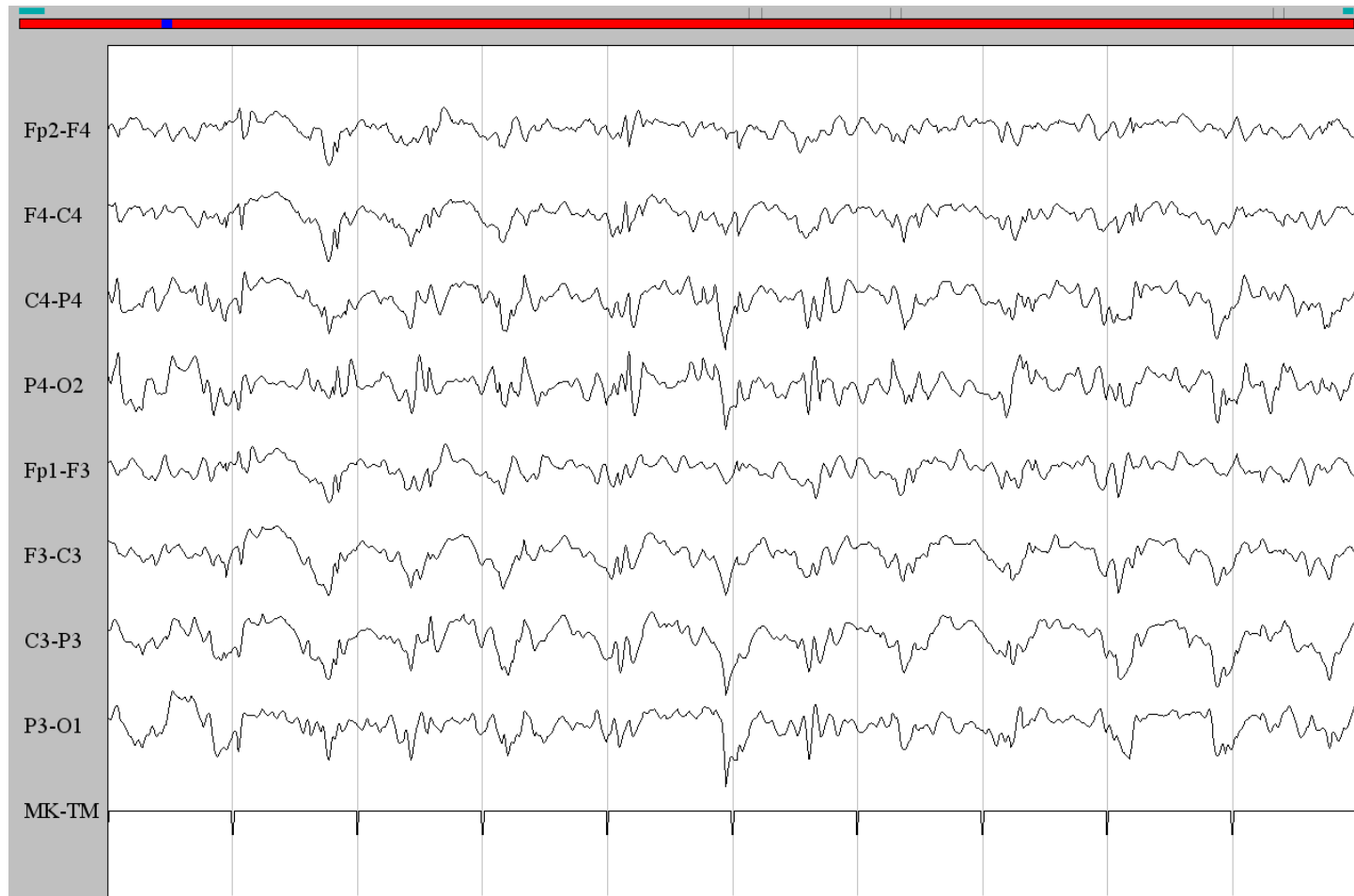
## SCHEDA VALUTAZIONE COMA POST-ANOSSICO

Sig... **BP** .....Data nascita... **27-06-1950**... Et ... **63**.... Sesso M....

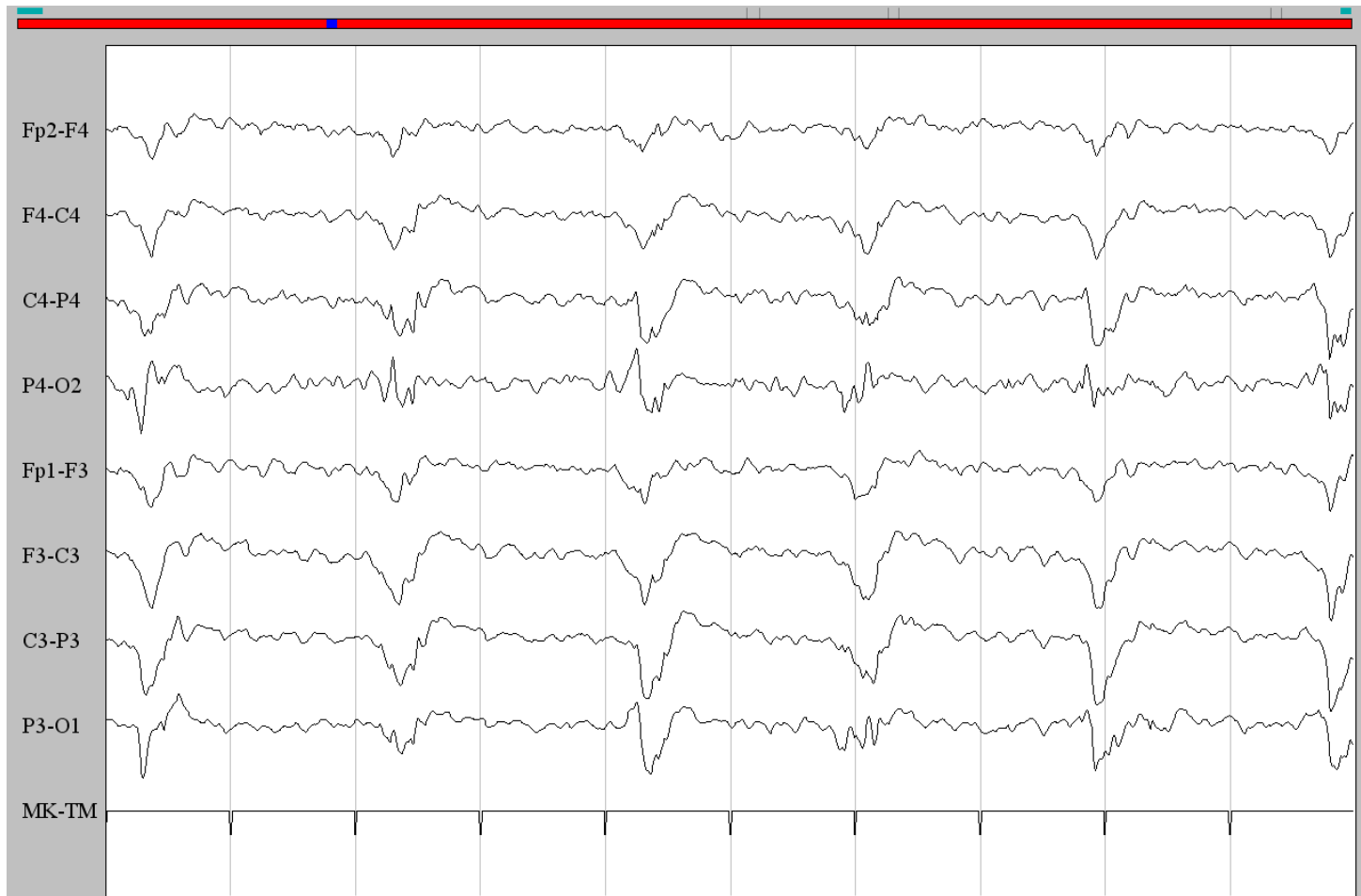
Reparto: **UTIC**

TIPO	DATI			
DATA ACR	15-03-2013			
Ora ACR	9.00			
LUOGO ACR				<b>EXTRAOSPEDALIERO</b>
CAUSA ACR	TRAUMA	ACIDOSI	<b>ALTRO</b>	
			<b>X</b>	
RITMO ESORDIO	FV/TV	ASISTOL	PEA(Pulseless Electrical Activity)	
	<b>X</b>			
DURATA ARRESTO	45'			
TEMPO STIMATO ROS	45'			
GCS INGRESSO 118/PS	E1	V1	M2	Tot: 4
GCS INGRESSO ICU	E1	V1	M2	Tot: 4
Pupille		Diametro Reattivit�	Miotiche	media midr midriatiche <b>SI</b> <b>NO</b>
Episodi ipossia peri - arresto	SI	<b>NO</b>		
Episodi Ipotensione Protratta (>30')	SI	<b>NO</b>		
INIZIO IPOT DA ACR (ore)	3 h			
DURATA IPOTERMIA (ore)	24 h			

# B.P. 72h

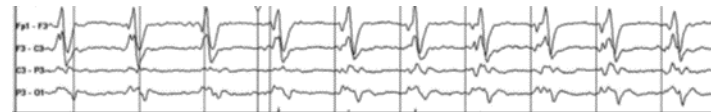
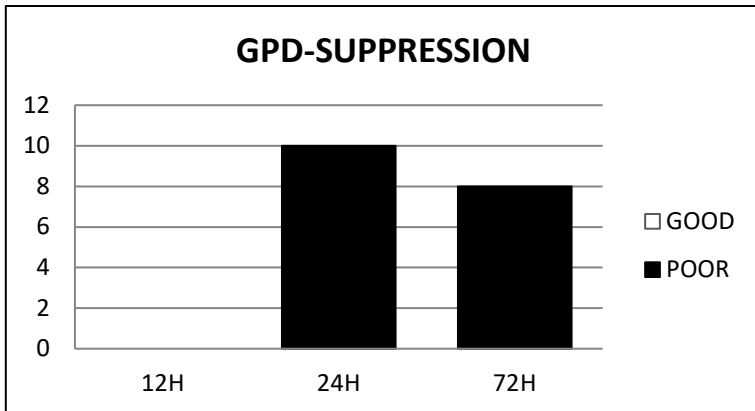
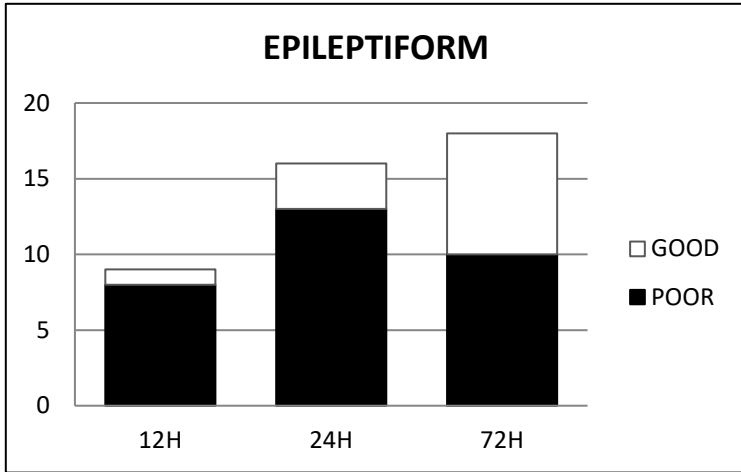


# B.P. 72h



# EPILETTIFORMI

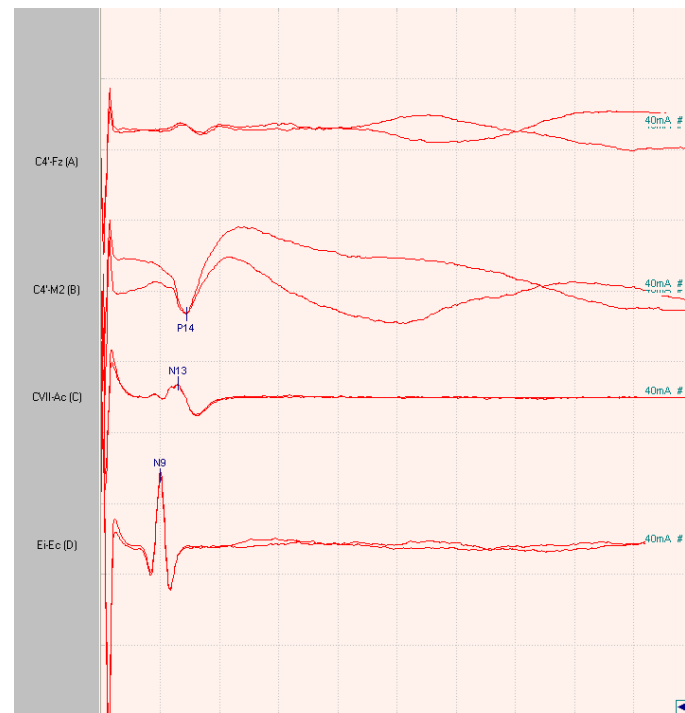
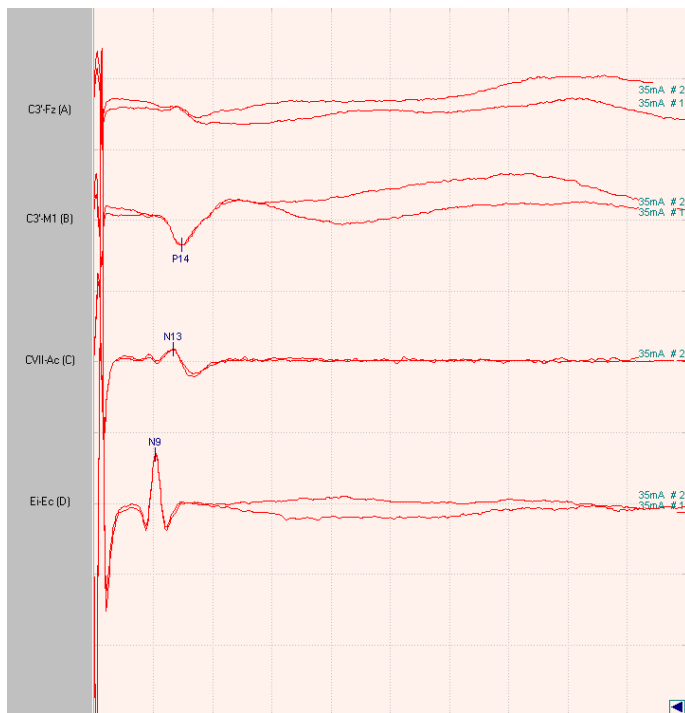
CPC: 1-3 VS 4-5







# BP 72 h





Sig...RT.....Data nascita...8-12-1925.....Età...85.....Sesso: M



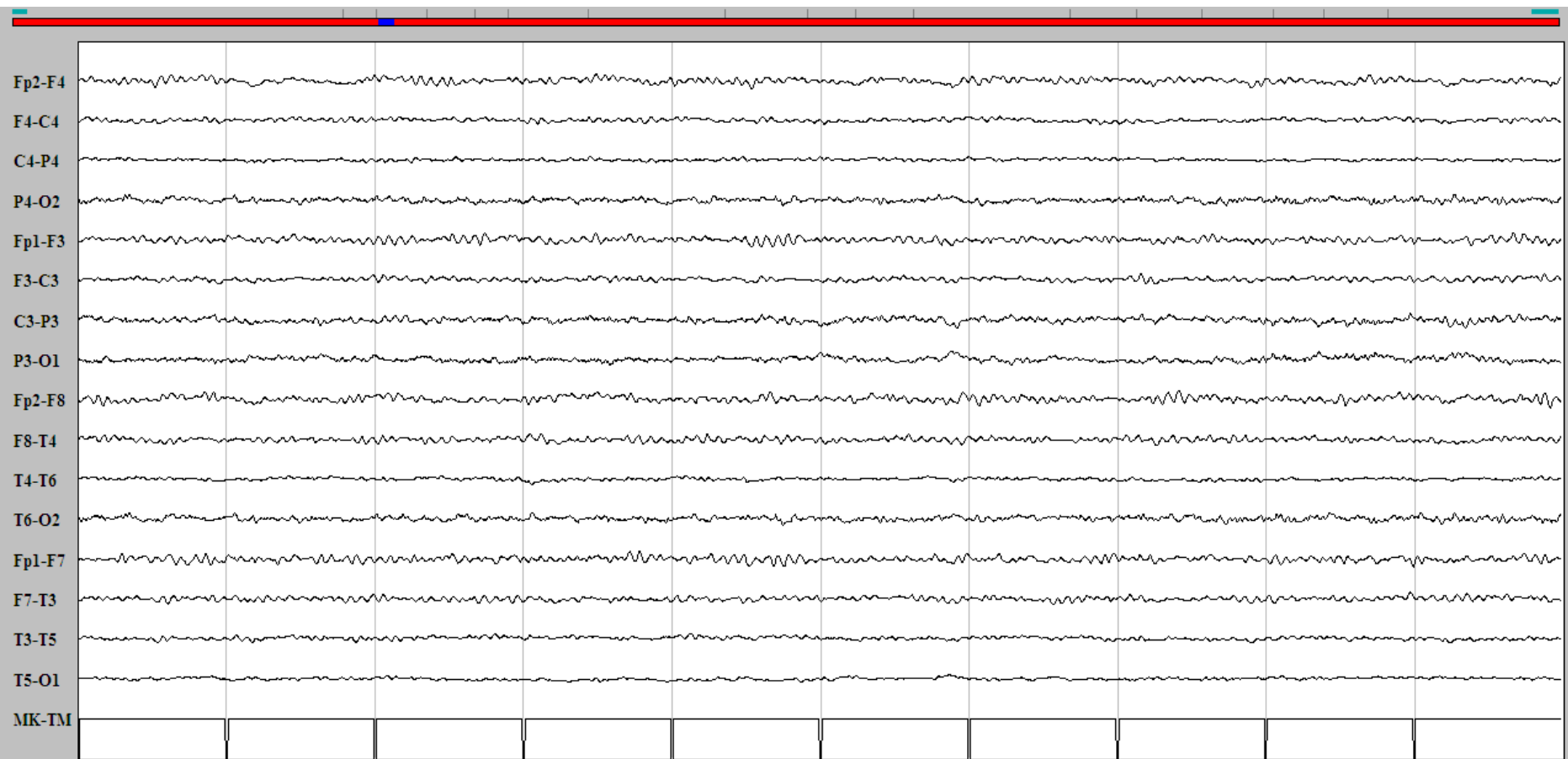
## Scheda Valutazione Coma Post-Anossico

TIPO	DATI			
DATA ACR		Ora ACR		
LUOGO ACR			EXTRAOSP	
CAUSA ACR	TRAUMA	ACIDOSI	ALTRO	
			X	
RITMO ESORDIO	FV/TV	ASISTOLIA	Pulseless Electrical Activity	
		X		
DURATA ARRESTO	15'	TEMPO STIMATO ROS	25'	
GCS INGRESSO 118/PS	E=1	V=1	M=1	Tot:3
GCS INGRESSO ICU	E=1	V=1	M=2	Tot:4
Pupille		Diametro Reattività	X Miotiche SI	media midr NO midriatiche



R.T.

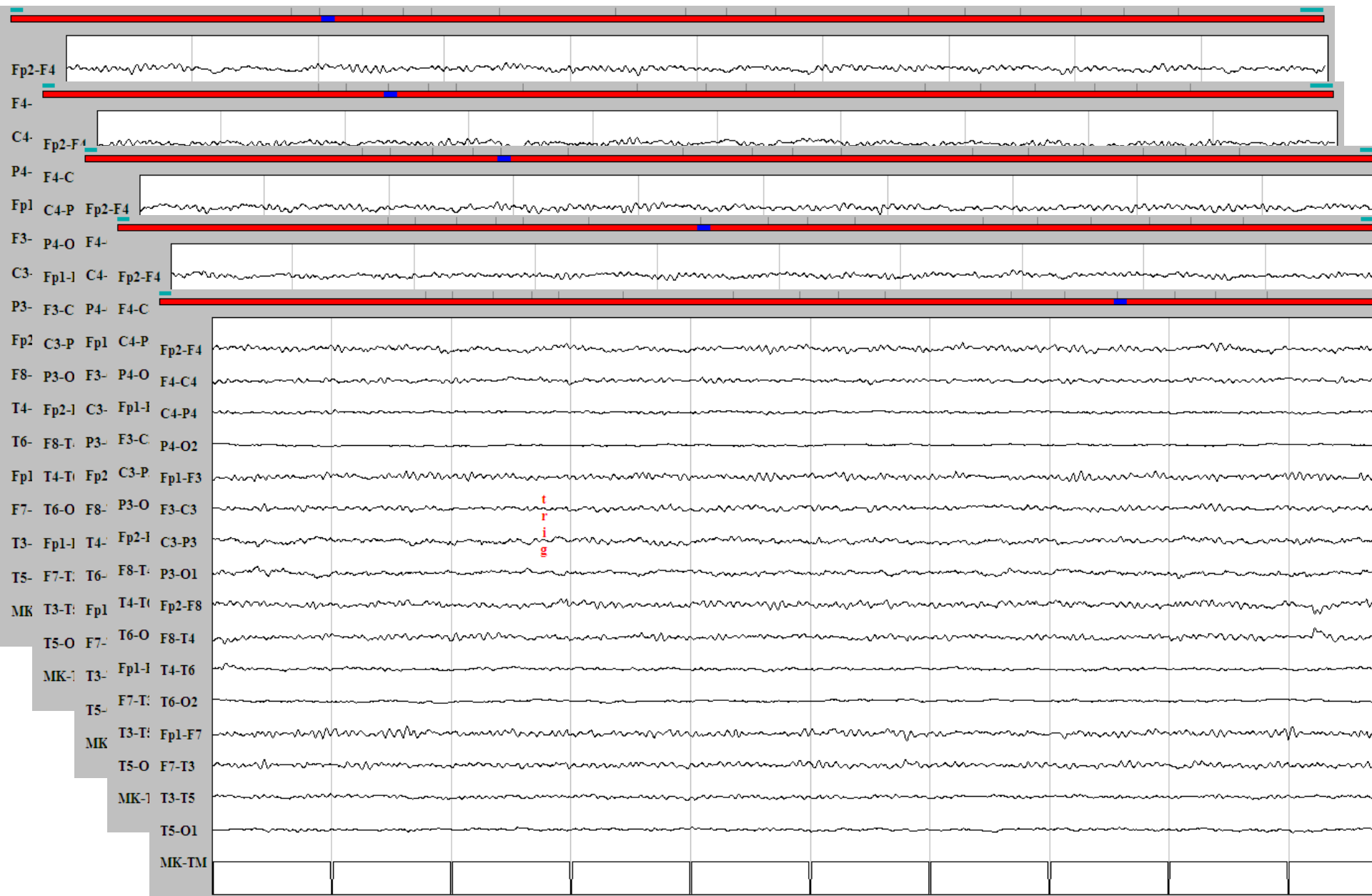
72 h





R.T.

72 h

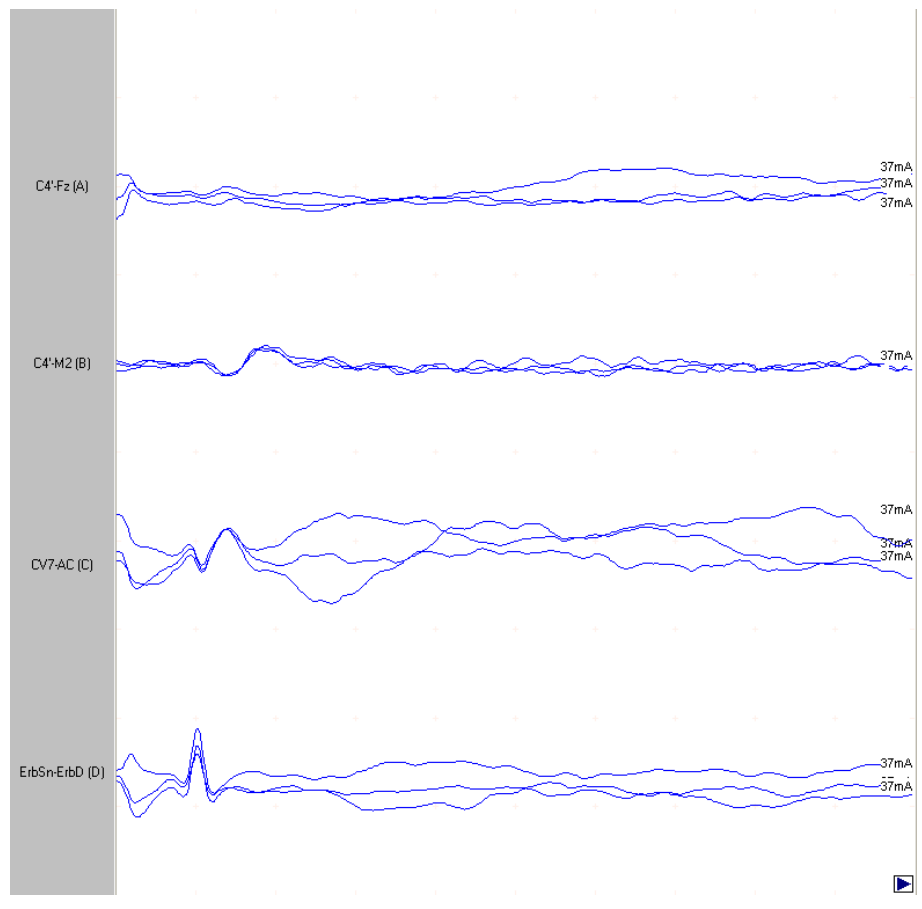
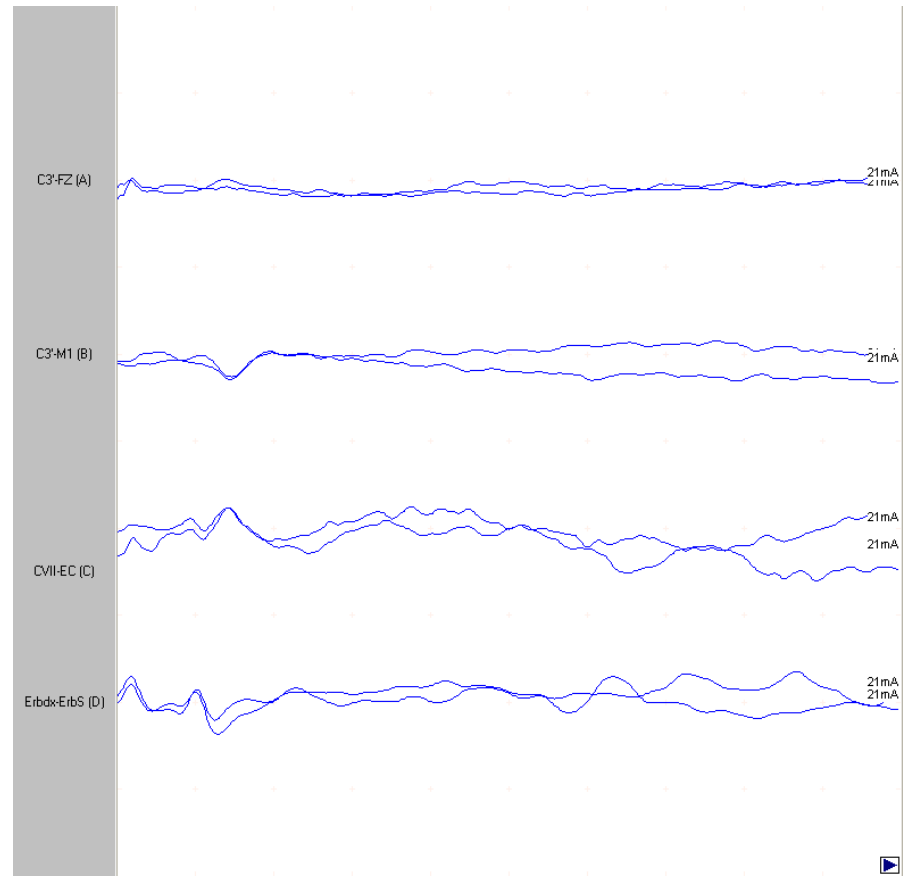


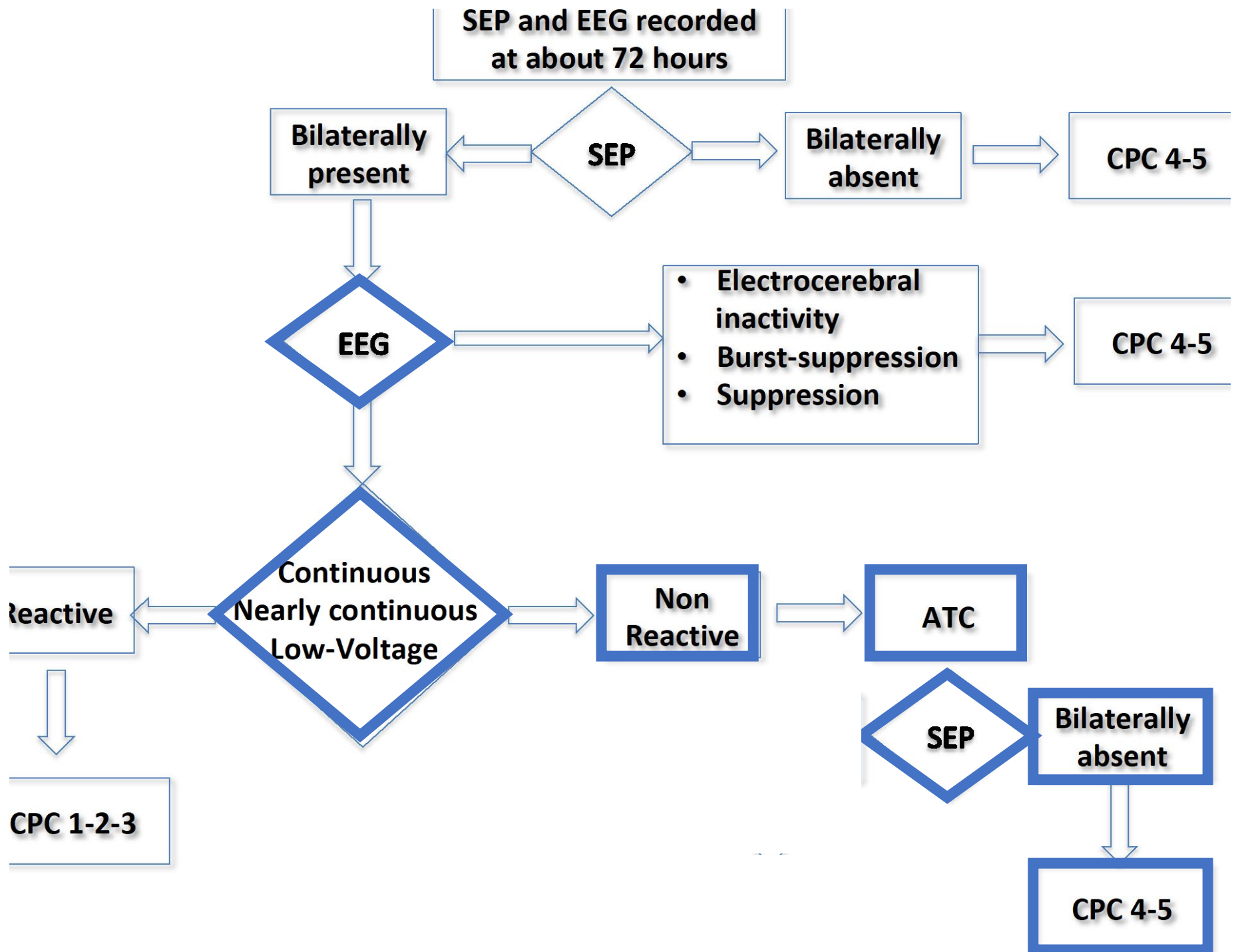


R.T.

PES

72 h





Sig...CM.....Data nascita...18-12-1930...Età...81.....Sesso: F

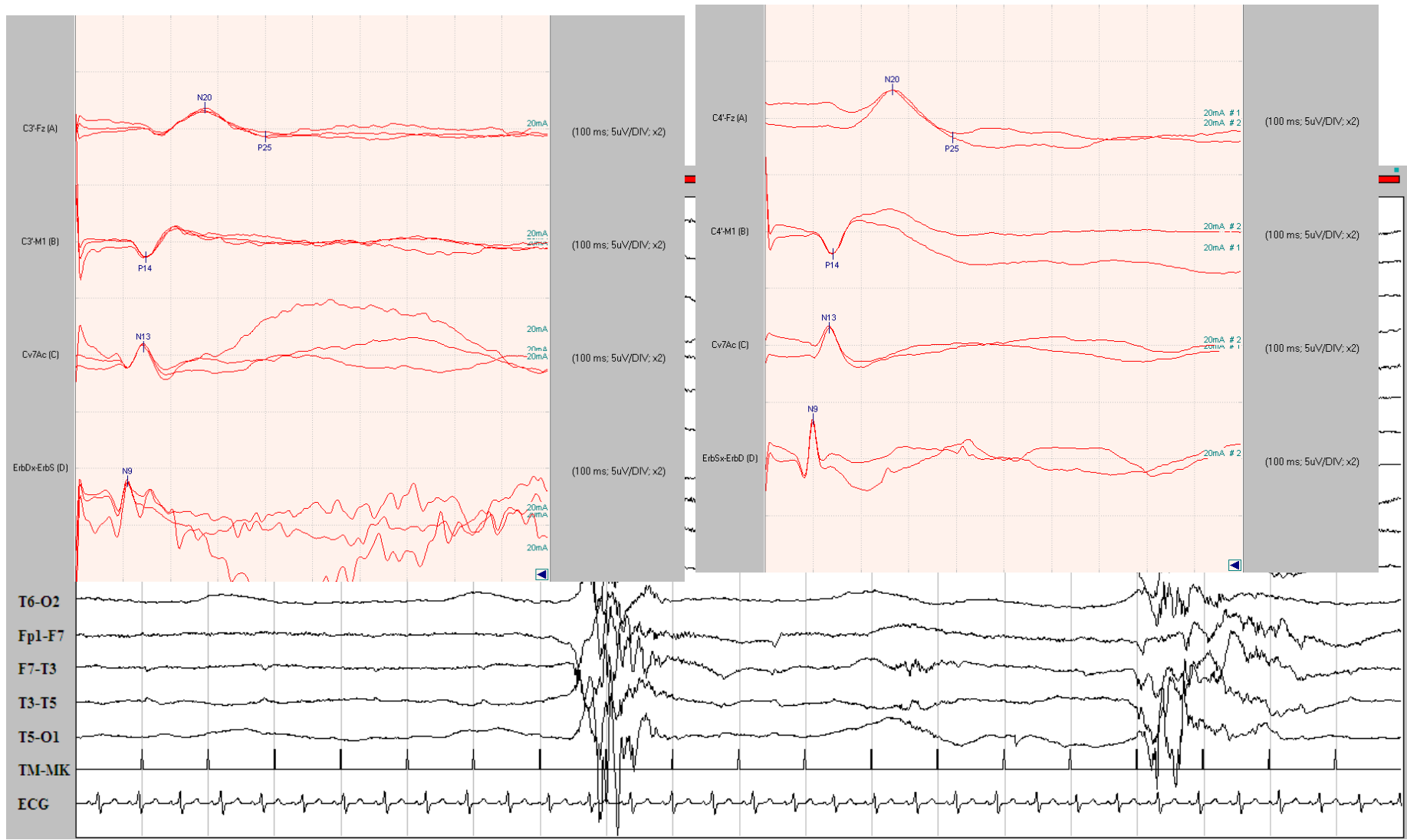


## Scheda Valutazione Coma Post-Anossico

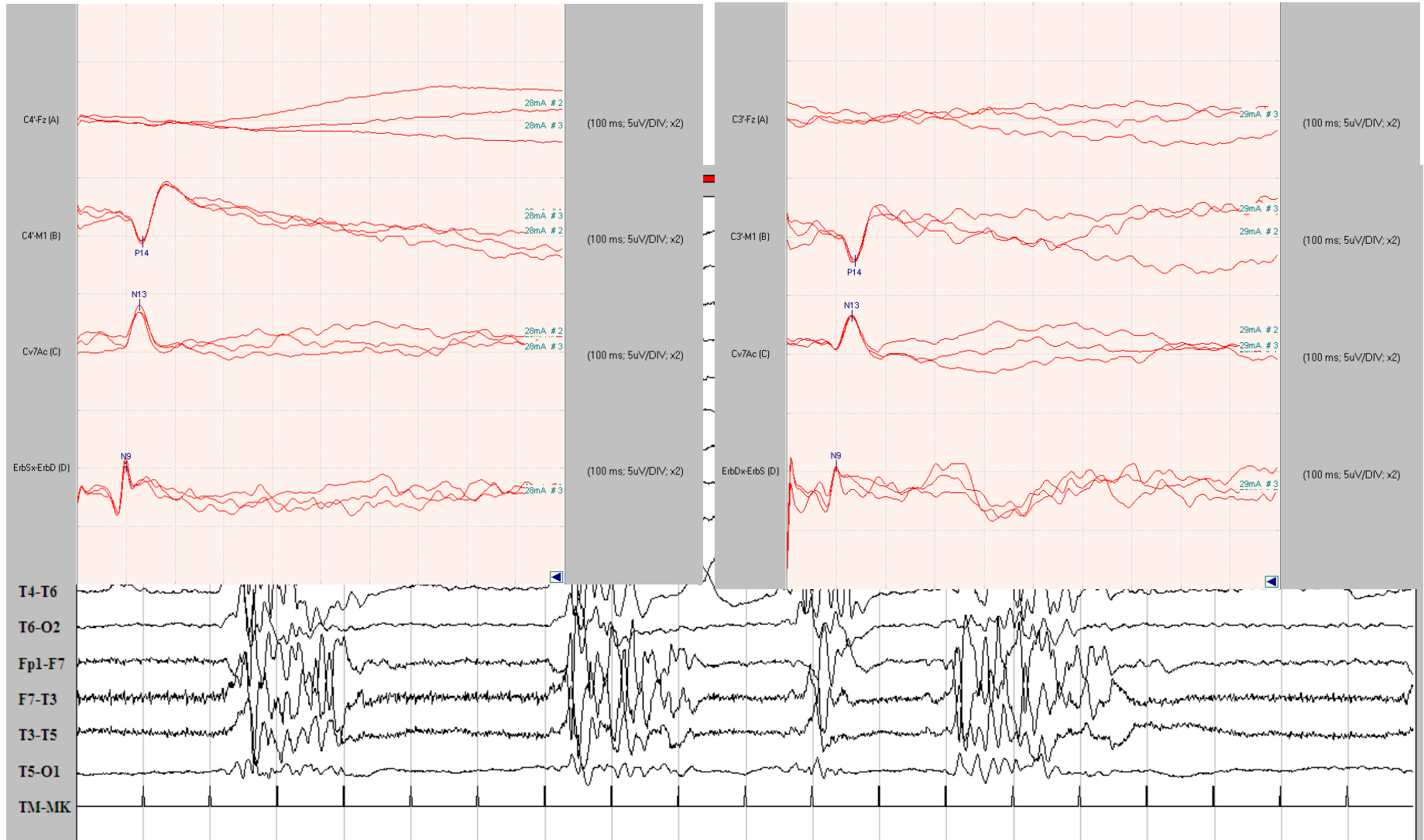
TIPO	DATI			
DATA ACR	30-01-2010	Ora ACR	16.00	
LUOGO ACR	INTRAOSPEDALIERO			
CAUSA ACR	TRAUMA	ACIDOSI	ALTRO	
			X	
RITMO ESORDIO	FV/TV	ASISTOLIA	Pulseless Electrical Activity	
		X		
DURATA ARRESTO	10'	TEMPO STIMATO ROS	10'	
GCS INGRESSO 118/PS	E=1	V=1	M=1	Tot:3
GCS INGRESSO ICU	E=1	V=1	M=2	Tot:4
Pupille		Diametro Reattività	X Miotiche SI	media midr NO midriatiche



# CM -17 ore da ACR



# CM - 72 ore da ACR



**Pronto soccorso**  
**VG 71 a**  
**2h30min dopo AC**  
(GCS=4, pup isoc miotiche)

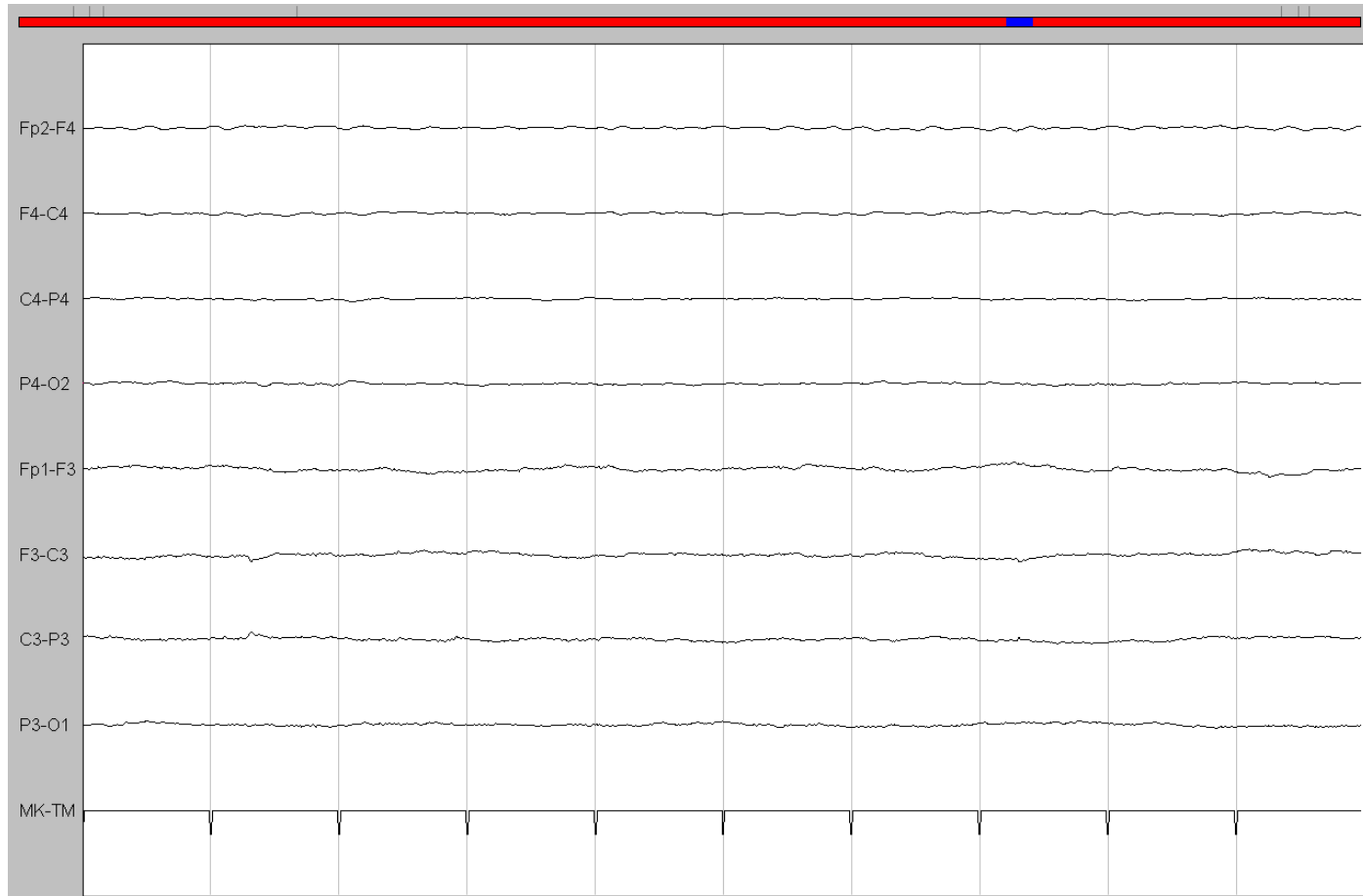
- Pz sedato (midazolam), ECMO, rottura m. papillare valvola mitrale
- Cardiochirurgo: indicazione all'intervento
- Intensivista: richiede valutazione neurologica prognostica
- TC cranio: difficoltà ad eseguirla in ECMO
- Veniamo consultati

# Che cosa fare?

- Andare?
- Attendere?
- Quanto attendere?
- Che cosa registrare?

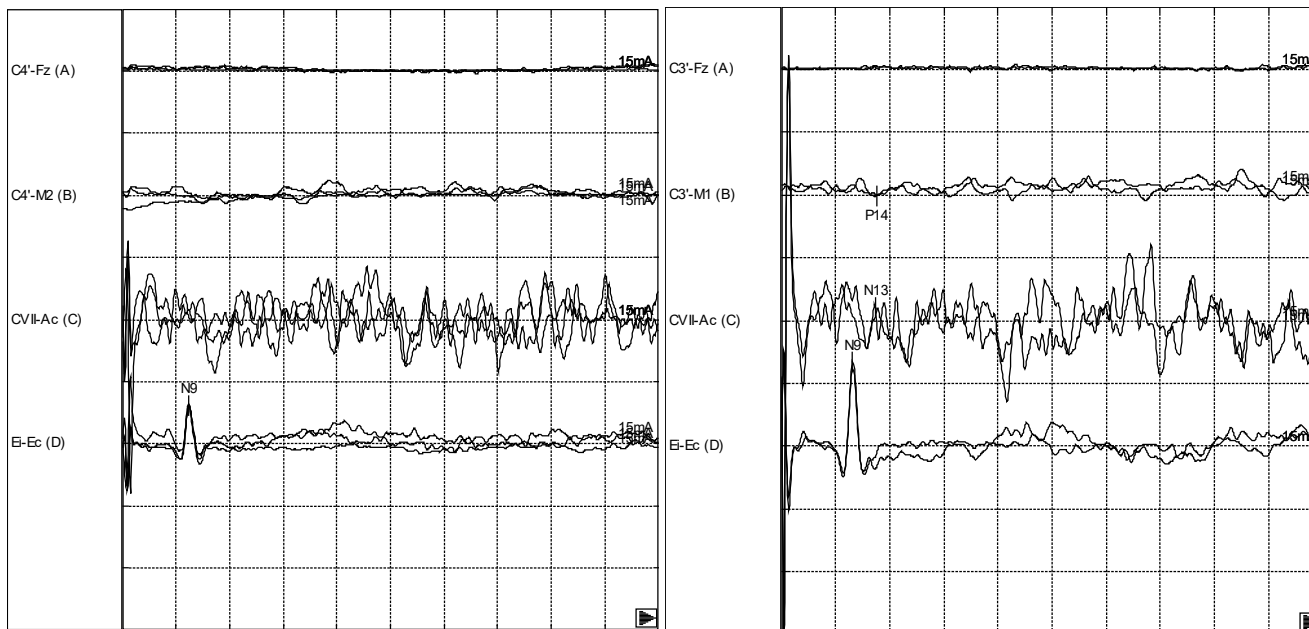


## EEG 2h30' dopo AC



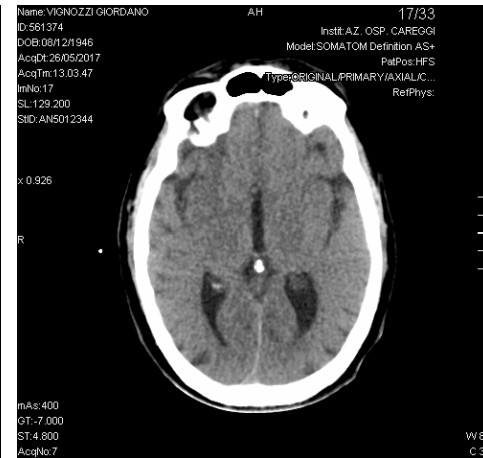
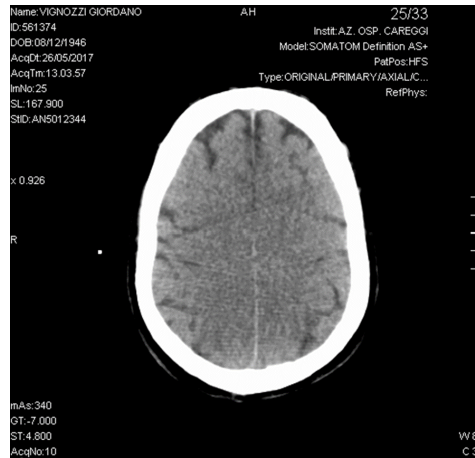


## SEP 2h30' dopo AC



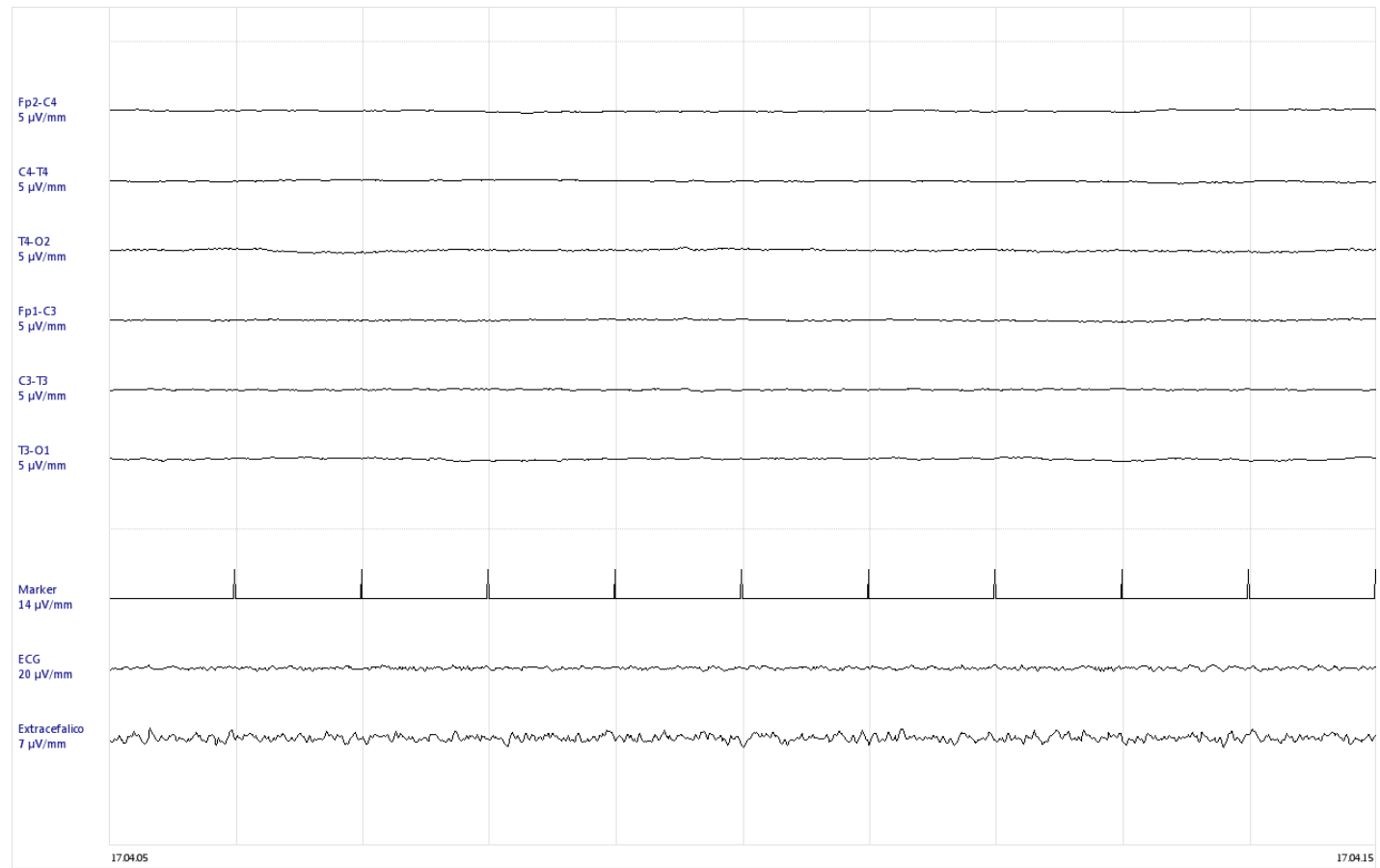
# TC cranio

GM/WM  
ratio <  
1.07  
  
(0.98)



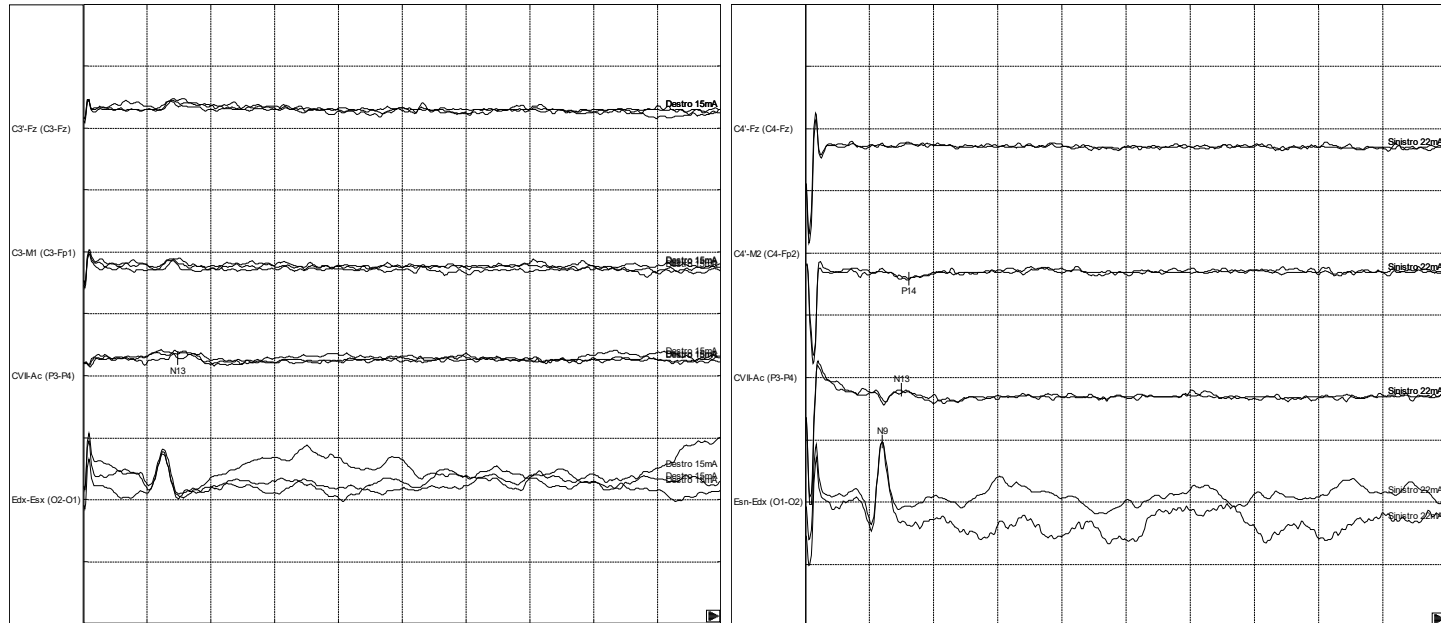


# EEG 6h dopo AC





# SEP 6h dopo AC



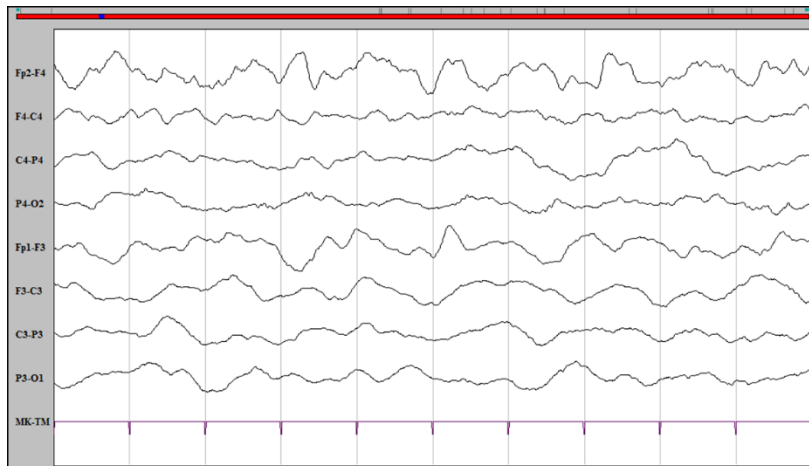
## Contributo di un modello multimodale al work-up diagnostico-terapeutico

- **2h30 dopo AC:** considerate assenza SEP corticali (con EEG soppresso) consigliamo nuova valutazione prognostica a 6 ore prima di stabilire indicazione all'intervento CCH
- **6h00 dopo AC:** conferma di prognosi neurologica infausta basata su SEP e TC; non indicazione all'intervento CCH
- **26h00: Morte encefalica**

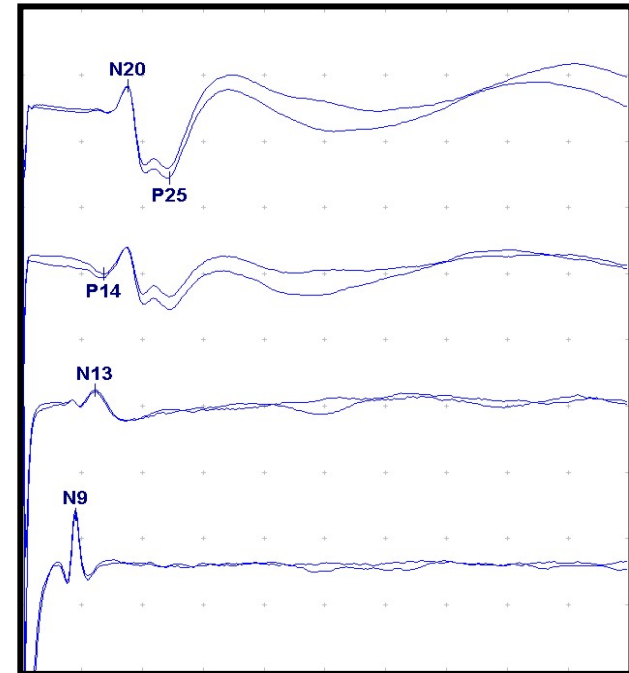


# Perché integrare EEG/PES

**EEG**



**PES**

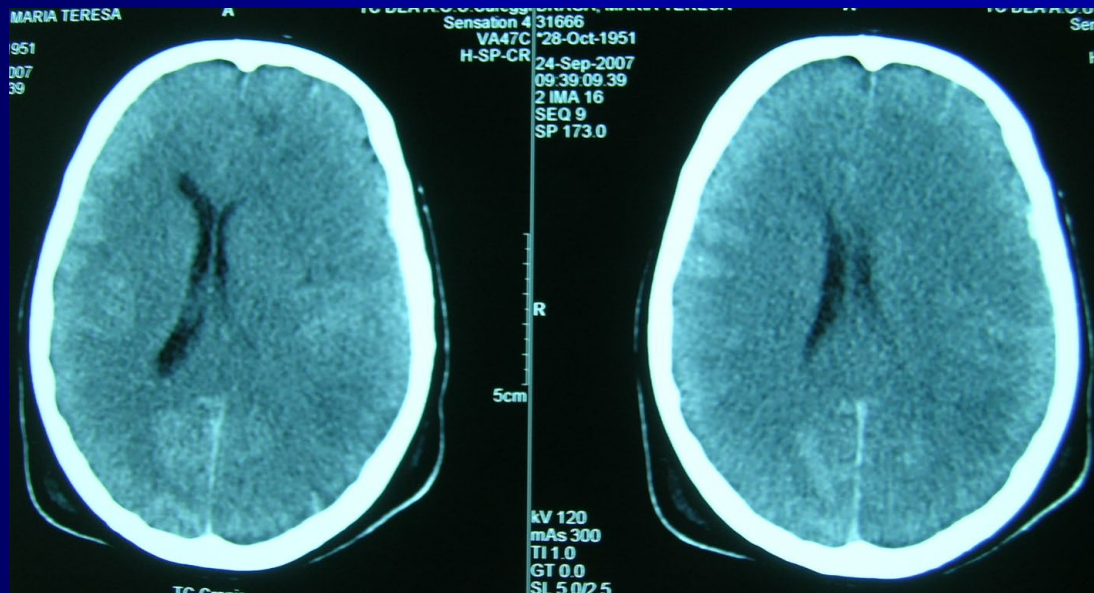


MT.R a 53

ESA - embolizzazione an. a.c.m. Sn

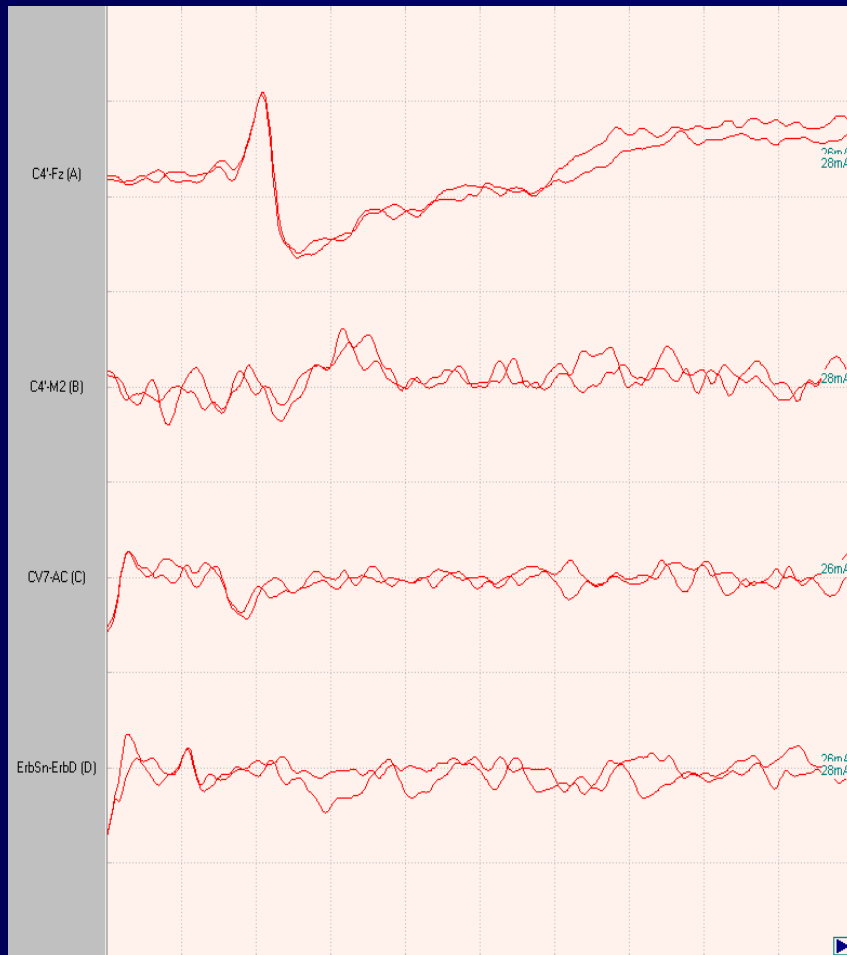
edema diffuso + emisfero Sn

10°g GCS=5, propofol 3mg/Kg/h

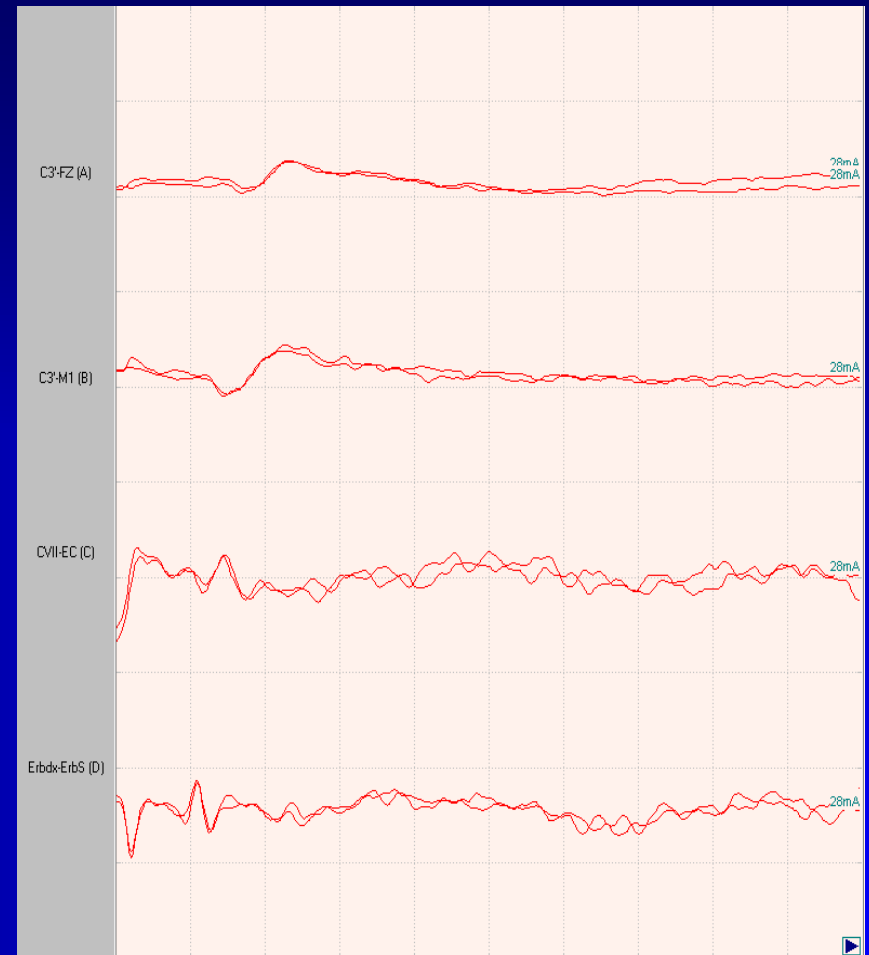


10°g

## PES emisfero Dx



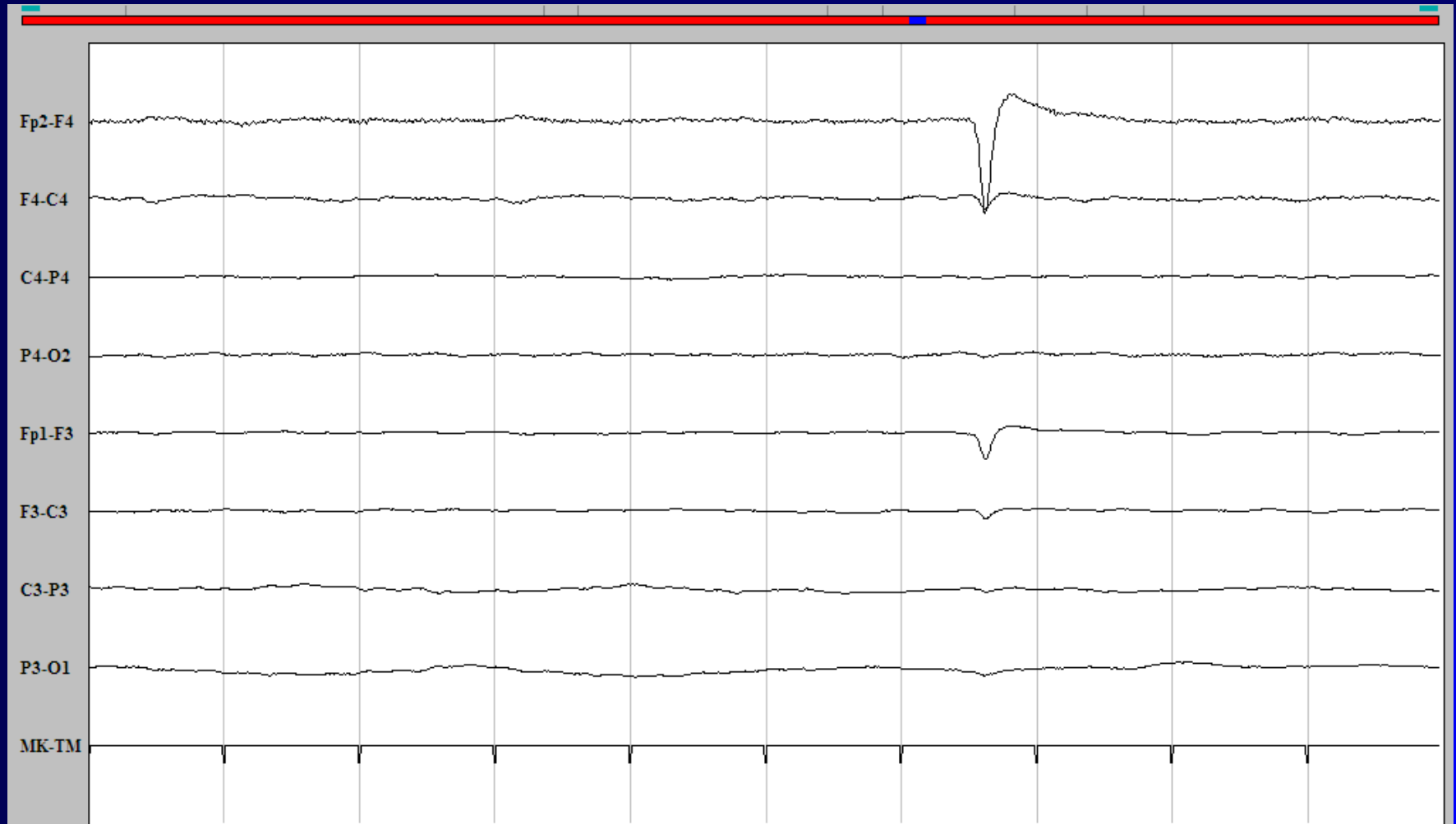
## PES emisfero Sn



15°g

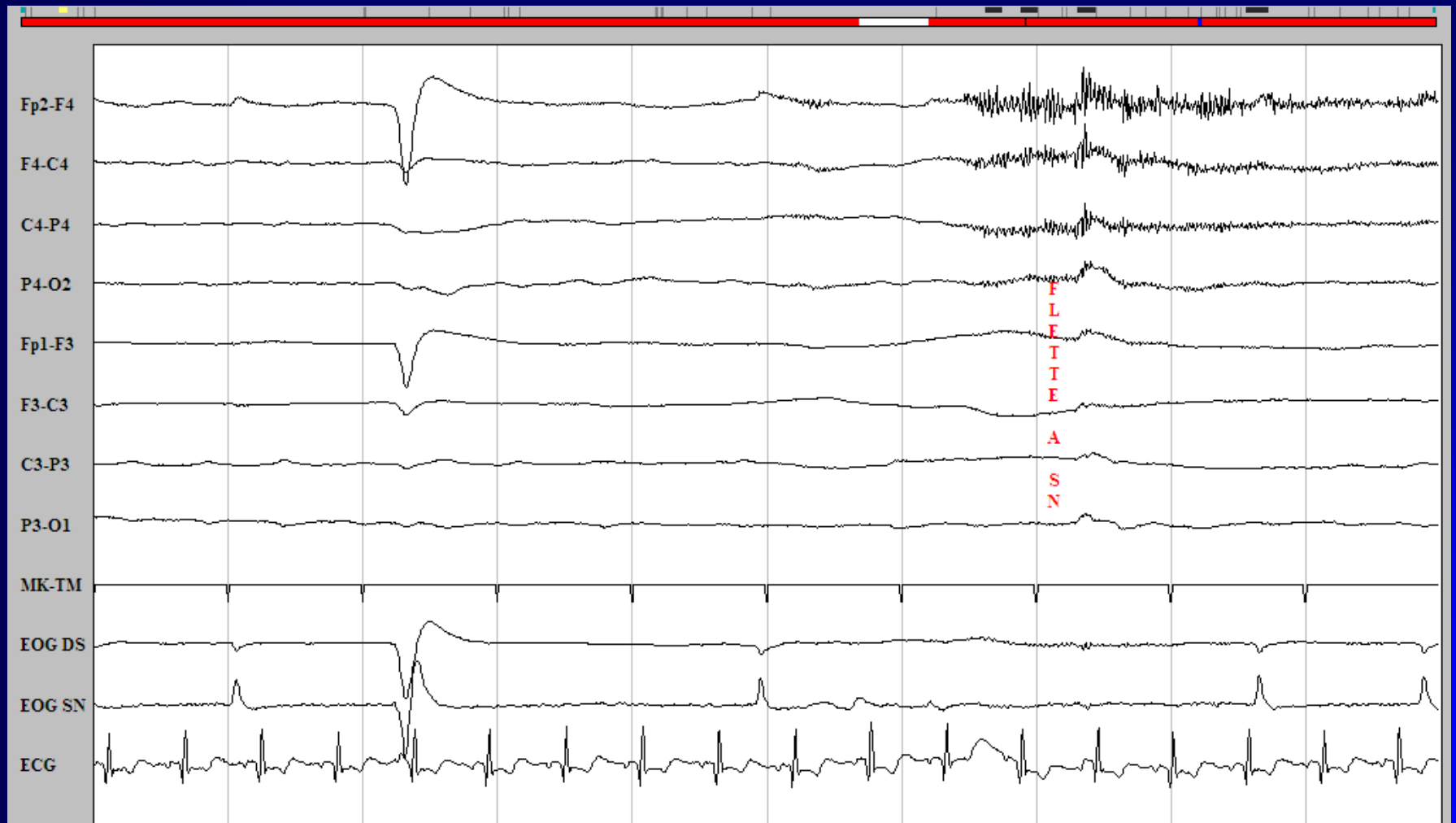
GCS=8 (M3,E4, V1)

EEG



15°g

# EEG





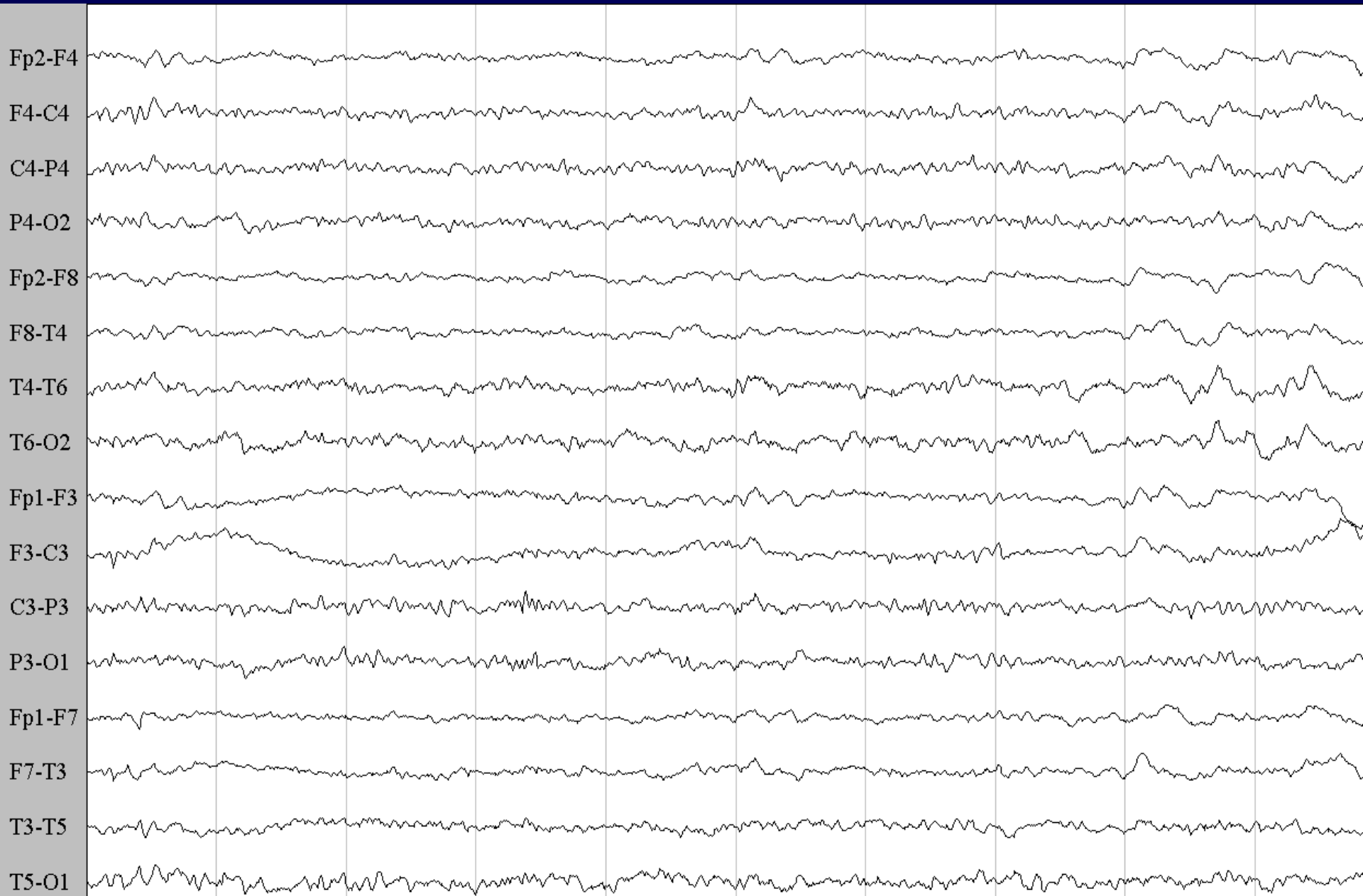
J.N., M, 56 aa

## TRAUMA CRANICO

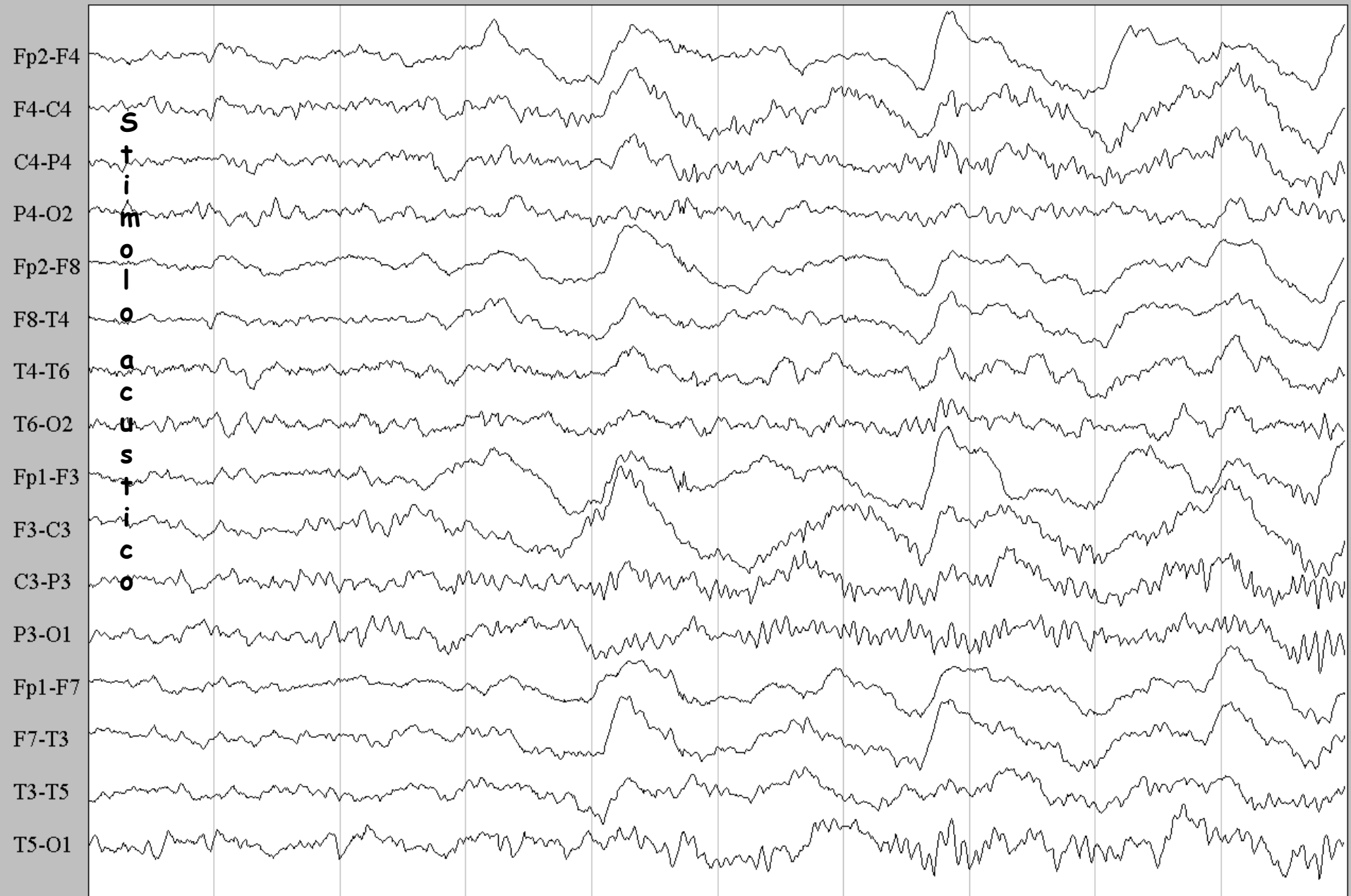
**GCS 4 all'ingresso**  
(in risposta agli stimoli dolorosi  
accenno all'estensione  
dell'arto superiore a destra)

**7° g GCS 4**  
(fotomotore presente, occhi chiusi)

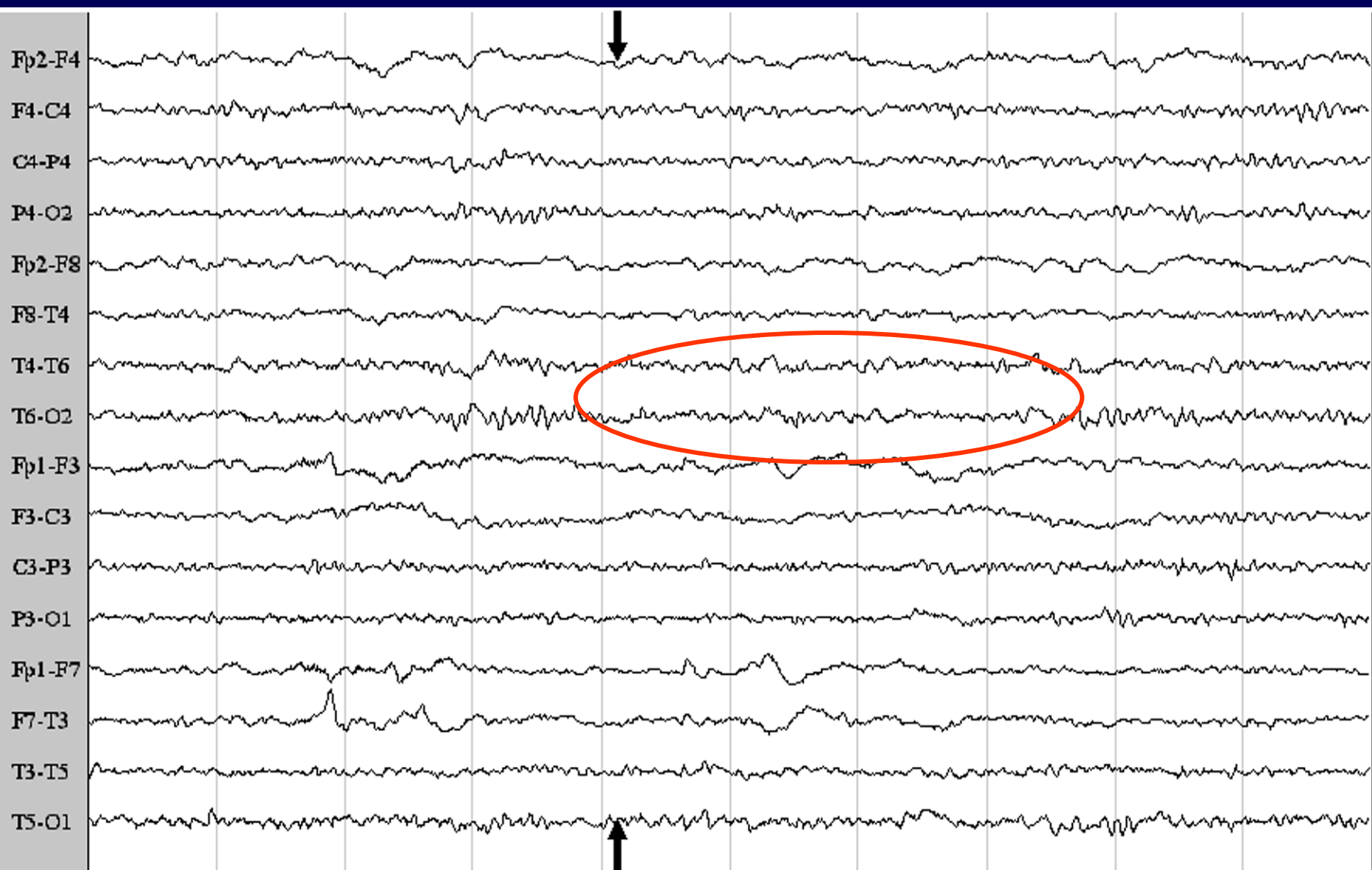
# EEG (7° g)



# EEG 7°g

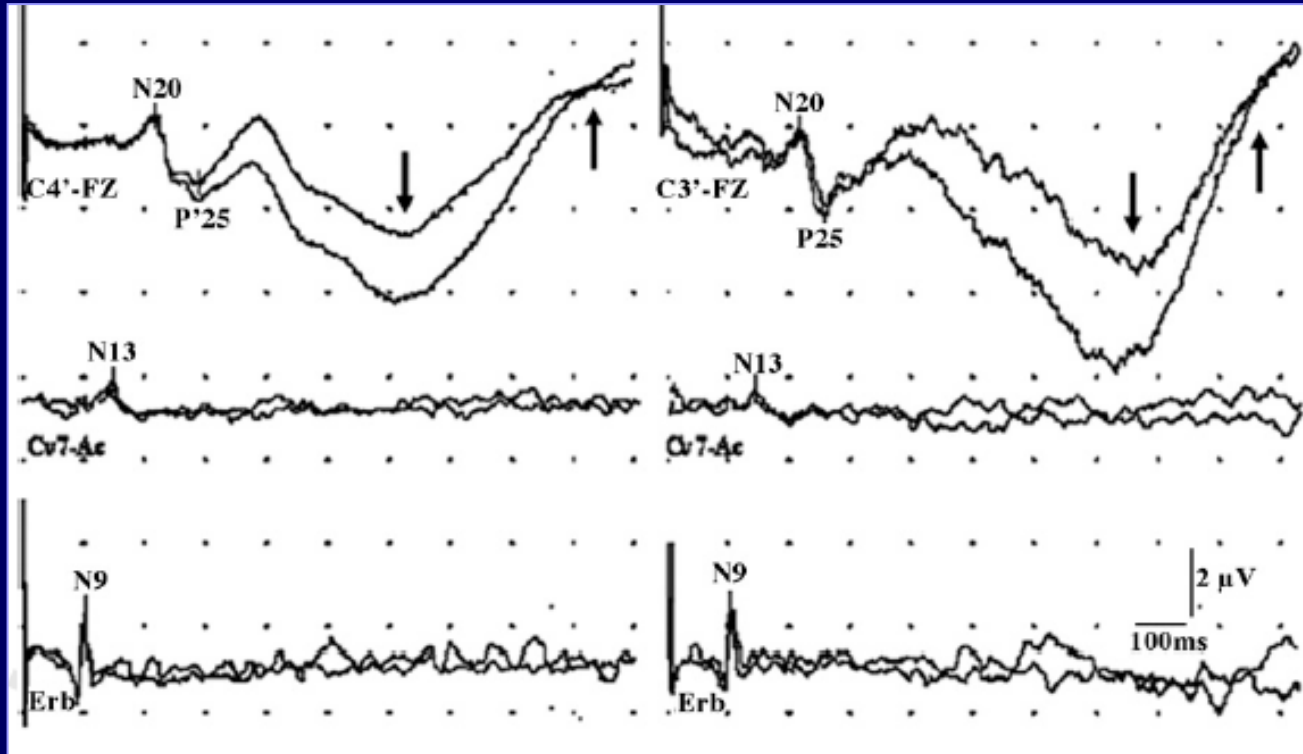


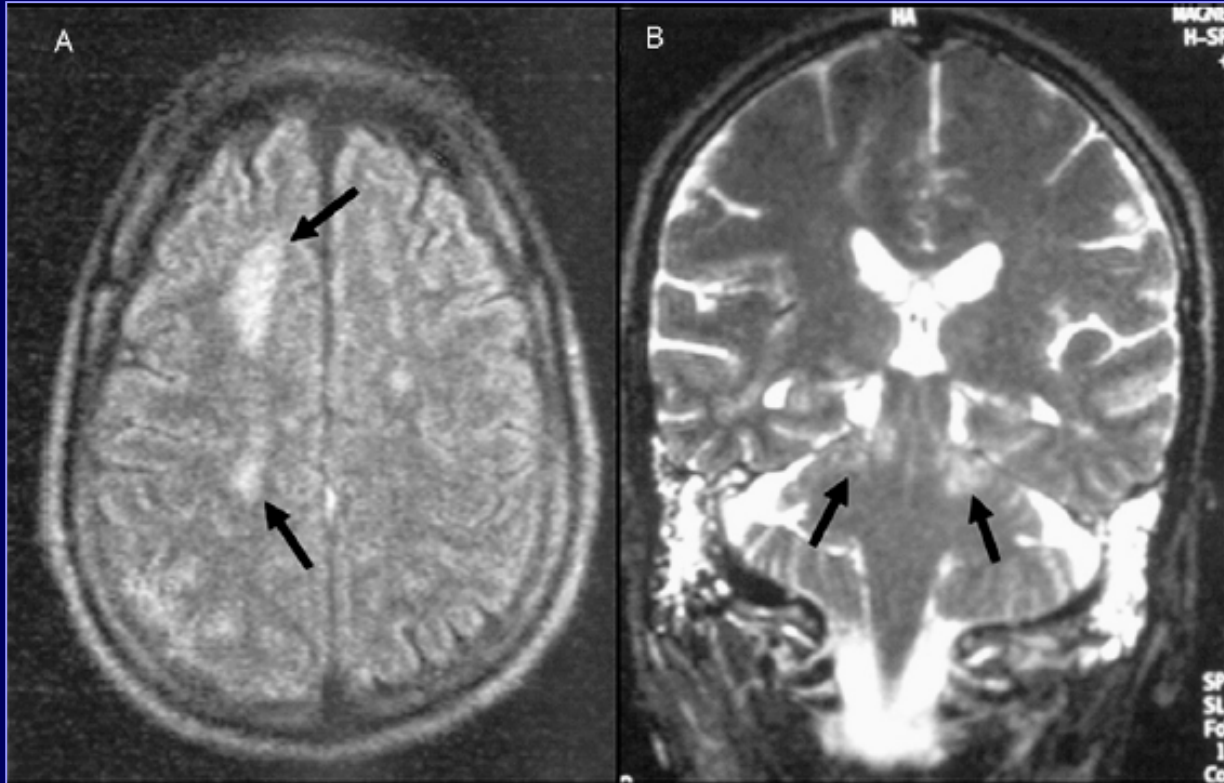
# EEG (7° g)



Apertura passiva occhi

# EEG (7° g)



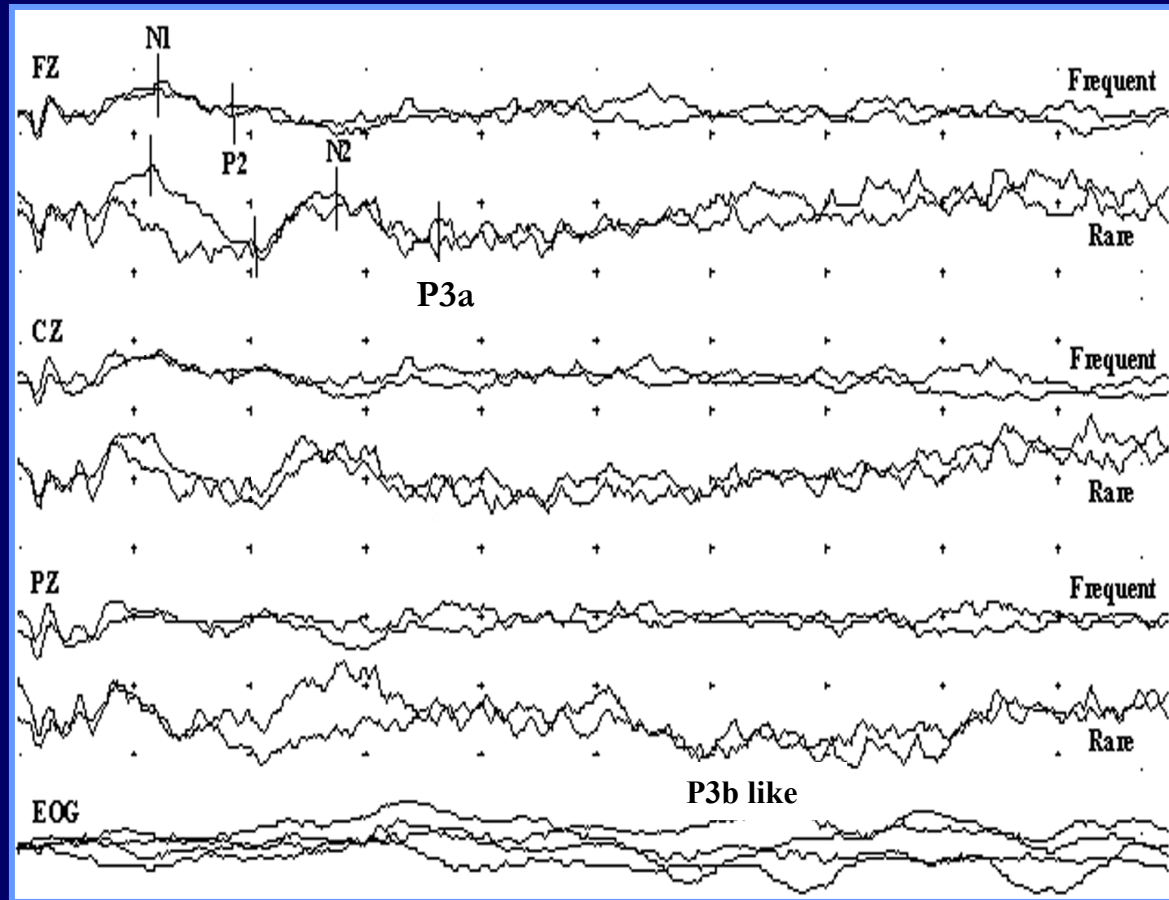


**DANNO ASSONALE DIFFUSO**

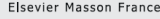

# ERPs (12° g)

*frequenti*

*rari*



Neurophysiologie Clinique/Clinical Neurophysiology (2009) 39, 95–100

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www.sciencedirect.com www.em-consulte.com

ORIGINAL ARTICLE / ARTICLE ORIGINAL

**Transient post-traumatic locked-in syndrome: A case report and a literature review**

**À propos d'un cas de syndrome de dé-efférentation post-traumatique réversible. Revue de la littérature**

R. Carrai<sup>a,\*</sup>, A. Grippo<sup>a,c</sup>, S. Fossi<sup>a</sup>, M.C. Campolo<sup>d</sup>, G. Lanzo<sup>a</sup>, F. Pinto<sup>a</sup>, A. Amantini<sup>a</sup>

***“Recent studies have shown that medical carers did not recognise signs of consciousness during the first weeks in more than half of patients with locked-in syndrome”***  
***(Laureys, 2005)***

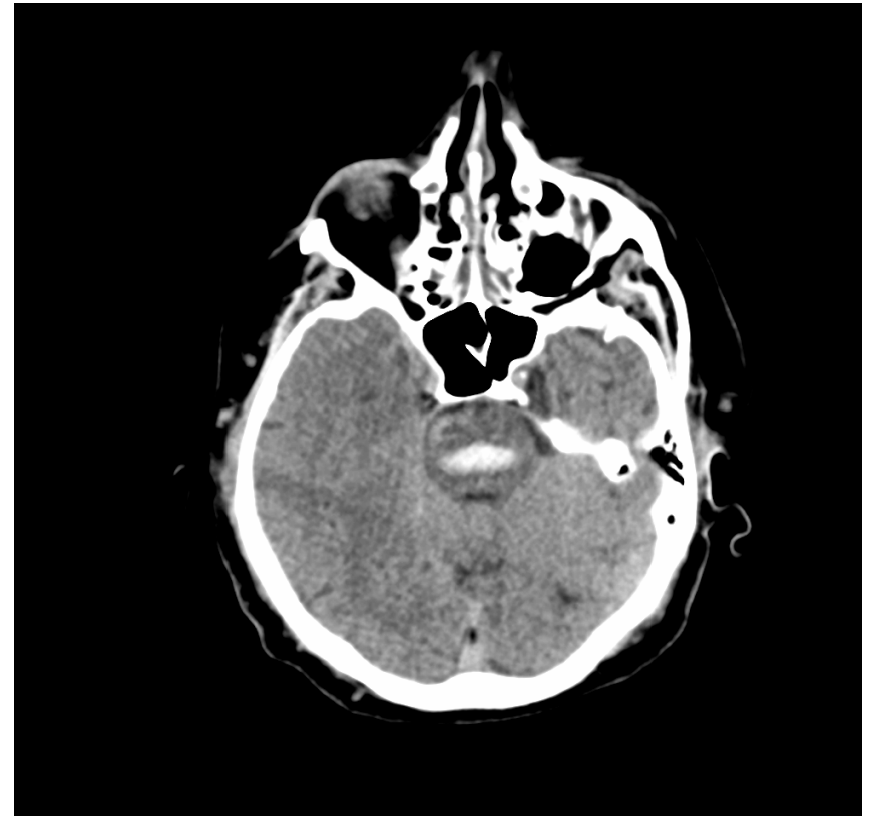
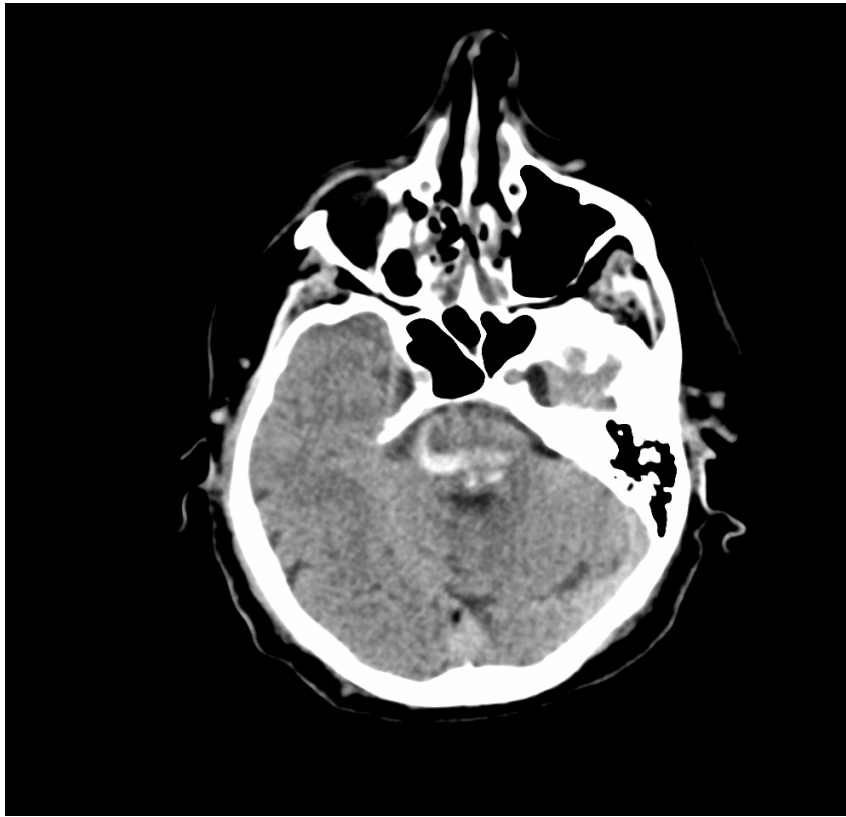




G.G. a. 67

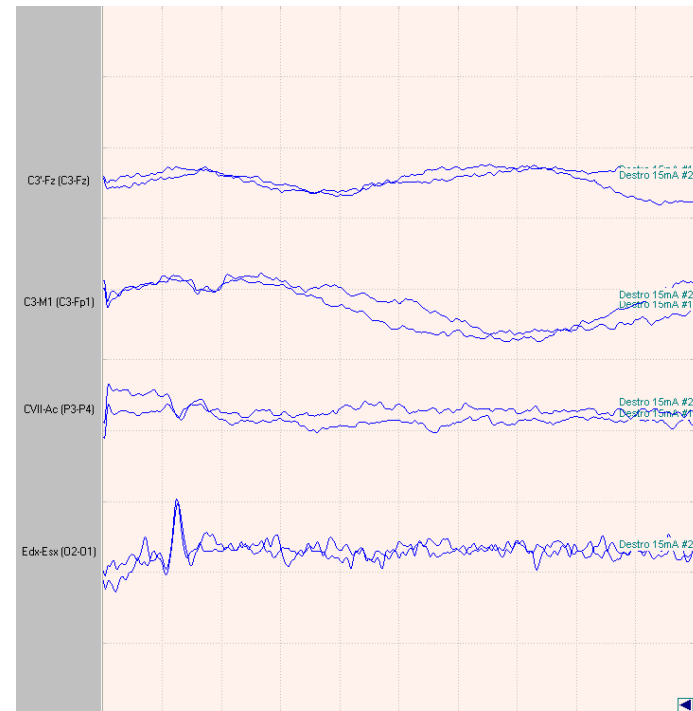
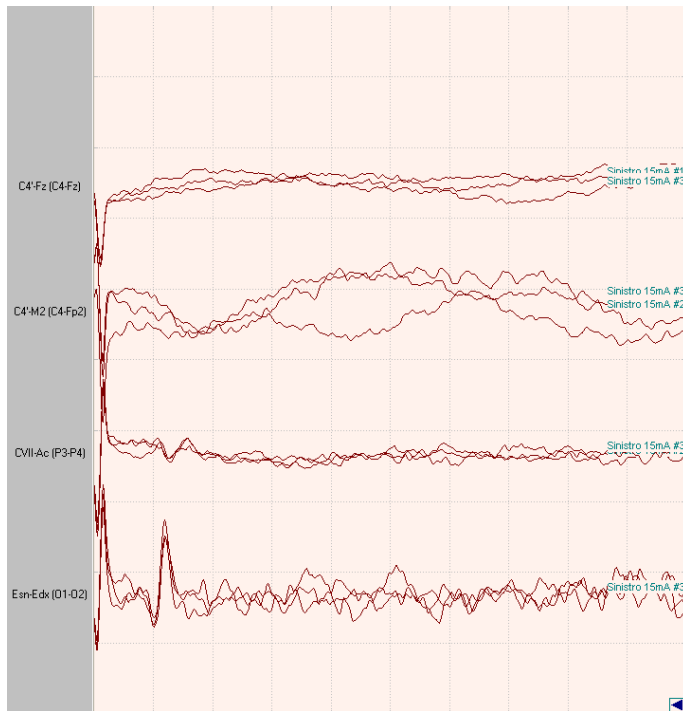
# TC 29/10 Emorragia ponto-mesencefalica

pupille miotiche isocoriche, GCS=3, sedato - propofol 2mg/Kg/h



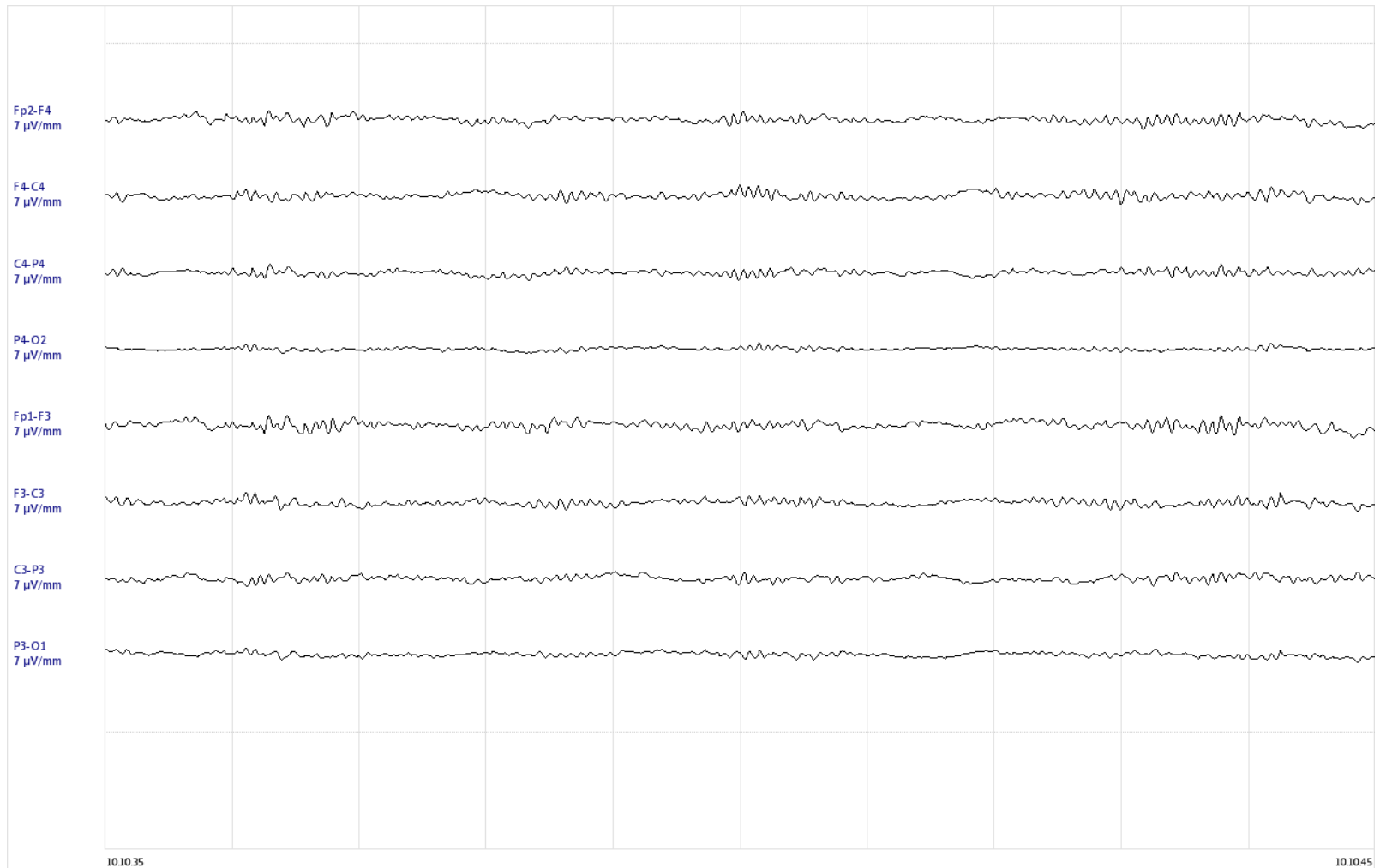
# PES 29/10

pupille miotiche isocoriche, GCS=3, sedato - propofol 2mg/Kg/h

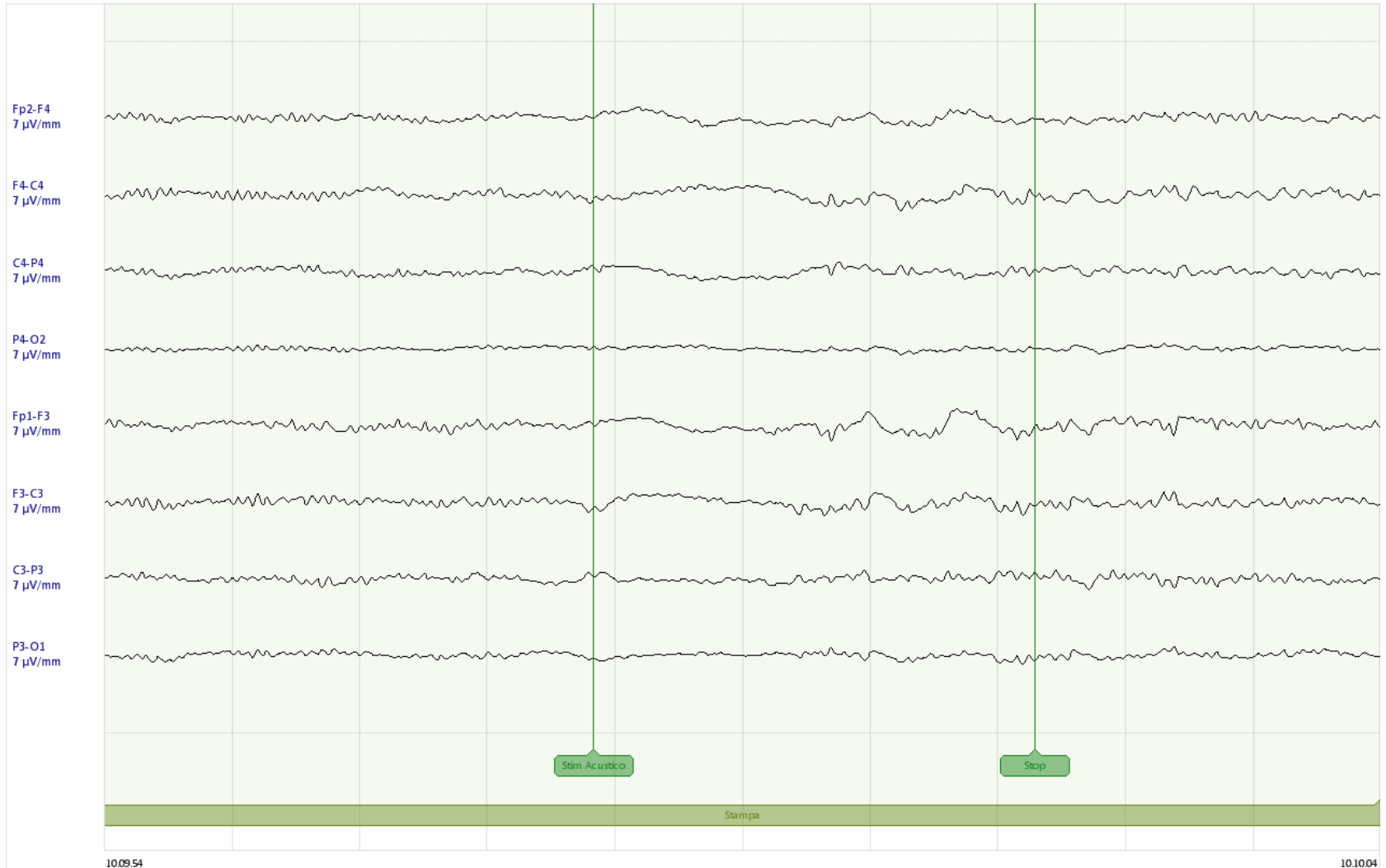


# EEG 29/10

pupille miotiche isocoriche, GCS=3, sedato - propofol 2mg/Kg/h

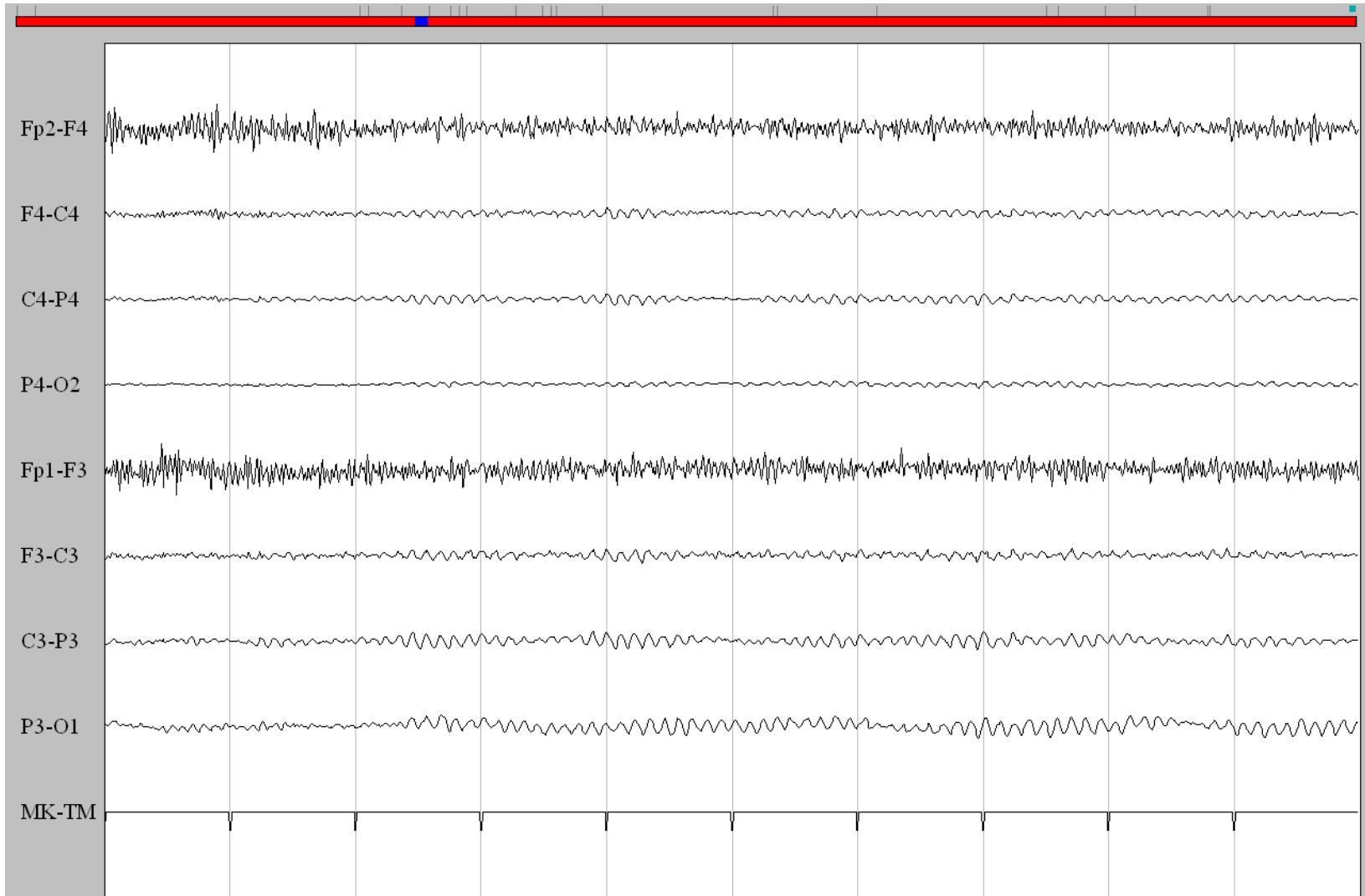


# EEG 29/10

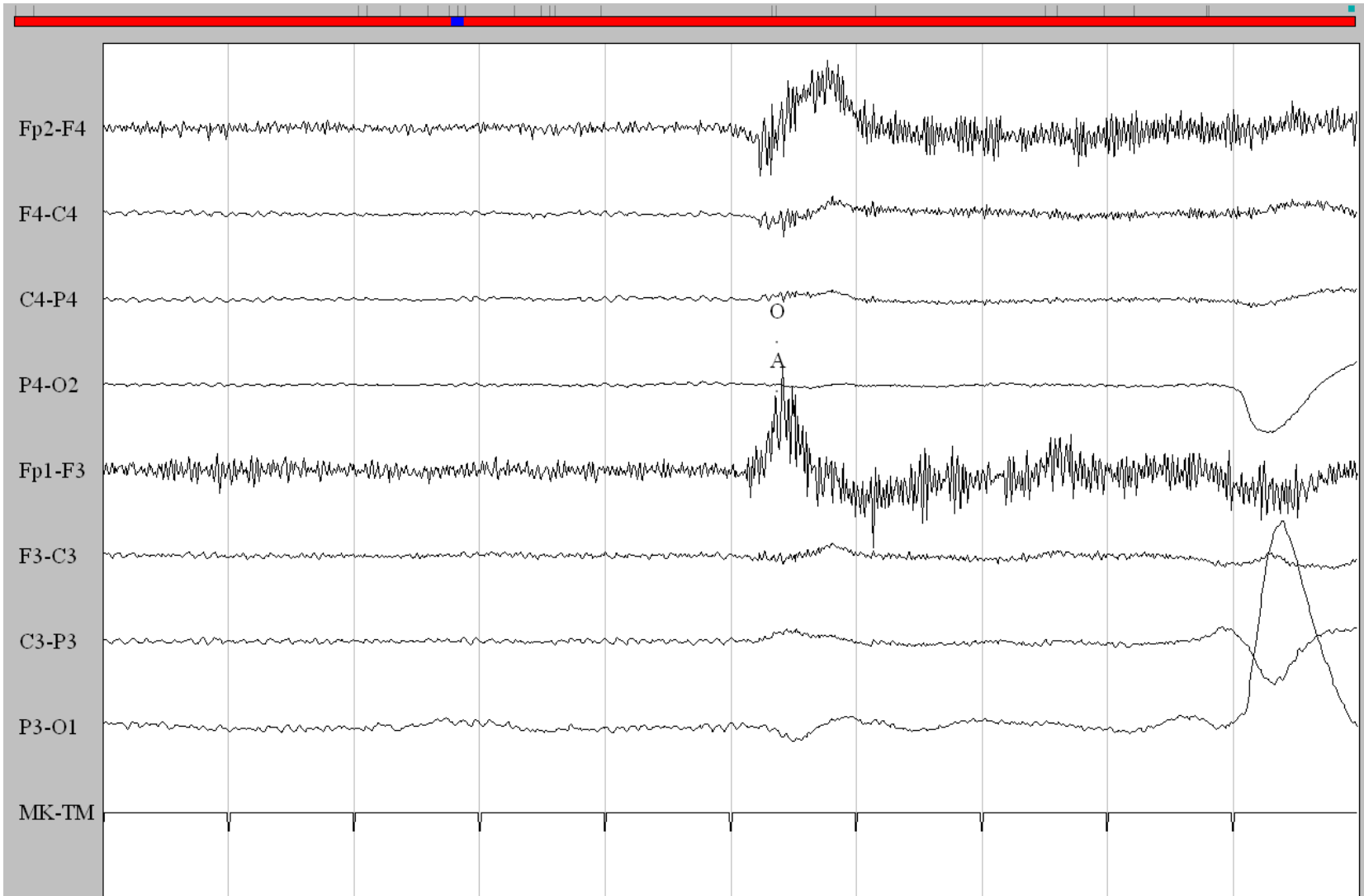


# 31/10

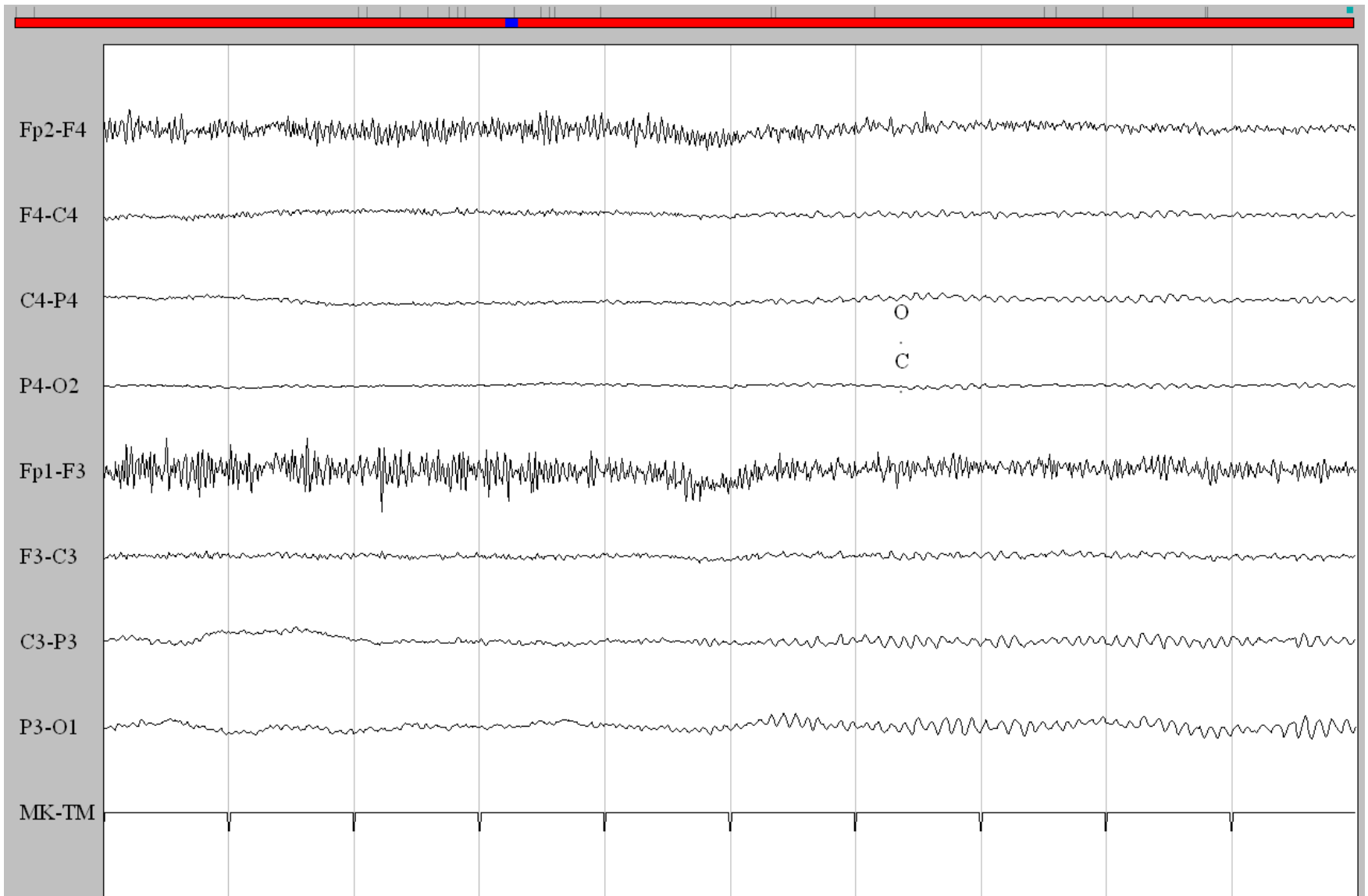
sedazione sospesa da 12 h.



# Apertura passiva OO

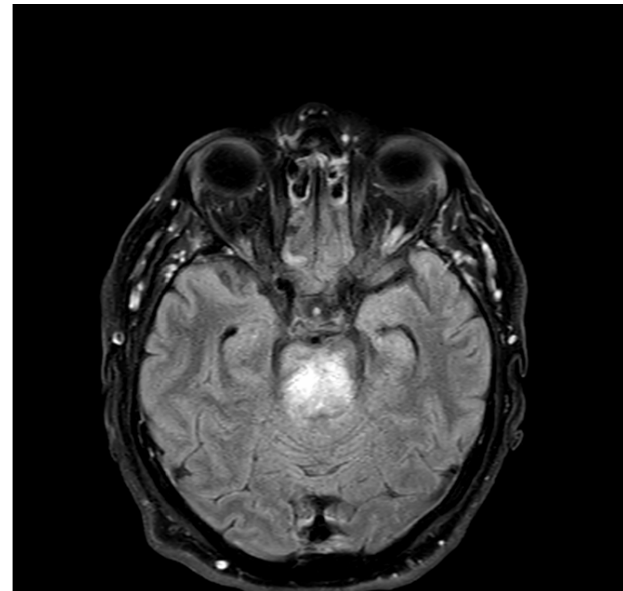
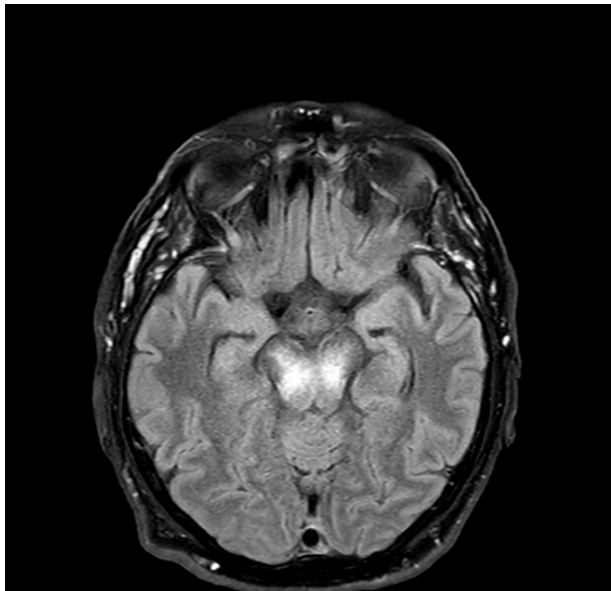
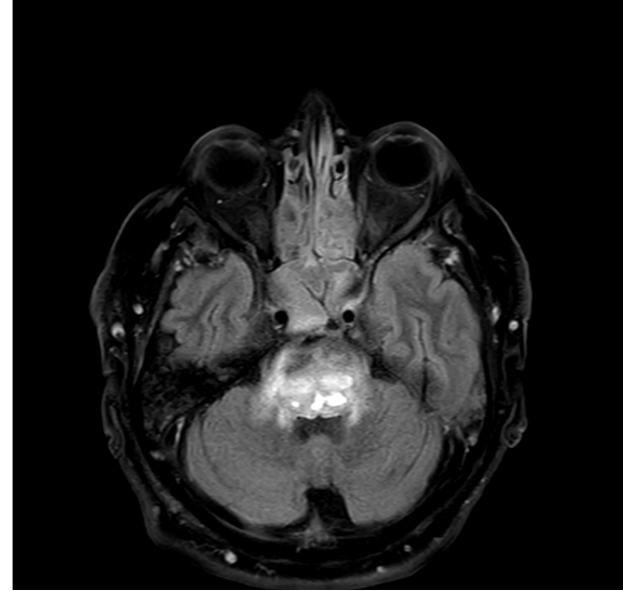


# Chiusura passiva OO





# RMN 31/10



# ABI traumatico e vascolare

Deterioramento rostro-caudale

*versus*

danno elettivamente o prevalentemente  
troncoencefalico

# CONCLUSIONI

## Indicatori prognostici neurofisiologici in fase precoce



Specificità/alto valore predittivo per prognosi sfavorevole:

a breve termine - deterioramento verso ME

a lungo termine - recupero stato di coscienza

Specificità/alto valore predittivo per prognosi favorevole

Contributo a stabilire l'effettivo stato di coscienza  
oltre l'evidenza clinica

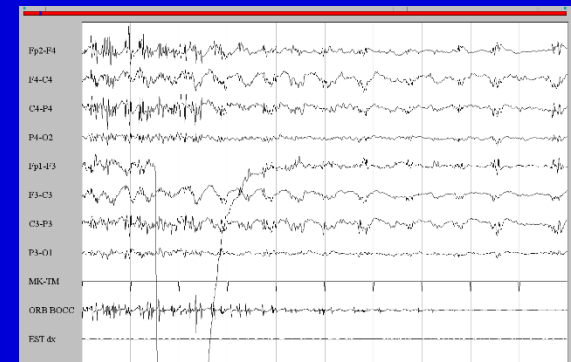
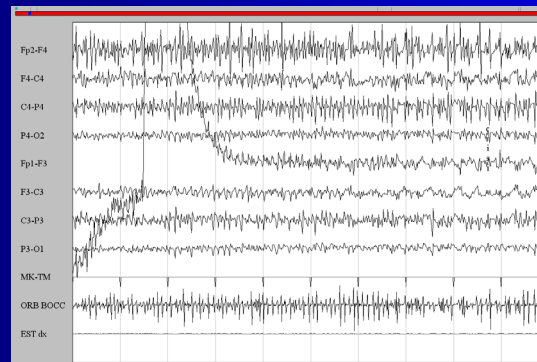
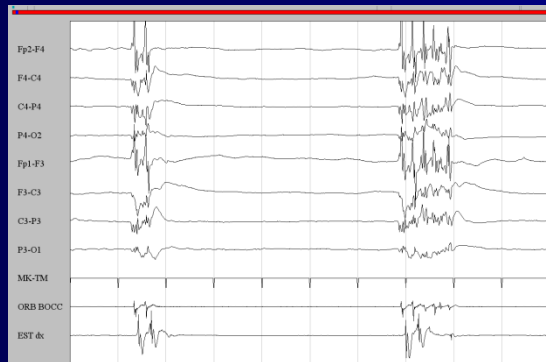
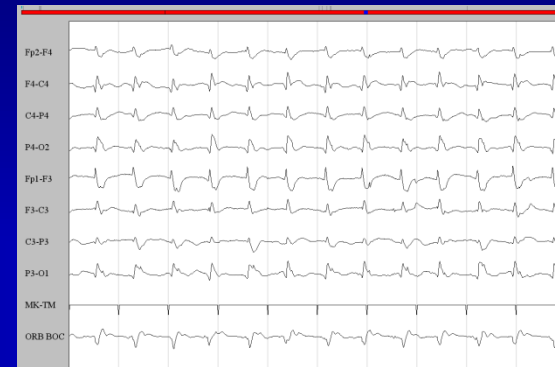
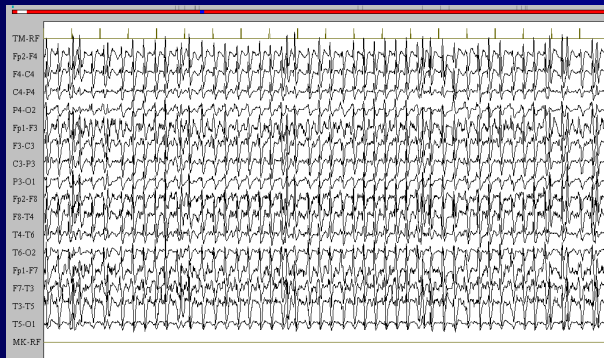
**(evitare errori prognostici falsamente pessimistici)**





# STATO EPILETTICO POST-ANOSSICO

( trattamento delle crisi convulsive, mioclono e SE non convulsivo)



# Trattamento crisi, stato epilettico e mioclono

- LPDs e GPDs da sole non ritenute stato epilettico
- Rimane aperto se definire SENC e trattare GPDs con frequenza maggiore di 2-2.5 c/s....
- Le crisi, lo stato epilettico convulsivo e non convulsivo (se presenti i criteri EEG di pattern critico)
- Il mioclono solo se associato a GPEDs



## SCHEDA VALUTAZIONE COMA POST-ANOSSICO

Sig... **BP** .....Data nascita...

...Età... **80** ..Sesso M....

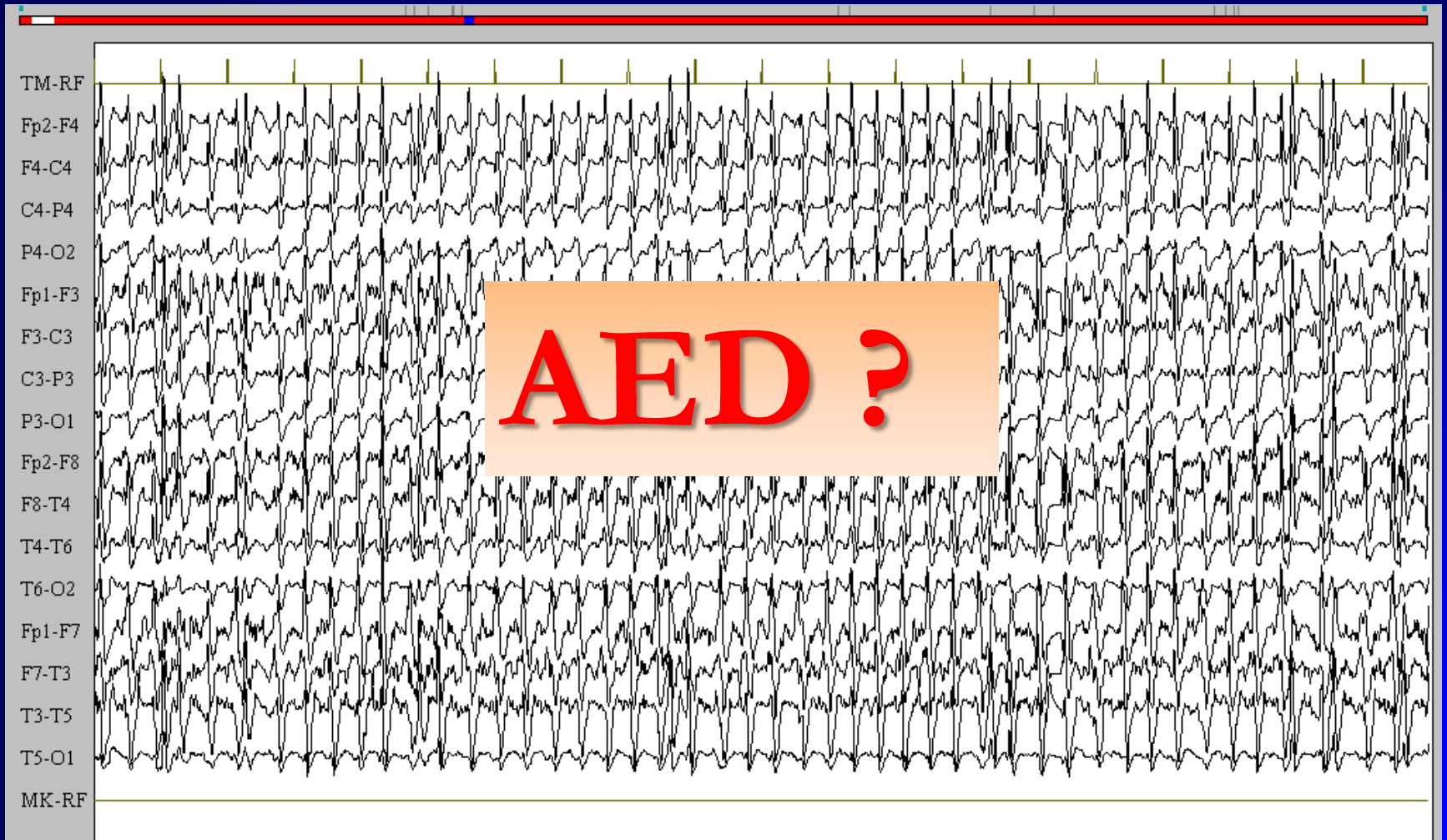
Reparto: **UTIC**

TIPO	DATI			
DATA ACR	15-03-2013			
Ora ACR	9.00			
LUOGO ACR				<b>EXTRAOSPEDALIERO</b>
CAUSA ACR	TRAUMA	ACIDOSI	<b>ALTRO</b>	
			<b>X</b>	
RITMO ESORDIO	FV/TV	ASISTOL	PEA(Pulseless Electrical Activity)	
	<b>X</b>			
DURATA ARRESTO	45'			
TEMPO STIMATO ROS	45'			
GCS INGRESSO 118/PS	E1	V1	M2	Tot: 4
GCS INGRESSO ICU	E1	V1	M2	Tot: 4
Pupille		Diametro Reattività	Miotiche	media midr midriatiche <b>SI</b> <b>NO</b>
Episodi ipossia peri - arresto	SI	<b>NO</b>		
Episodi ipotensione Protratta (>30')	SI	<b>NO</b>		
INIZIO IPOT DA ACR (ore)	3 h			
DURATA IPOTERMIA (ore)	24 h			



# STATO EPILETTICO POST-IPOSSI/ISCHEMICO

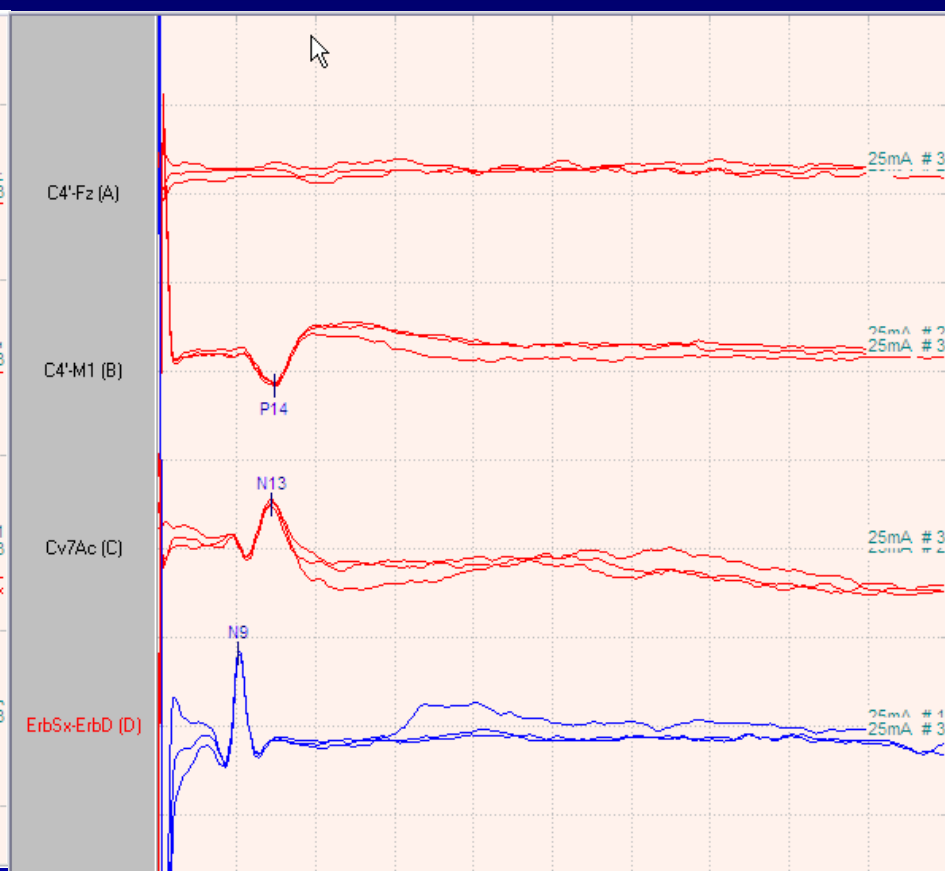
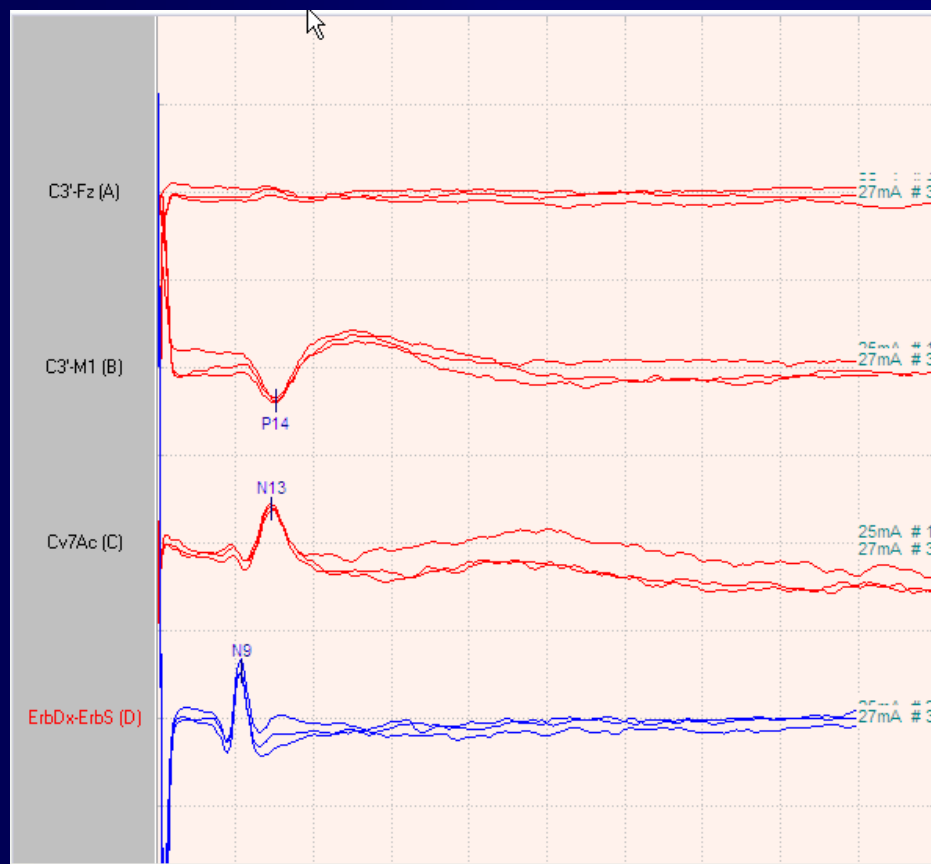
## 24 h



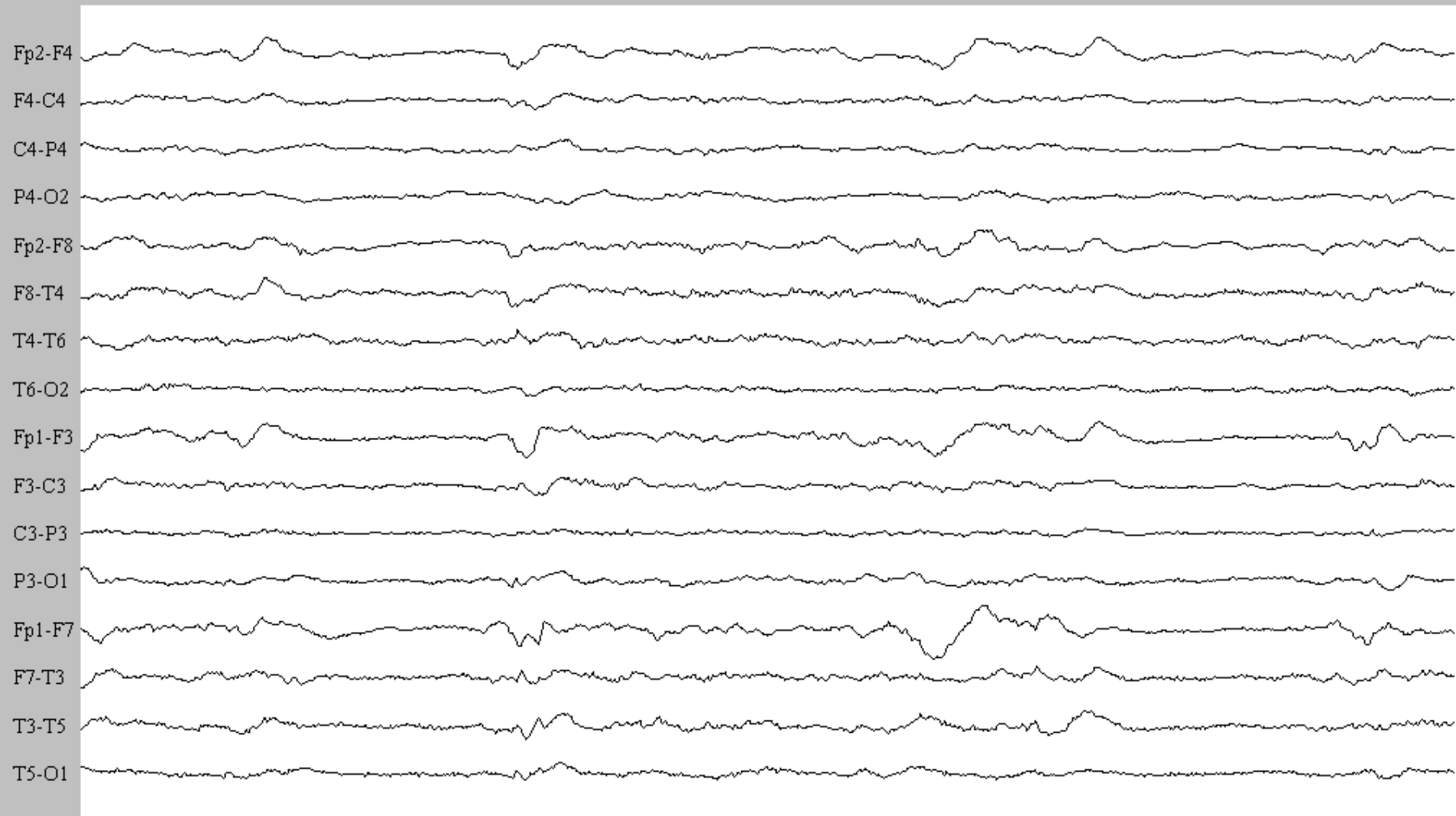
24 h

PES n. mediano Dx

PES n. mediano Sn



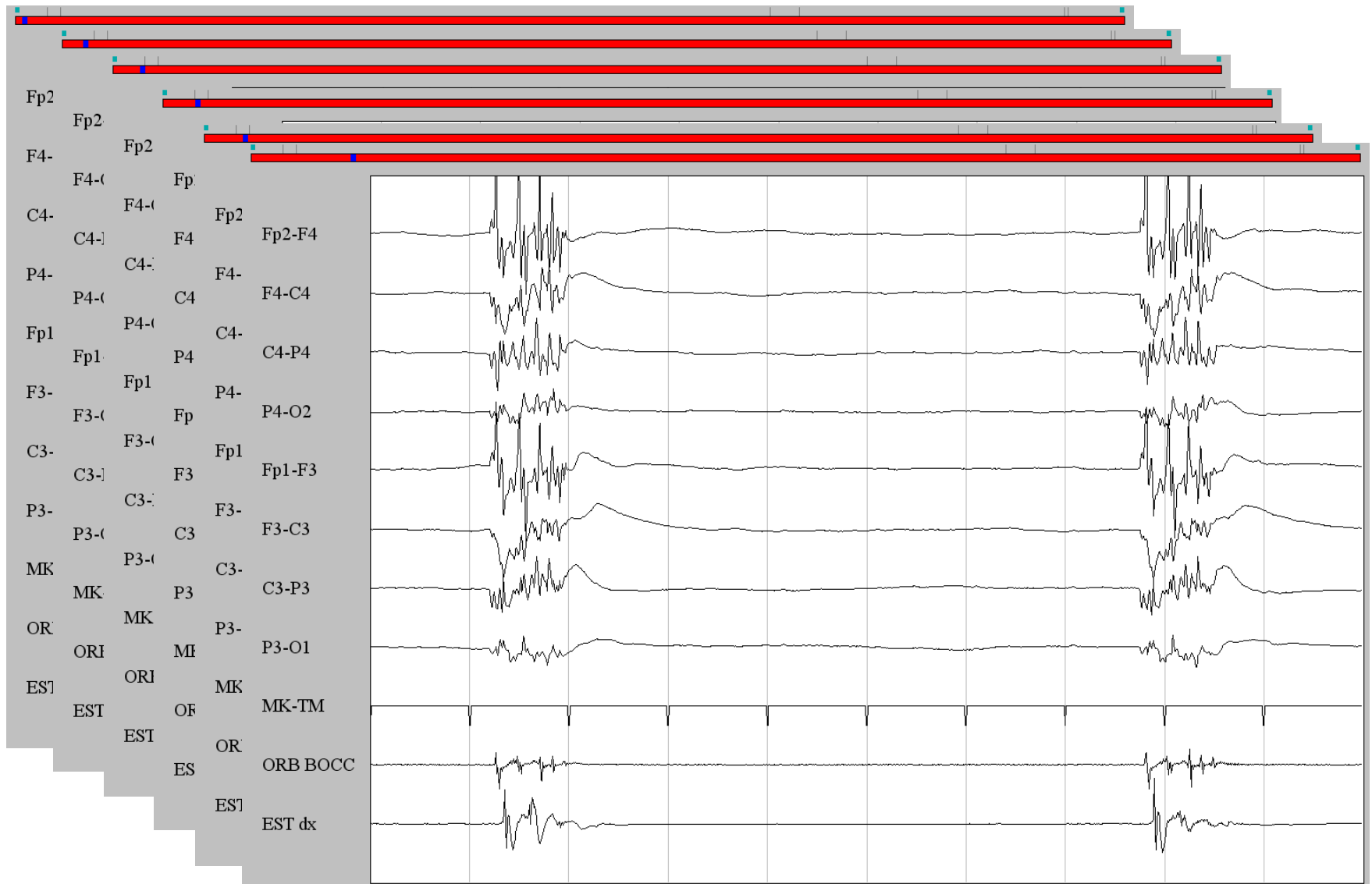
# evoluzione (48 h)



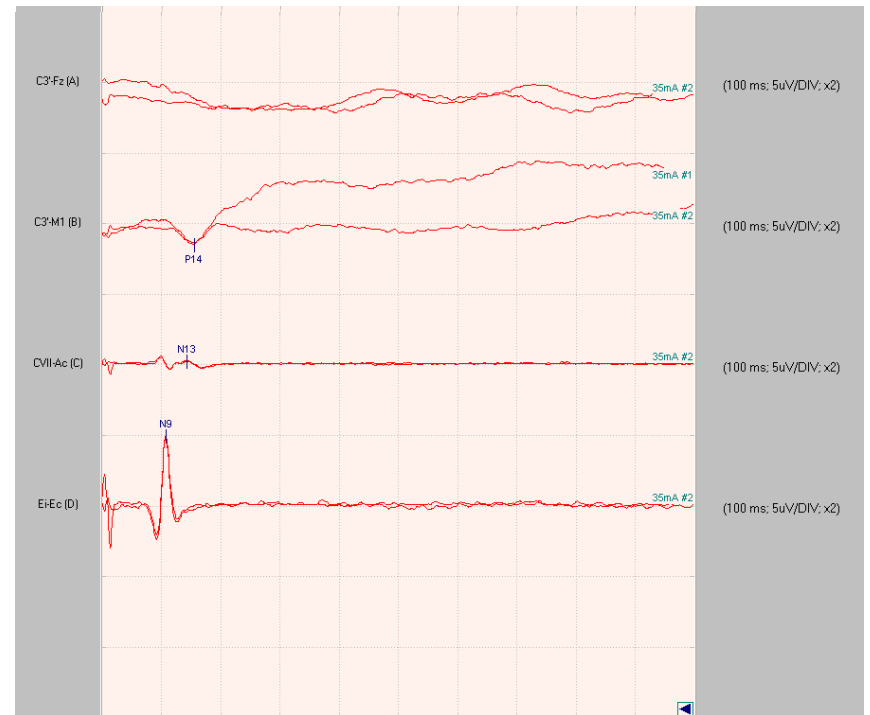
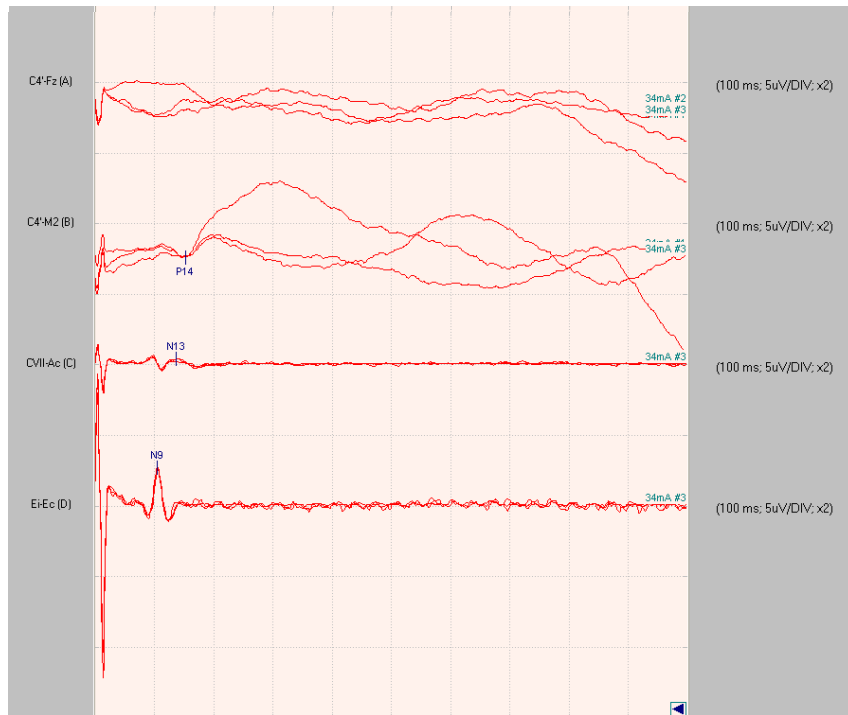
# evoluzione (4°g.)

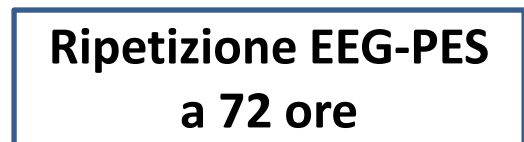
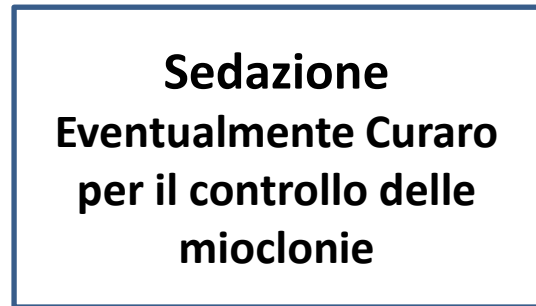
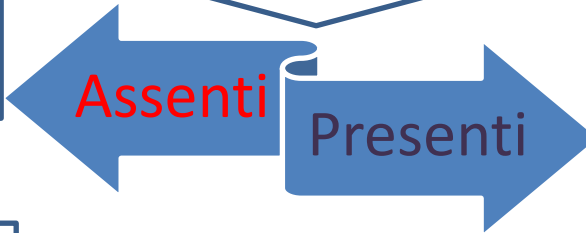


# 25/11 14h



# PES 25/11/13





Sig...LP.....Data nascita 07-06-1962.....Età...48.....Sesso: M

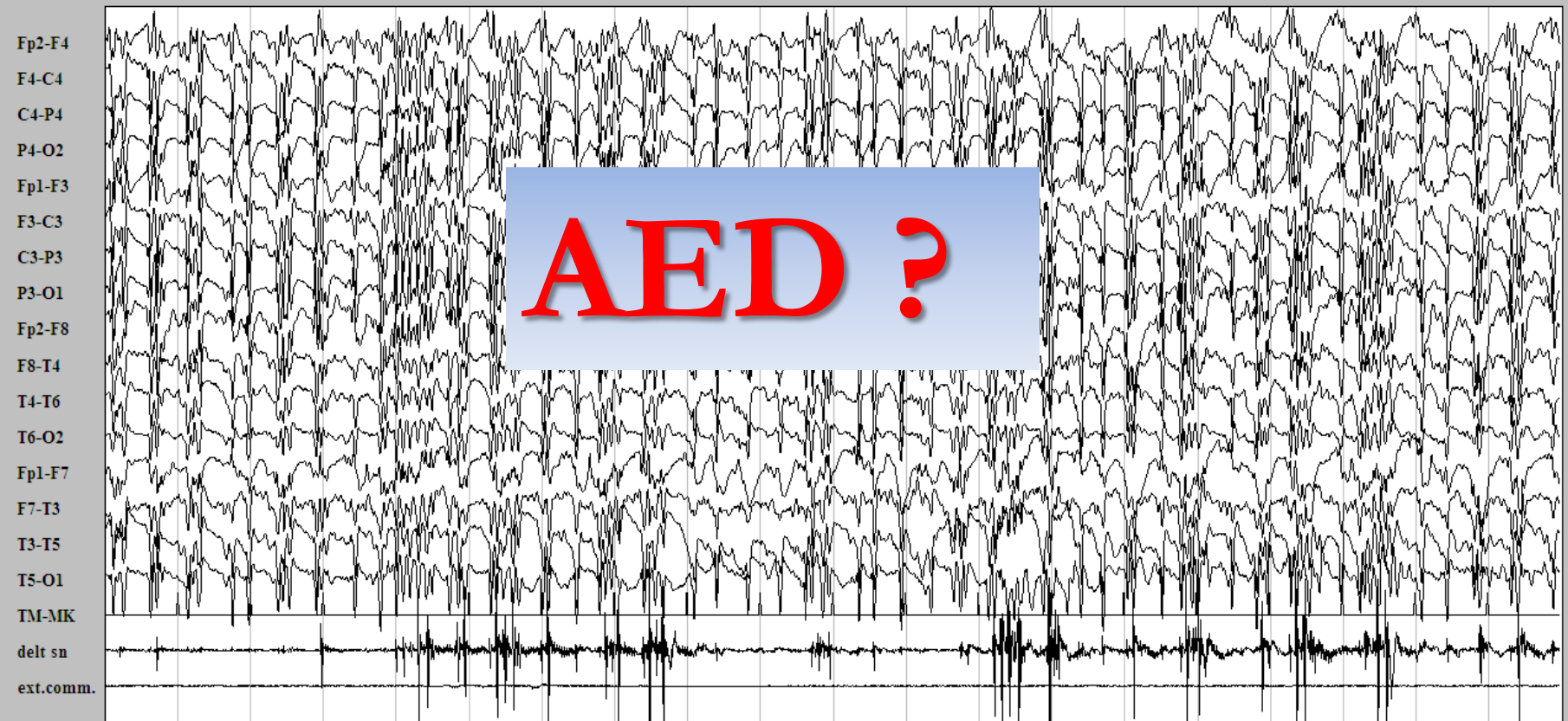


## Scheda Valutazione Coma Post-Anossico

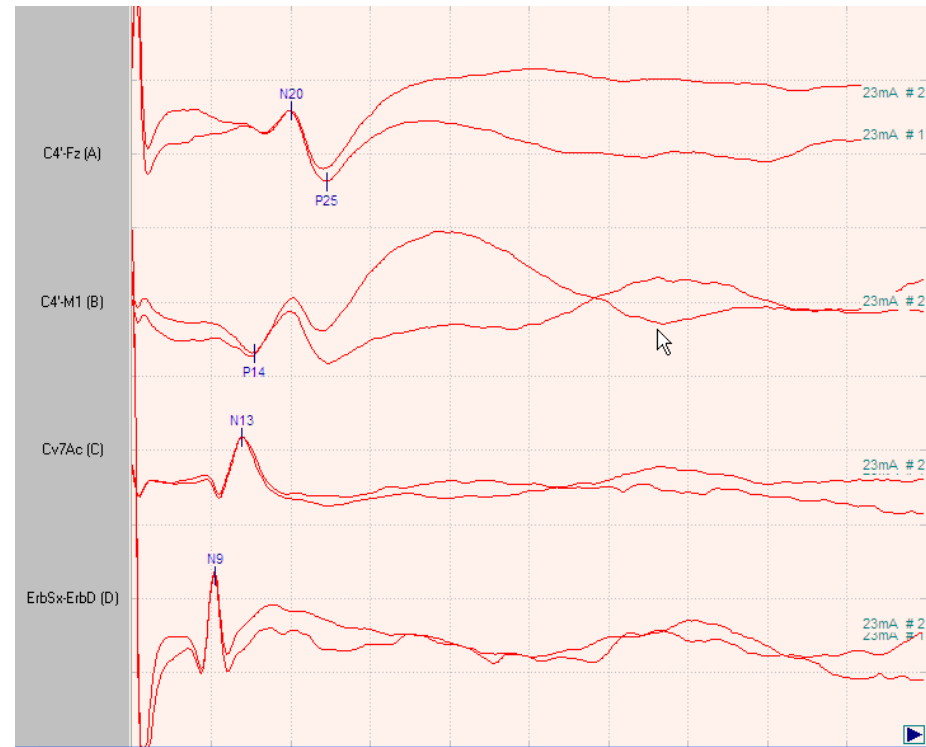
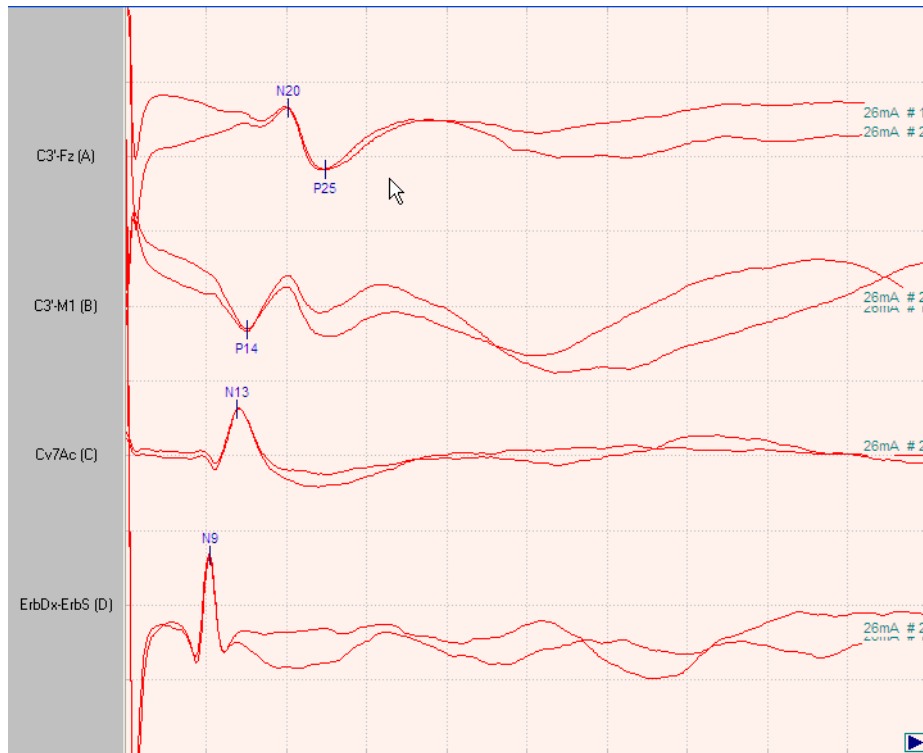
TIPO	DATI				
DATA ACR	14-11-2010	Ora ACR	17.00		
LUOGO ACR			EXTRAOSP		
CAUSA ACR	TRAUMA	ACIDOSI	ALTRO		
			X		
RITMO ESORDIO	FV/TV	ASISTOLIA	Pulseless Electrical Activity		
	X				
DURATA ARRESTO	10	TEMPO STIMATO ROS	25'		
GCS INGRESSO 118/PS	E=1	V=1	M=1	Tot:3	
GCS INGRESSO ICU	E=1	V=1	M=2	Tot:3	
Pupille		Diametro	X Miotiche	media midr	midriatiche
		Reattività	SI	NO	
INIZIO IPOT DA ACR (ore)					
DURATA IPOTERMIA (ore)	24				

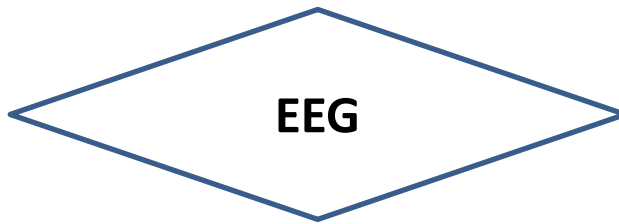


# LR - 16.11.2010 (2°gg)

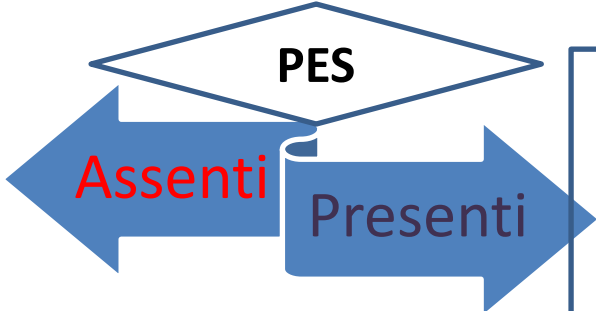


# LR - 16.11.2010 (2°gg)





Attività epilettiforme continua associata o meno a stato mioclonico



Sedazione + AED  
Levetiracetam  
2000mg/ Bolo  
2-3000mg/24h I.V.

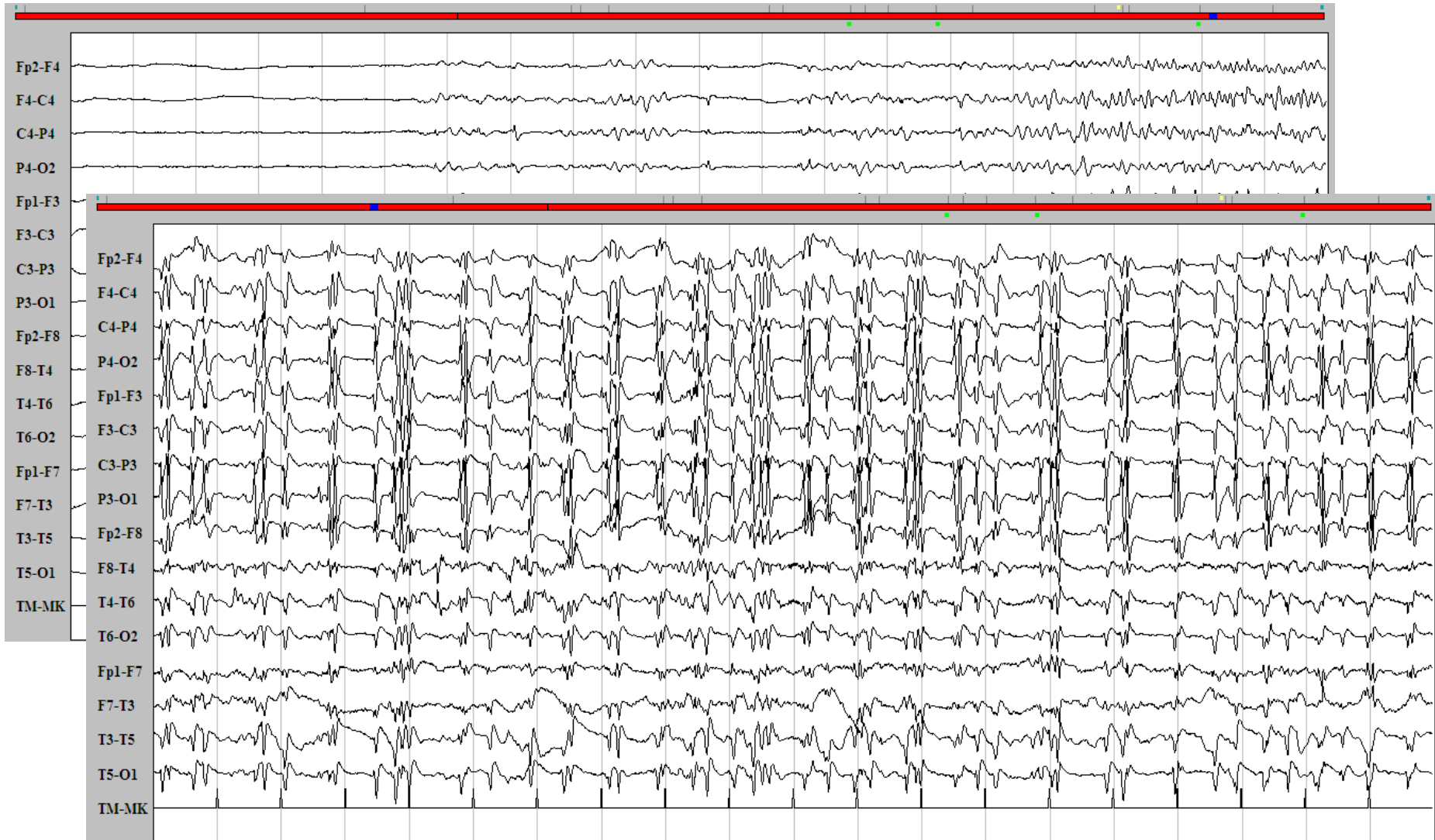
Sedazione per 24 h

No Remissione  
Mioclonie

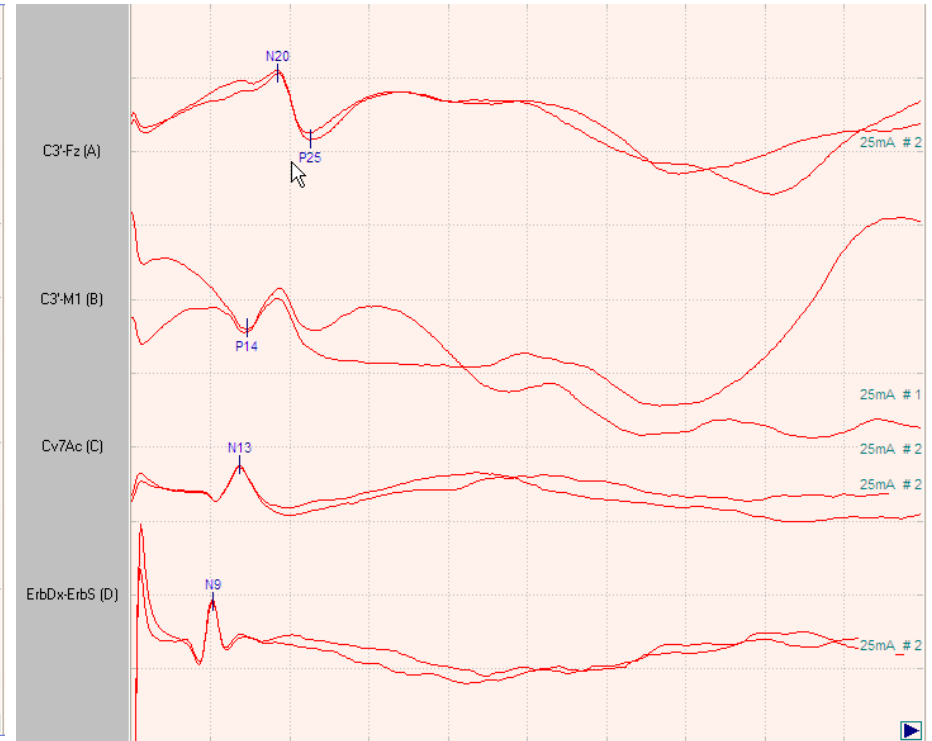
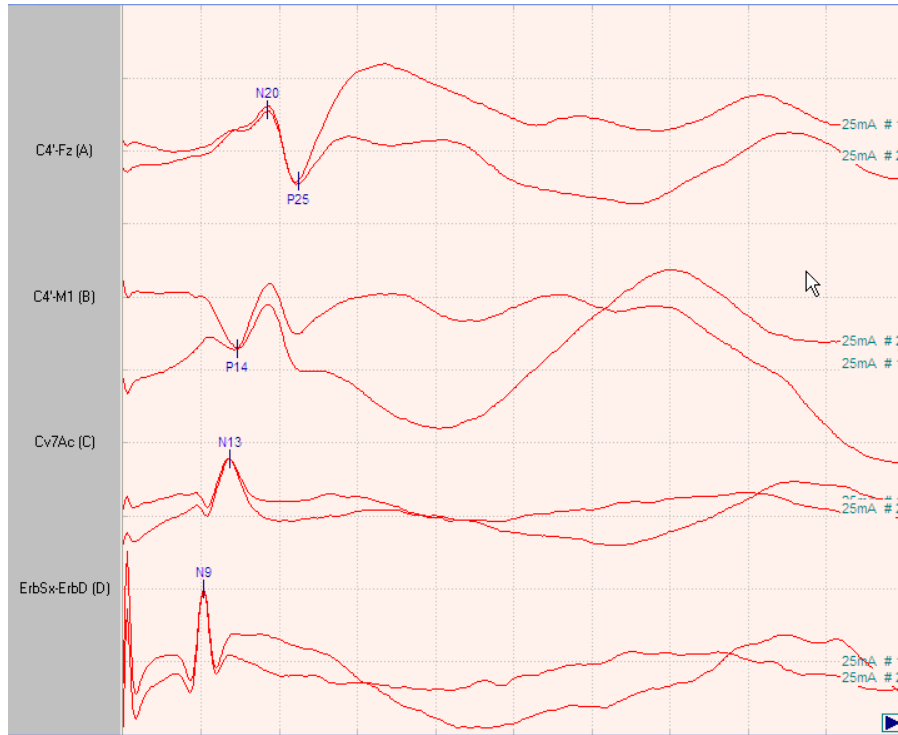
Remissione  
Mioclonie

Depakin  
30mg/Kg Bolo  
1-2mg/Kg/h I.V

# LR - 19.11.2010 (5° gg)



# LR - 19.11.2010 (5° gg)



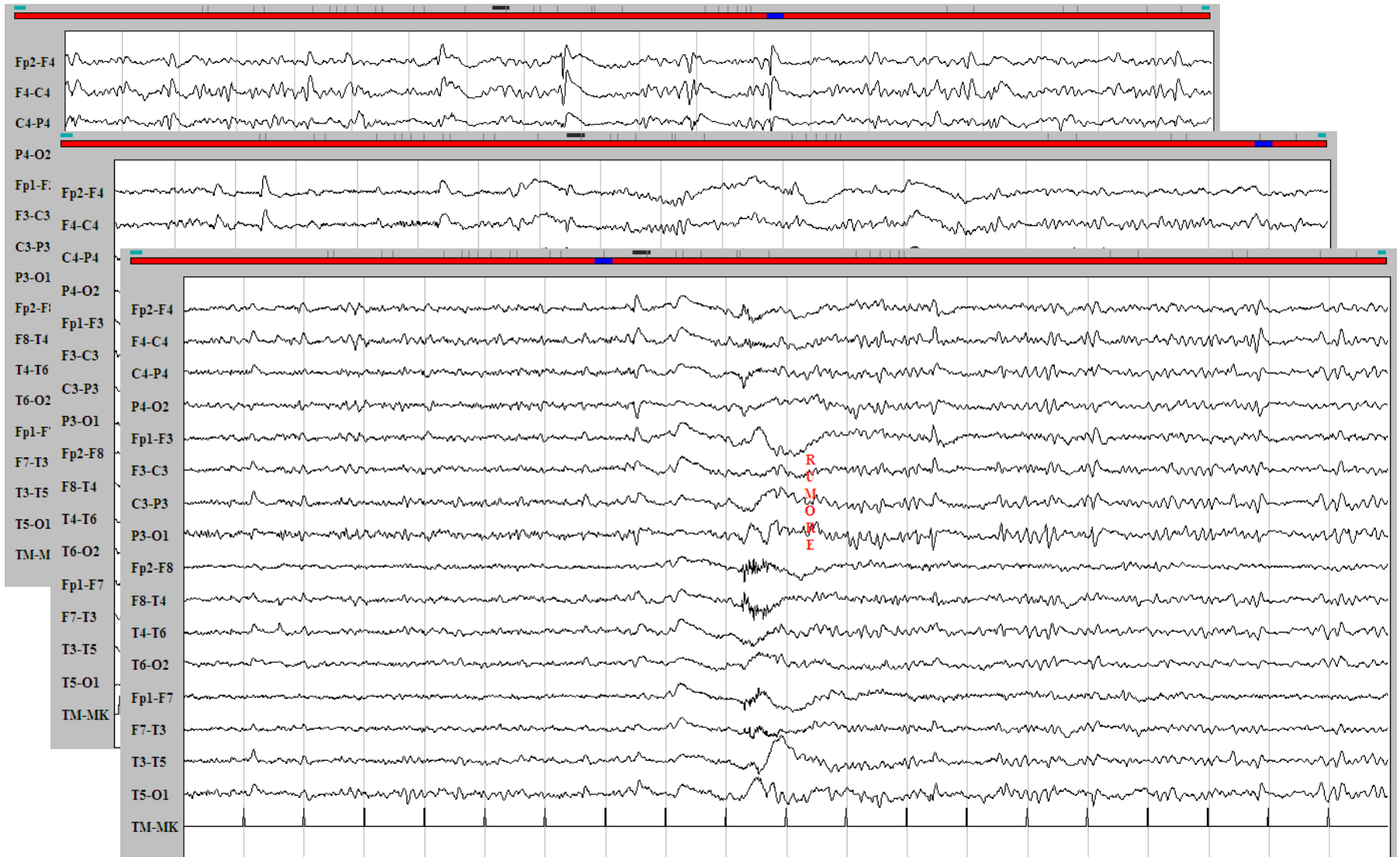
# LR - 23.11.2010 (9°gg)



# LR - 30.11.2010 (16° gg)

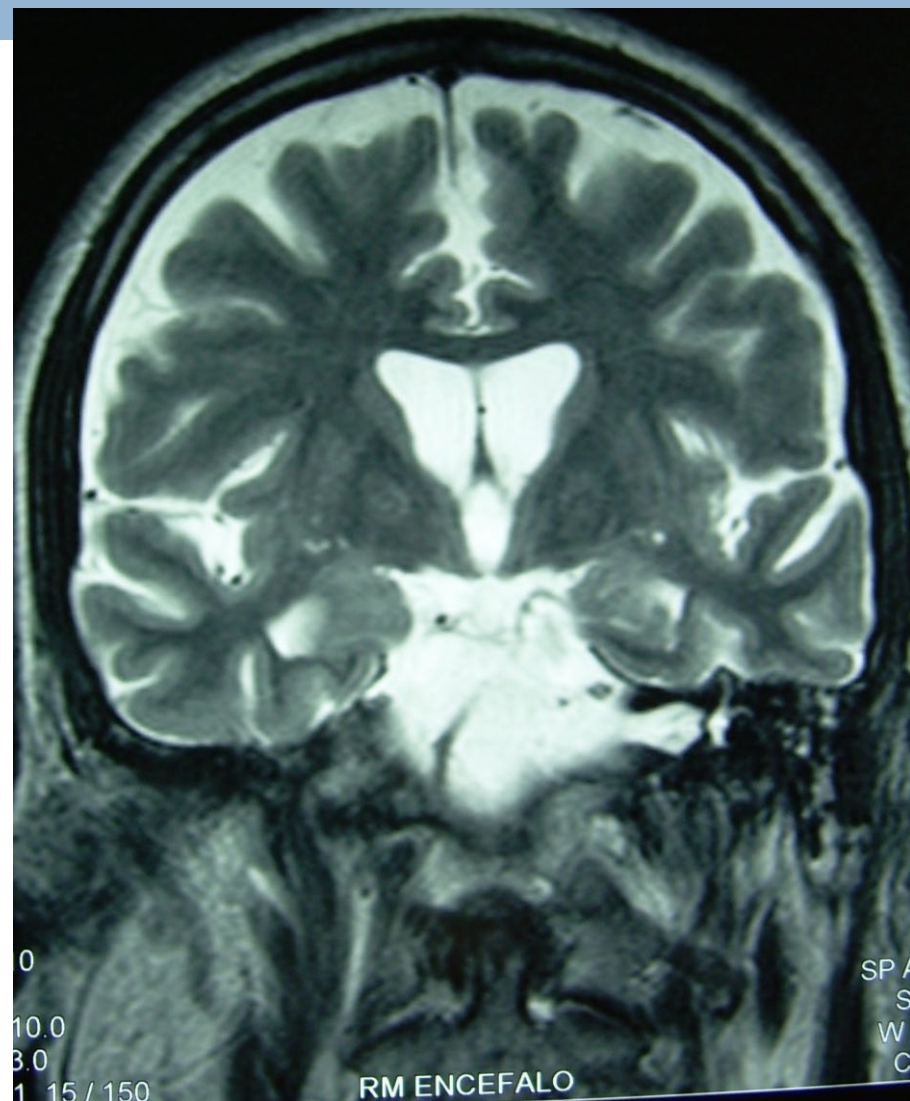
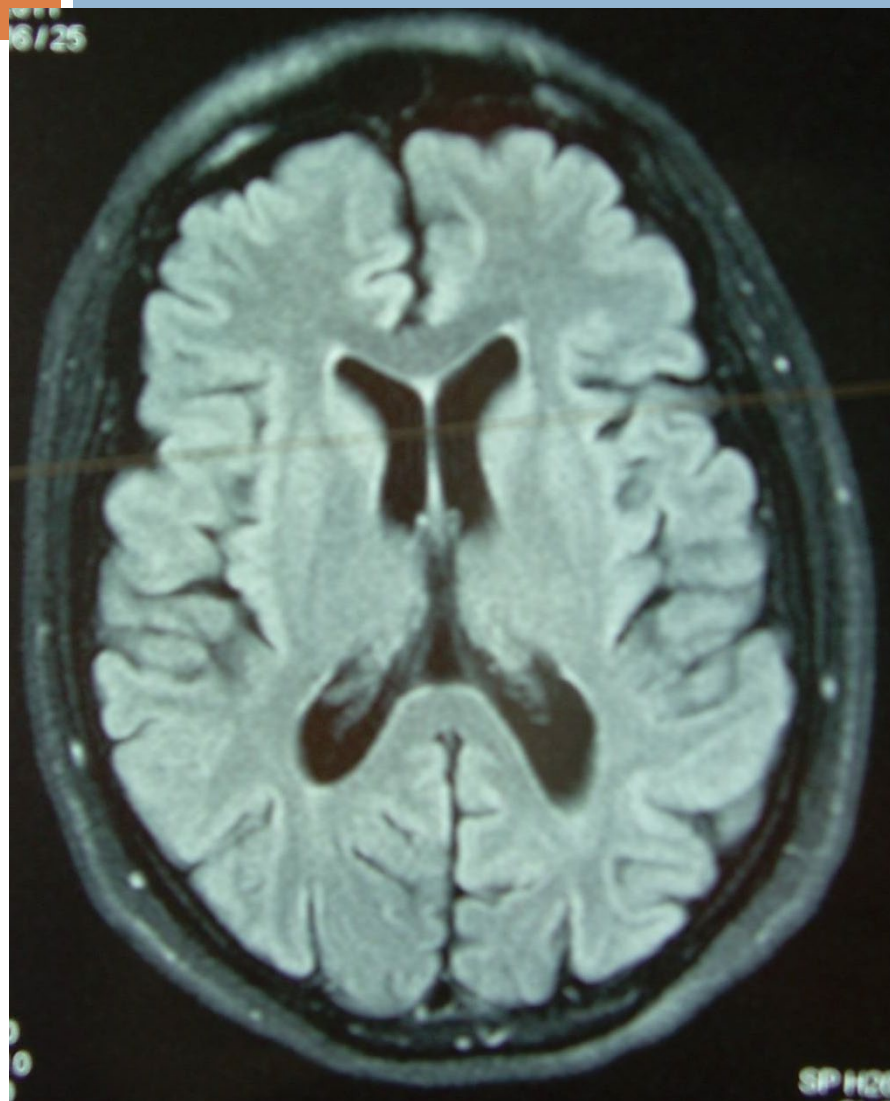


# LR - 06.12.2010 (23°gg)

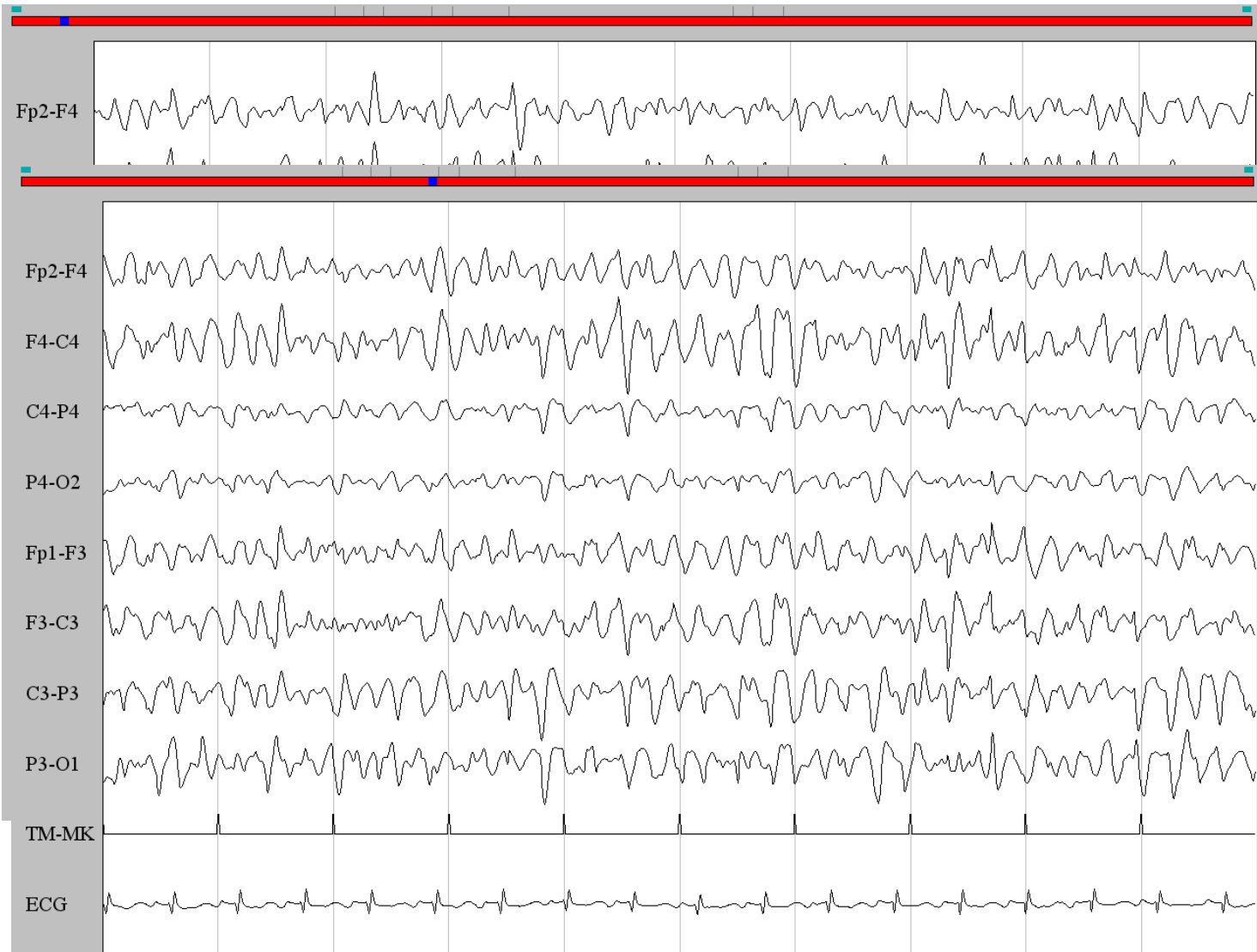




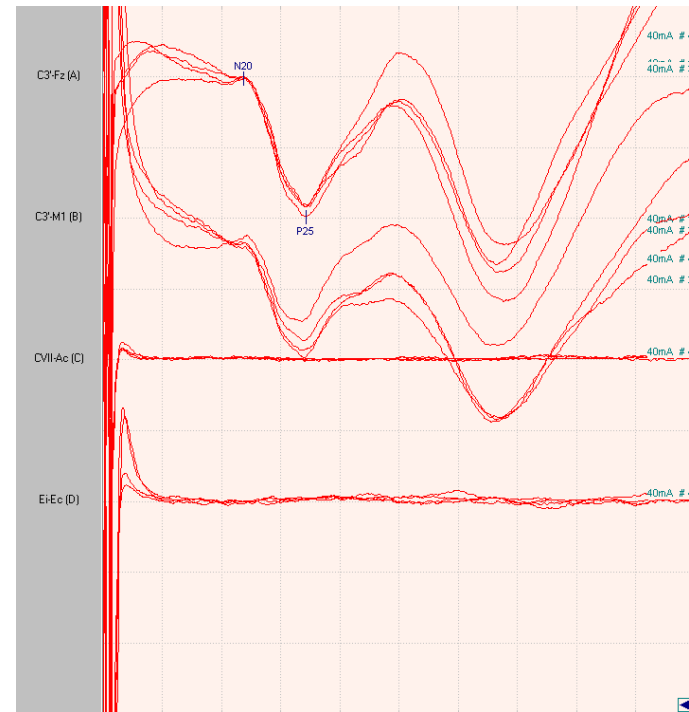
LR 12-01-2011



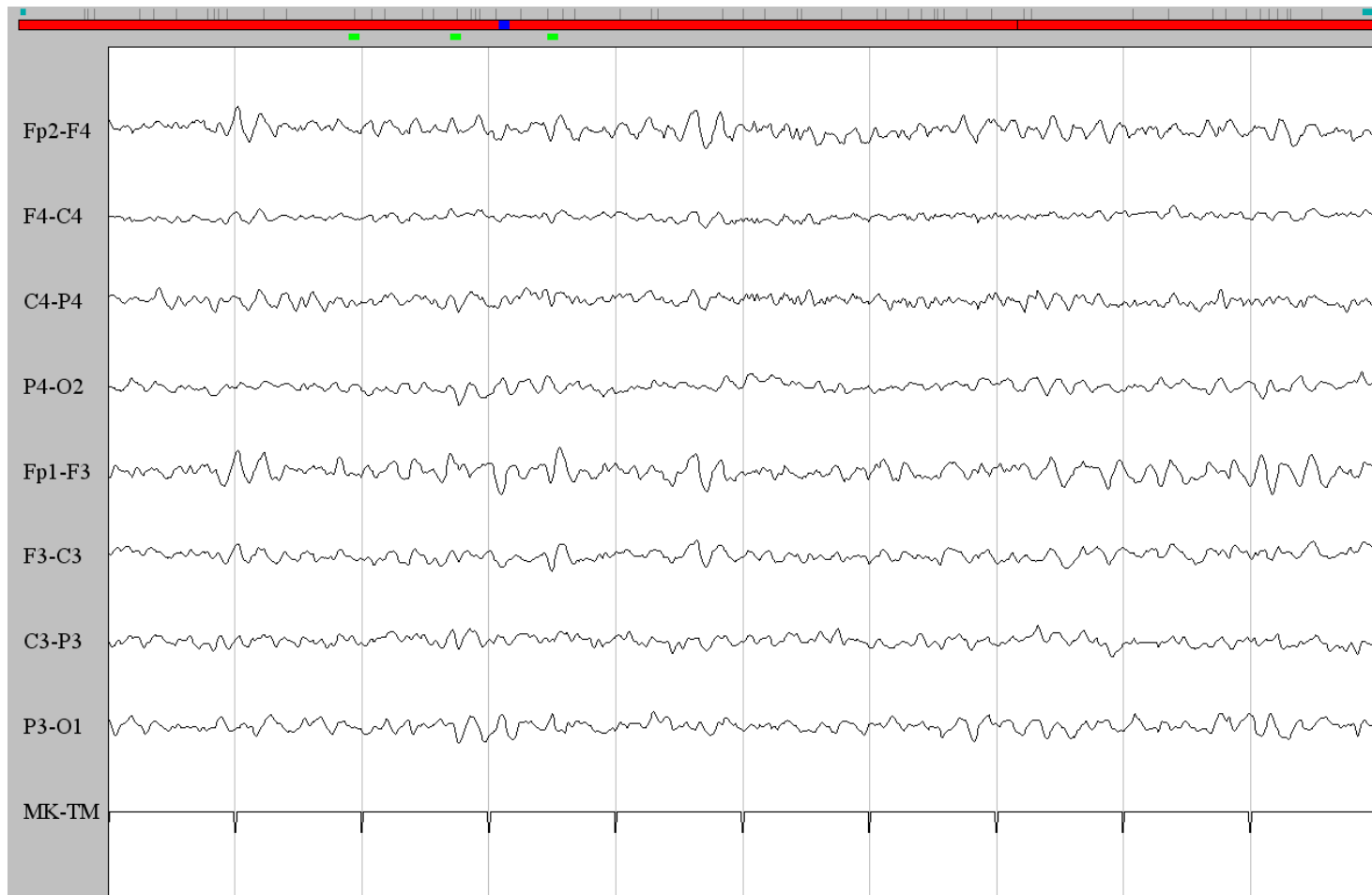
# N M a.79, ACR GCS=3 PS EEG 12 h (ipotermia)



# N M a.79, ACR GCS=3 PS PES 12 h (ipotermia)

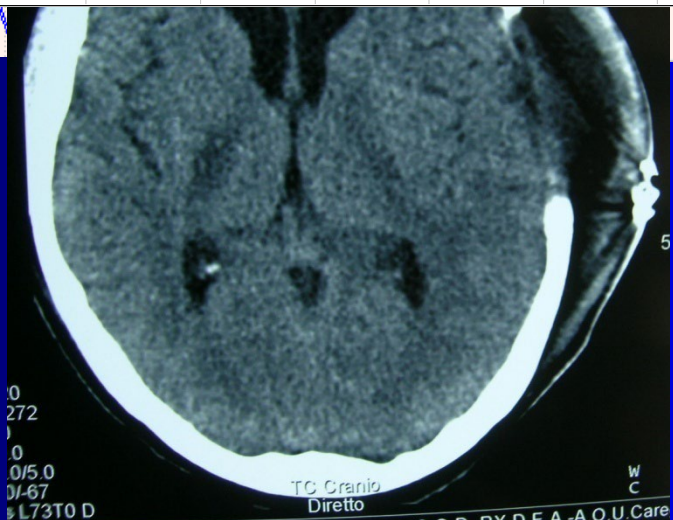
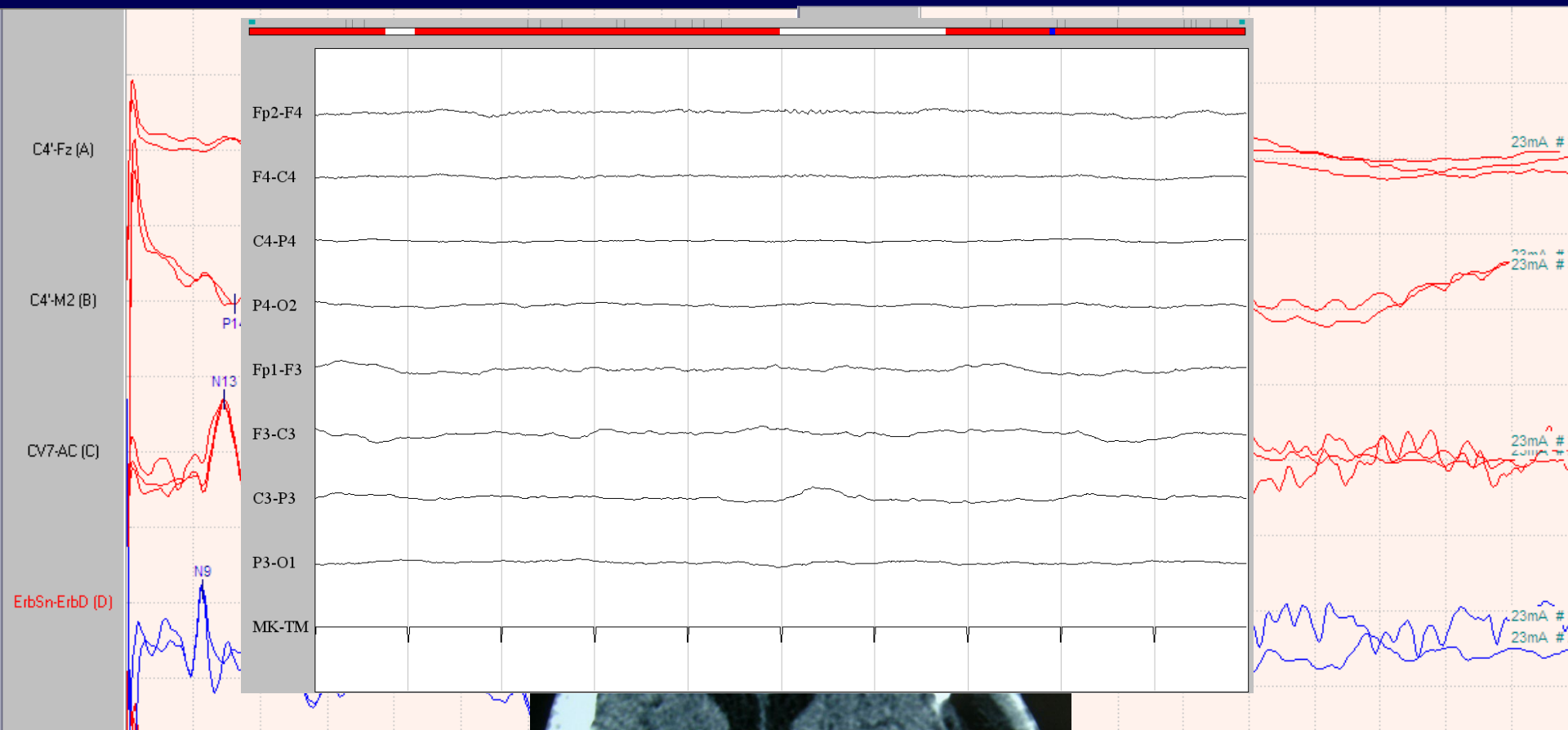


# NM a 79, EEG 48 h (normotermia)



# NM a 79, PES 48 h (normotermia)





# RMN: DAI severo

