

CONGRESSO NAZIONALE IRC 2023



Vicenza

20 • 21 OTTOBRE

Vicenza Convention Centre



LA RIVOLUZIONE DEI SISTEMI



Italian
Resuscitation
Council

Gemelli



Fondazione Policlinico Universitario A. Gemelli
Università Cattolica del Sacro Cuore

Misurare l'outcome: quando è buono e quando è cattivo



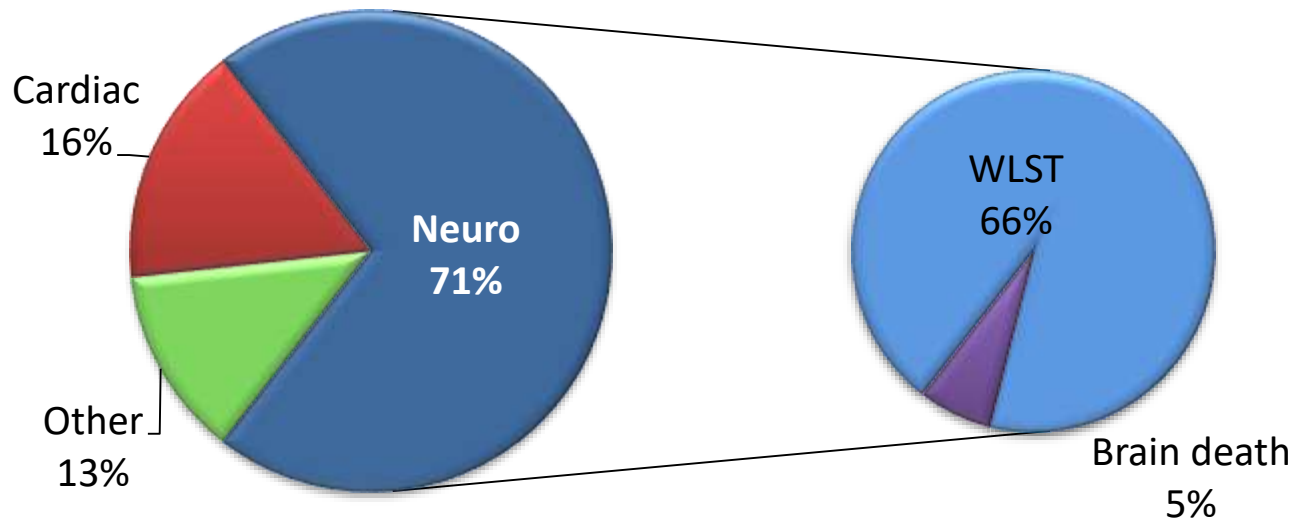
Sonia D'Arrigo

UOC Rianimazione, Terapia Intensiva e Tossicologia Clinica
Fondazione Policlinico Universitario A. Gemelli IRCCS
Roma

Causes of death after resuscitation

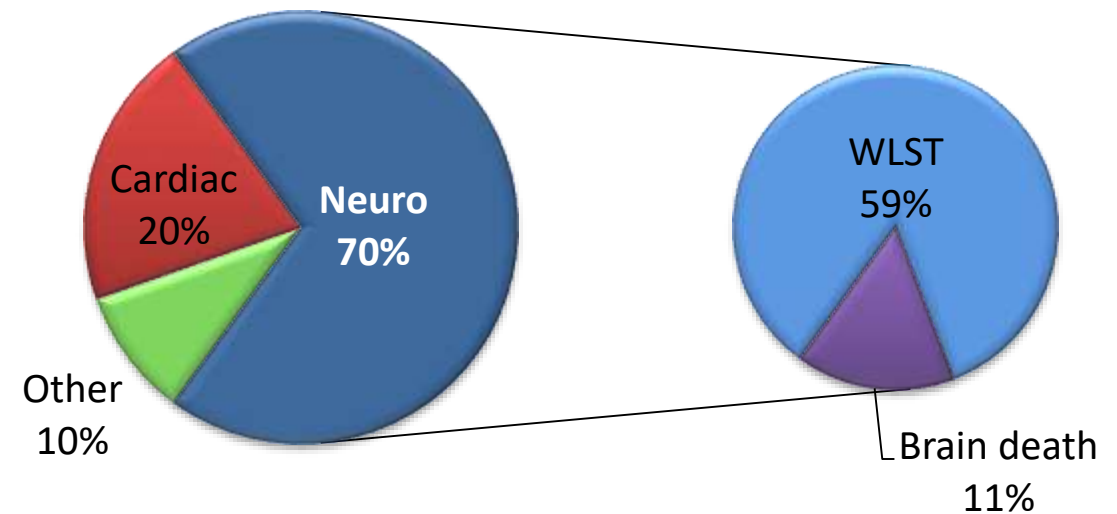
Dragancea 2013, Sweden

n= 86



Elmer 2016, USA

n= 2760



WLST = Withdrawal of Life-Sustaining Treatment

Perché formulare una prognosi ?



Per fornire
informazioni corrette



Per fornire cure
appropriate e proporzionate

Cure appropriate e proporzionate

Evitare
trattamenti futili

**Il paziente
'cristallizza'**



Evitare una
inappropriata
limitazione
dei trattamenti



Strategia multimodale

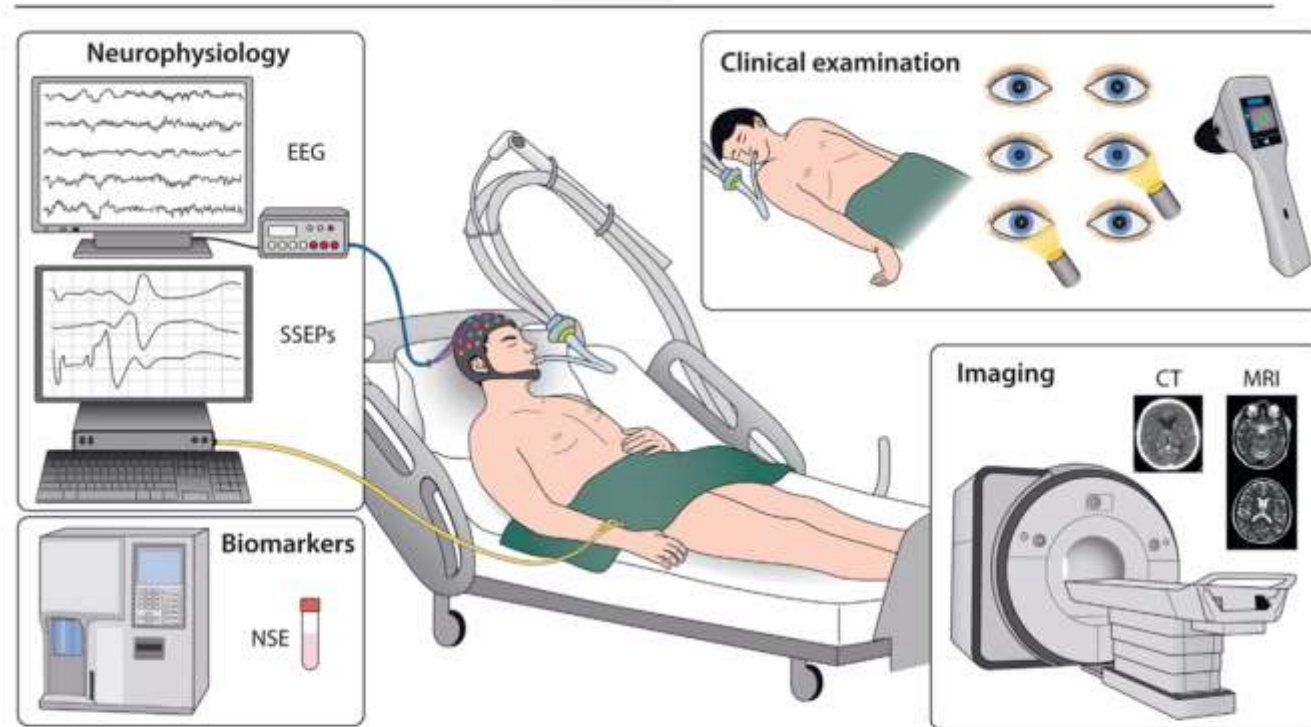
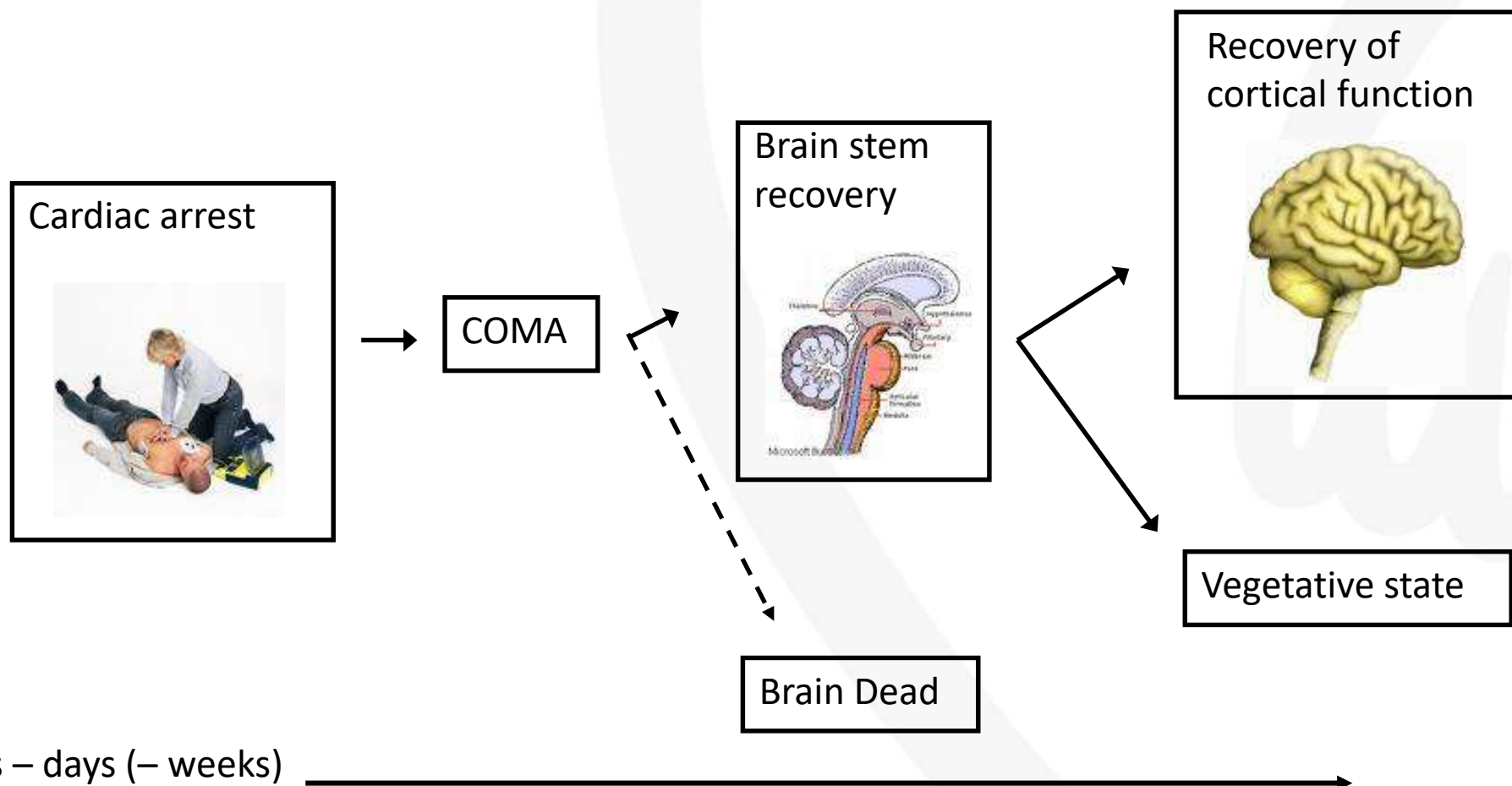


Fig. 4 - Prognostication modes. EEG electroencephalography; NSE neuron specific enolase; SSEP somatosensory evoked potential.

Nessun predittore è accurato al 100%

Natural course of neurological recovery following cardiac arrest

Patil KD et al. Circ Res. 2015 Jun 5;116(12):2041-9



No early predictors

3 main scenarios

1.The Good



2.The Ugly



3.The Bad



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Prognosi dell'arresto

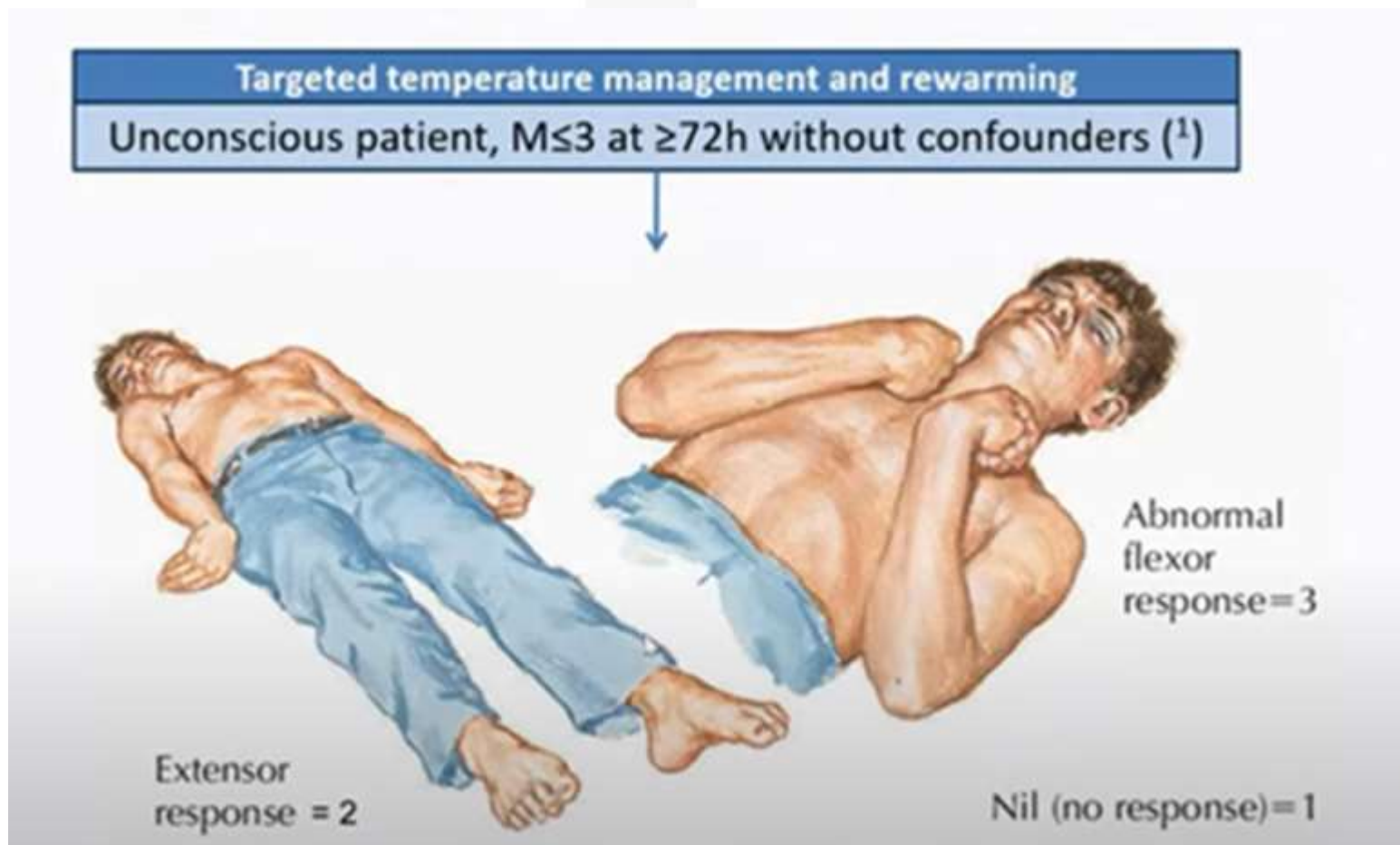
- >2/3 delle morti dopo arresto cardiaco sono neurologiche
 - e basate sulla prognosi attesa
- Prognostication = predizione di esito neurologico *sfavorevole*

Timing della valutazione prognostica

- La valutazione deve iniziare con un esame clinico
- In assenza di sedazione residua, l'esame è attendibile $\geq 72h$ dopo ROSC
- L'attendibilità dell'esame clinico è ridotta se sono stati somministrati sedativi $\leq 12h$ prima
- L'ipotermia prolunga gli effetti dei sedativi



Paziente incosciente



NEUROPROGNOSTICATION FOR THE COMATOSE PATIENT AFTER RESUSCITATION FROM CARDIAC ARREST



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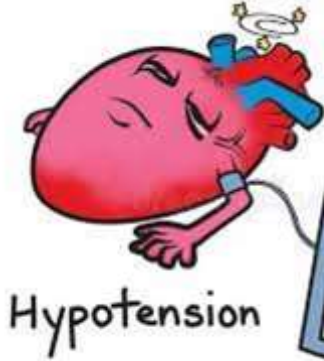
YES

Poor outcome likely ^(*)

NO

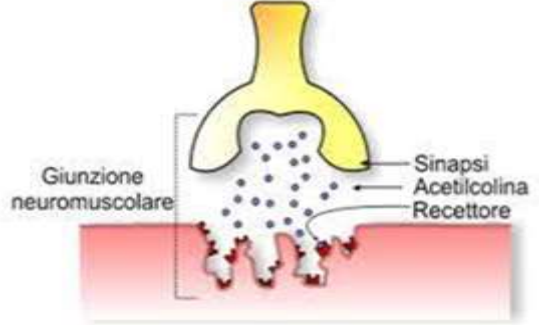
Observe and re-evaluate

- 1 Major confounders may include analgo-sedation, nei severe hypotension, hypoglycaemia, sepsis, and met
- 2 Use a
- 3 Suppr Neuro
- 4 Increa
- 5 Define
- * Cautio



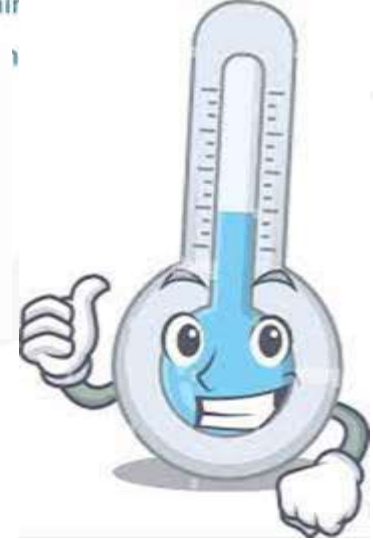
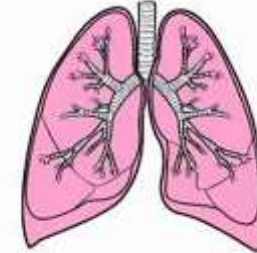
Hypotension

able, to a ges or bu

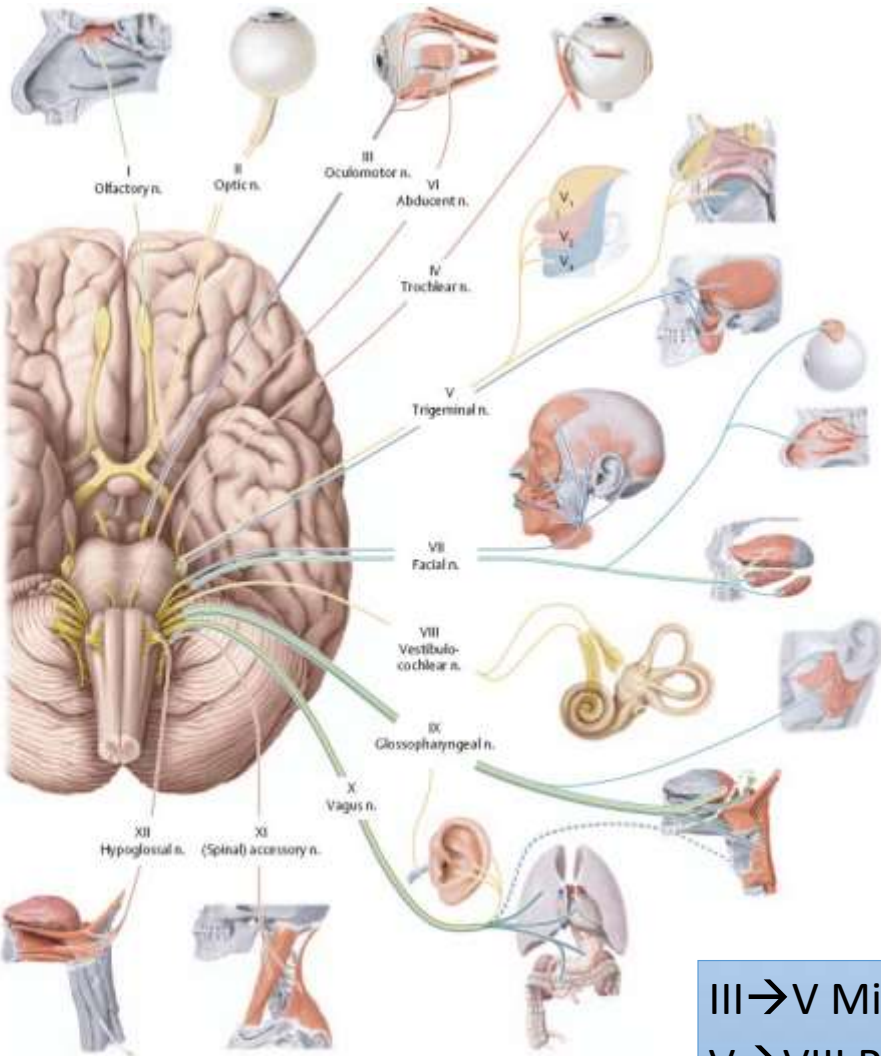


Clinical

24/48 and 72h further support a likely poor outcome
yoclonus persisting for 30 min



Standard vs Automated



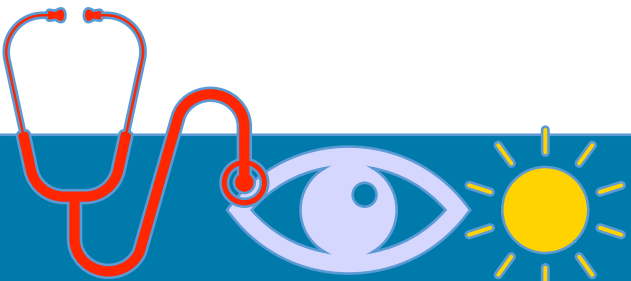
III→V Midbrain
V→VIII Pons
V, VII→XII Medulla



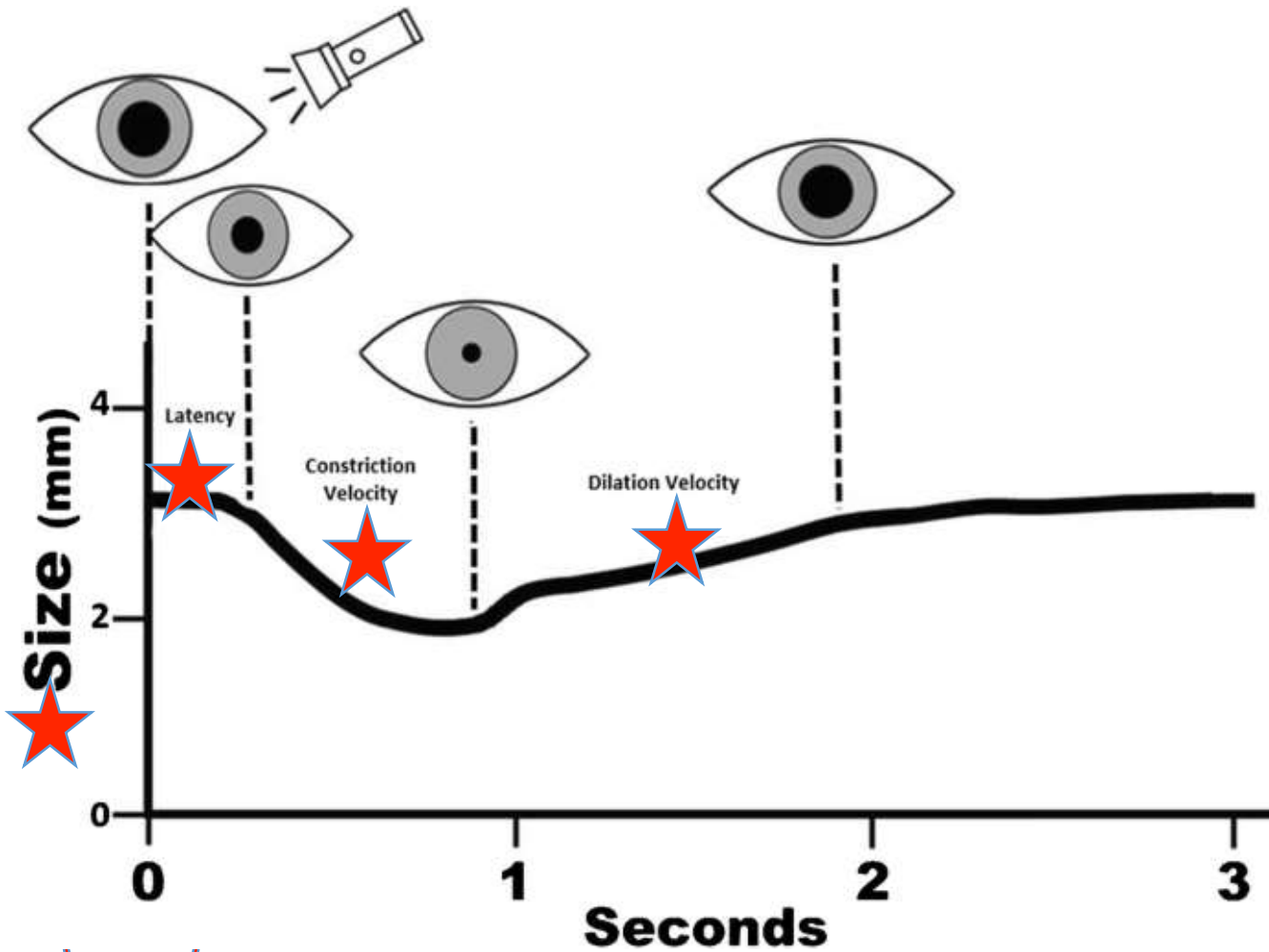
Pros easy and inexpensive
Cons qualitative, Inter examiner variability (>39%) and lack of reliability



Pros standardise the intensity, distance from the eye and duration of stimulus. Displays a quantitative and reproducible measures.
Cons cost



Automated pupillometry technique



Infrared & visible light source coupled with a camera

A infrared light measure the pupil baseline 

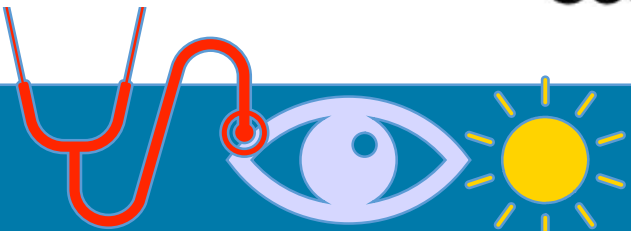
After 3'' a visible light delivered

The pupillary response recorded with camera

Other parameters

- pupillogram
- data trending

**Non invasive
neuromonitoring
bedside tool**





No comparable data on available devices
Possible that information with both devices is not the same

No comparable studies that examine accuracy

cubical nerve stimulator (10-60mA)

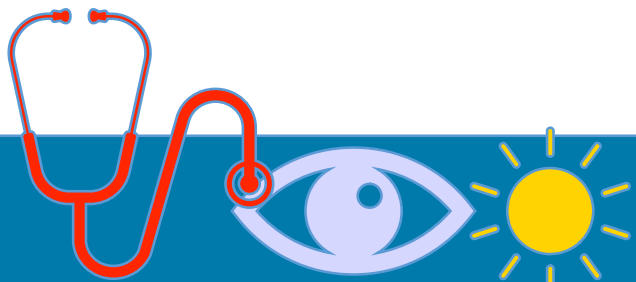
- PRD
- PPI

NPi index
algorithm derived value
 $NPi \geq 3$ normal reactivity

devices



Neuroptics NPi



Confronto NPi vs. sPLR

| Day after cardiac arrest | Sample size (n) | CPC 3–5 n (%) | Specificity % (95% CI) | Sensitivity % (95% CI) |
|--|-----------------|---------------|------------------------|------------------------|
| Neurological pupil index (NPi) ≤ 2 | | | | |
| Day 1–3 | 456 | 269 (59) | 100 (98–100) | 32 (27–38) |
| Day 1 | 450 | 264 (59) | 100 (98–100) | 22 (17–27) |
| Day 2 | 361 | 213 (59) | 100 (98–100) | 19 (14–25) |
| Day 3 | 271 | 166 (61) | 100 (97–100) | 17 (12–24) |
| Bilaterally absent standard pupillary light reflex (sPLR) | | | | |
| Day 1 | 392 | 225 (57) | 90 (85–94) | 35 (29–42) |
| Day 2 | 278 | 163 (59) | 90 (84–95) | 29 (22–36) |
| Day 3 | 206 | 128 (62) | 94 (86–98) | 18 (12–26) |

NEUROPROGNOSTICATION FOR THE COMATOSE PATIENT AFTER RESUSCITATION FROM CARDIAC ARREST



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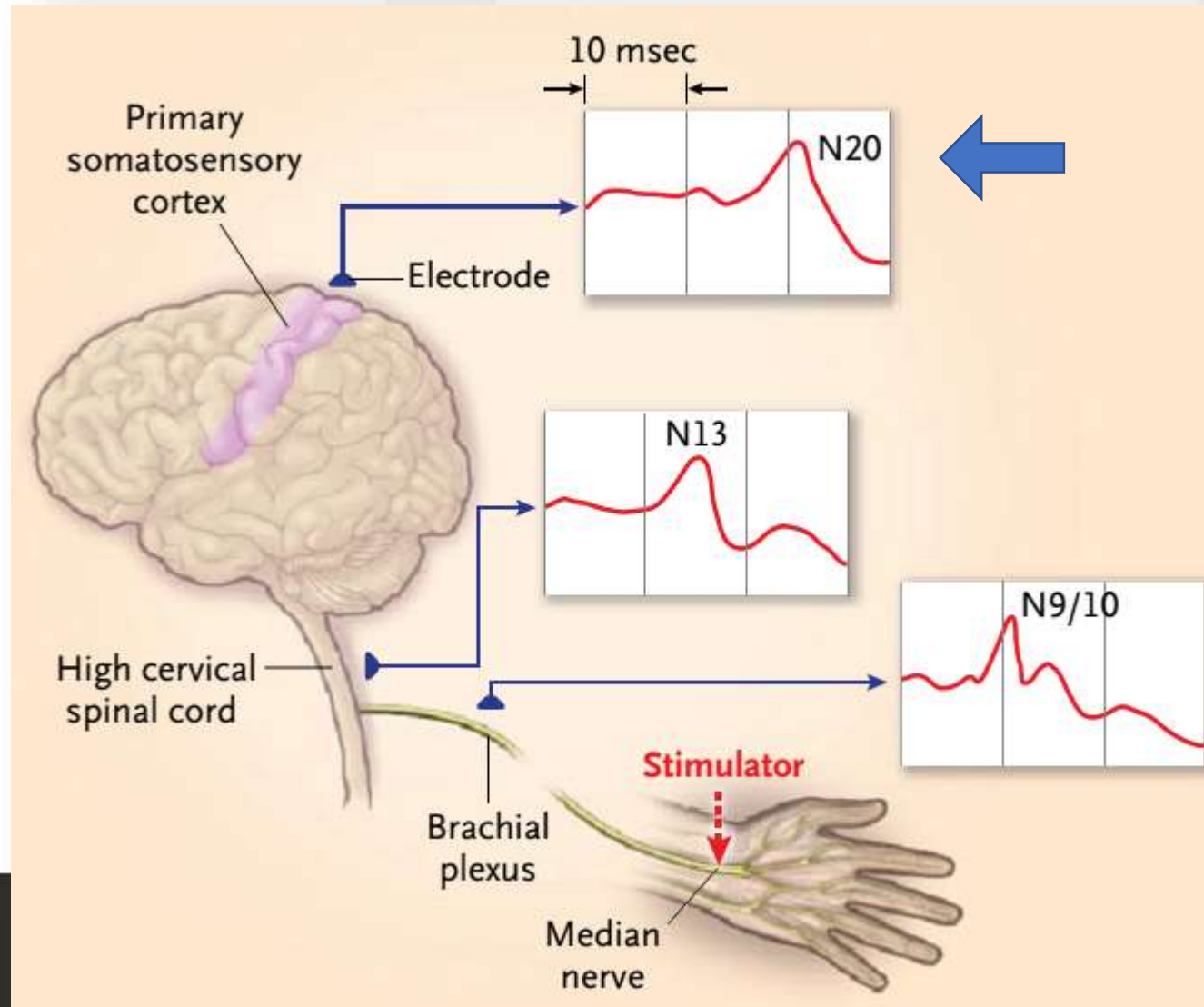
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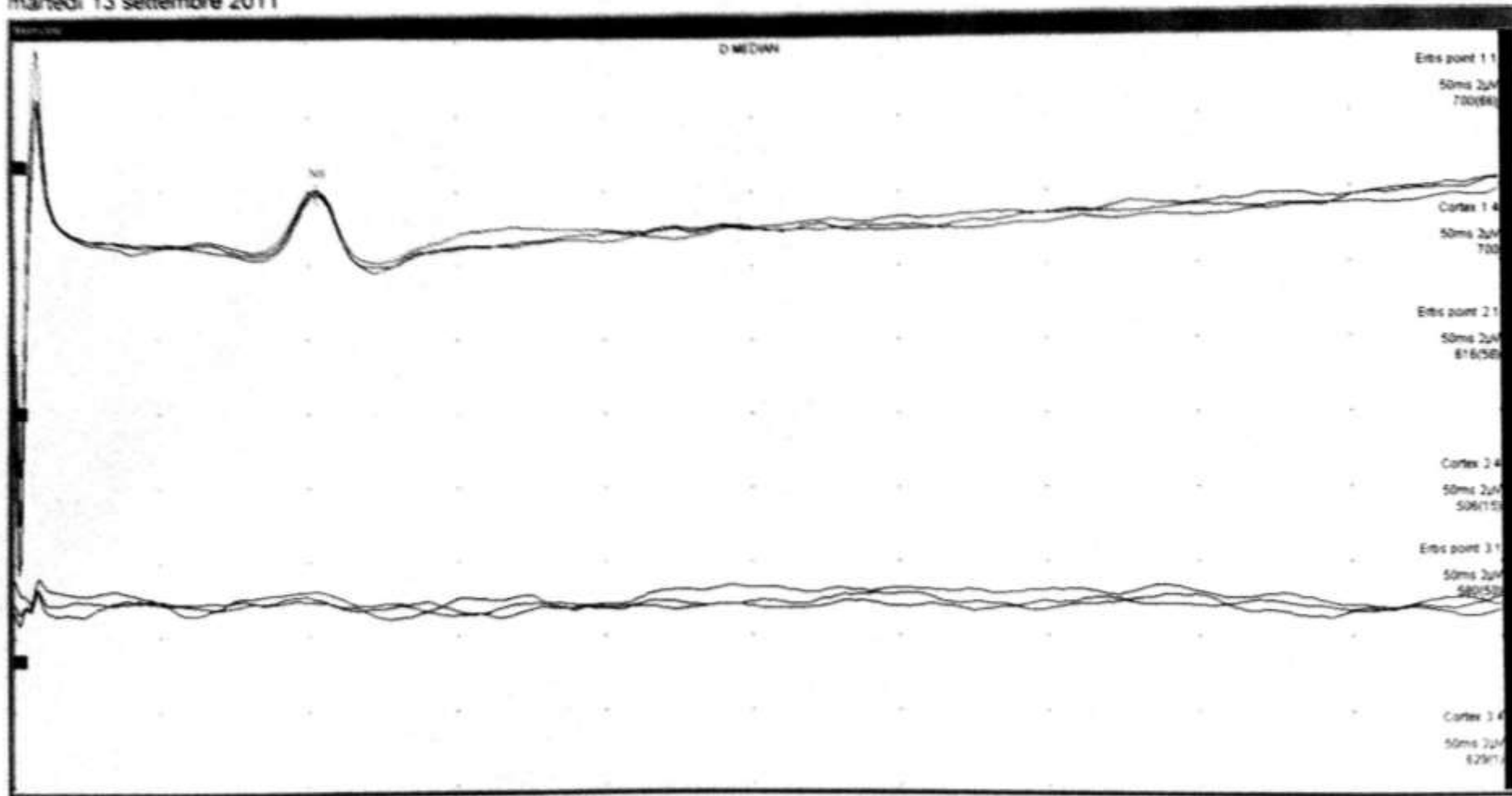
NO

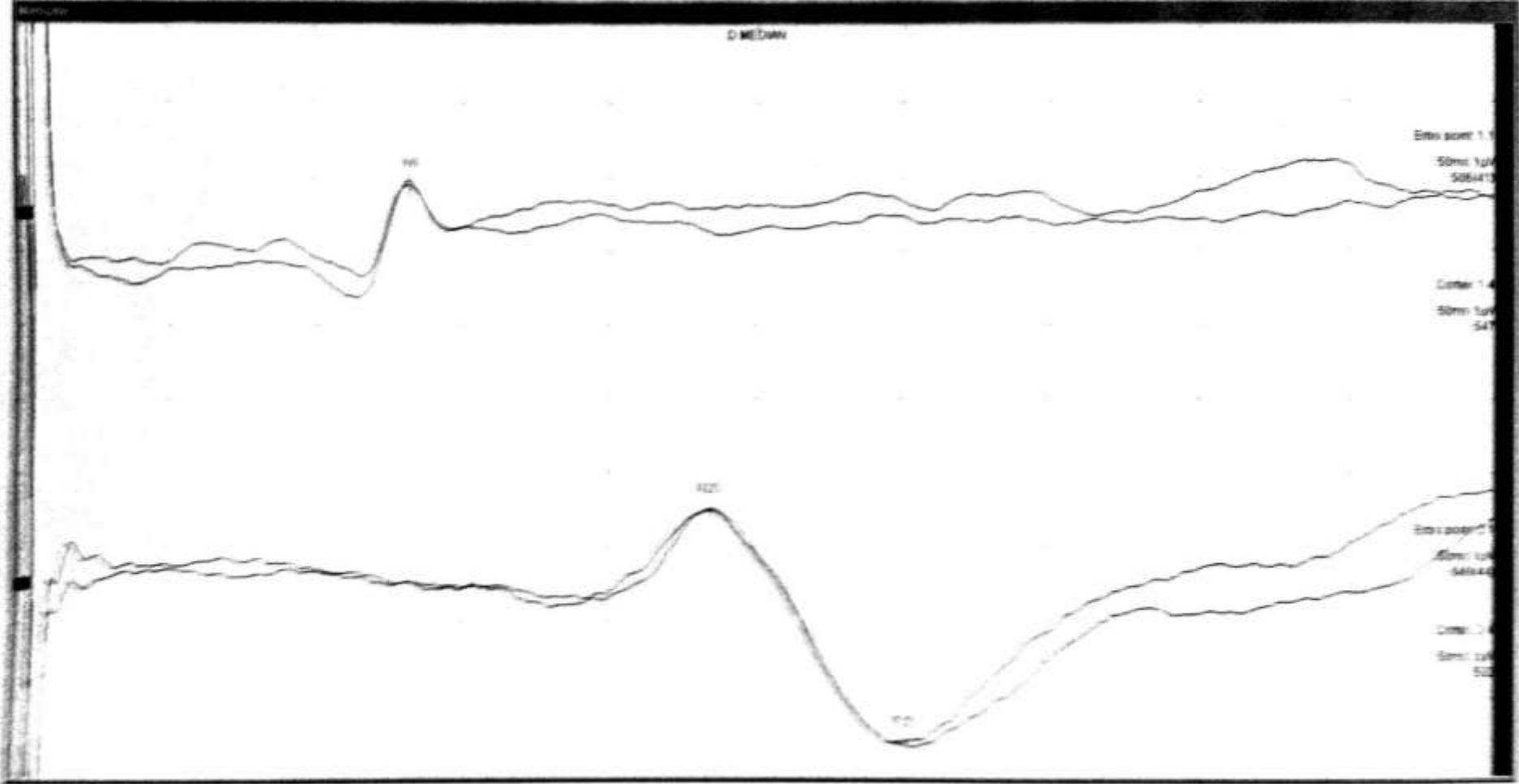
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- ^{*} Caution in case of discordant signs indicating a potentially good outcome (see text for details).

Potenziali evocati somatosensoriali a breve latenza (SSEP)









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Co

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18 - 21 OTTOBRE
in Convegni e Concorsi

I SISTEMI

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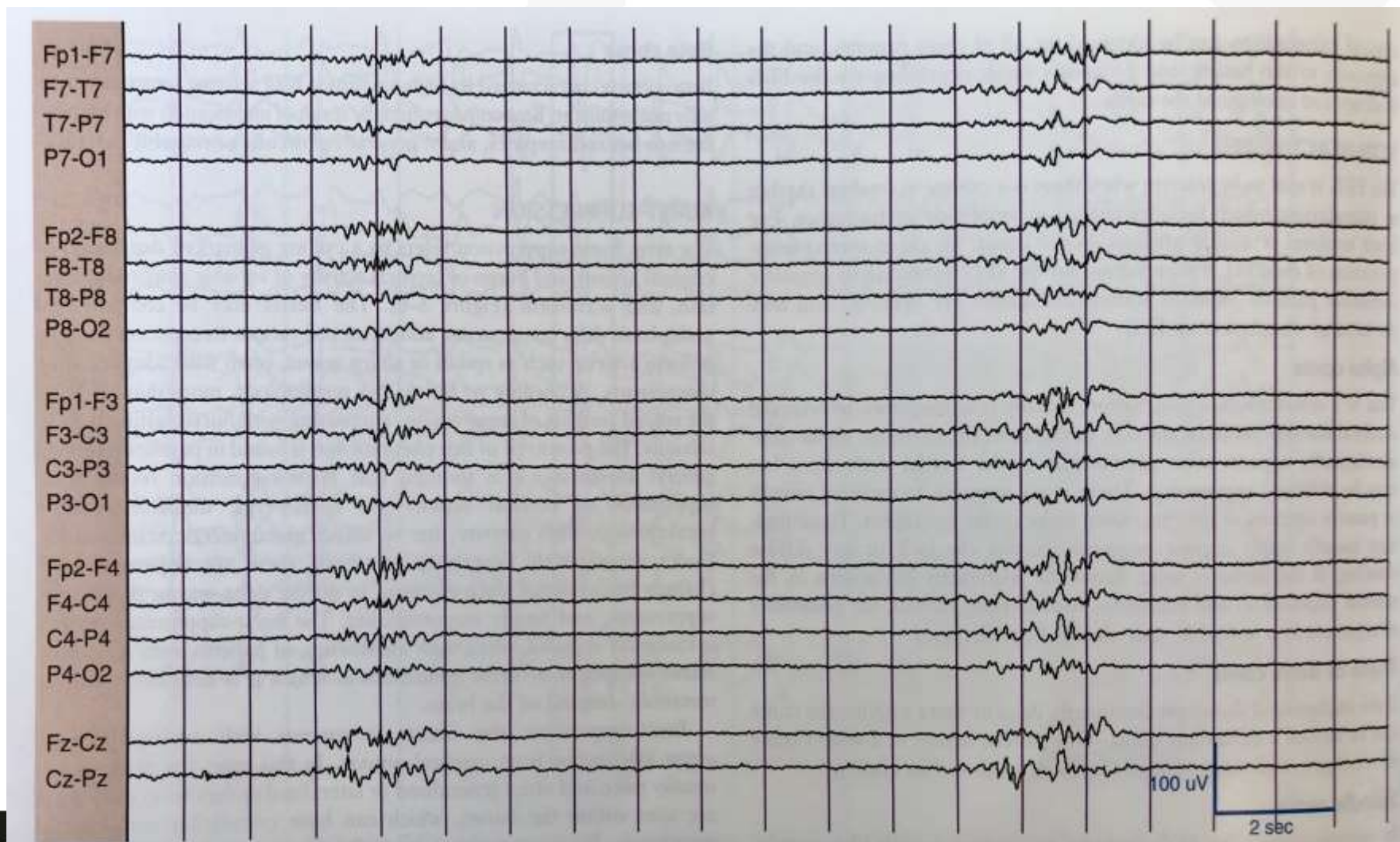
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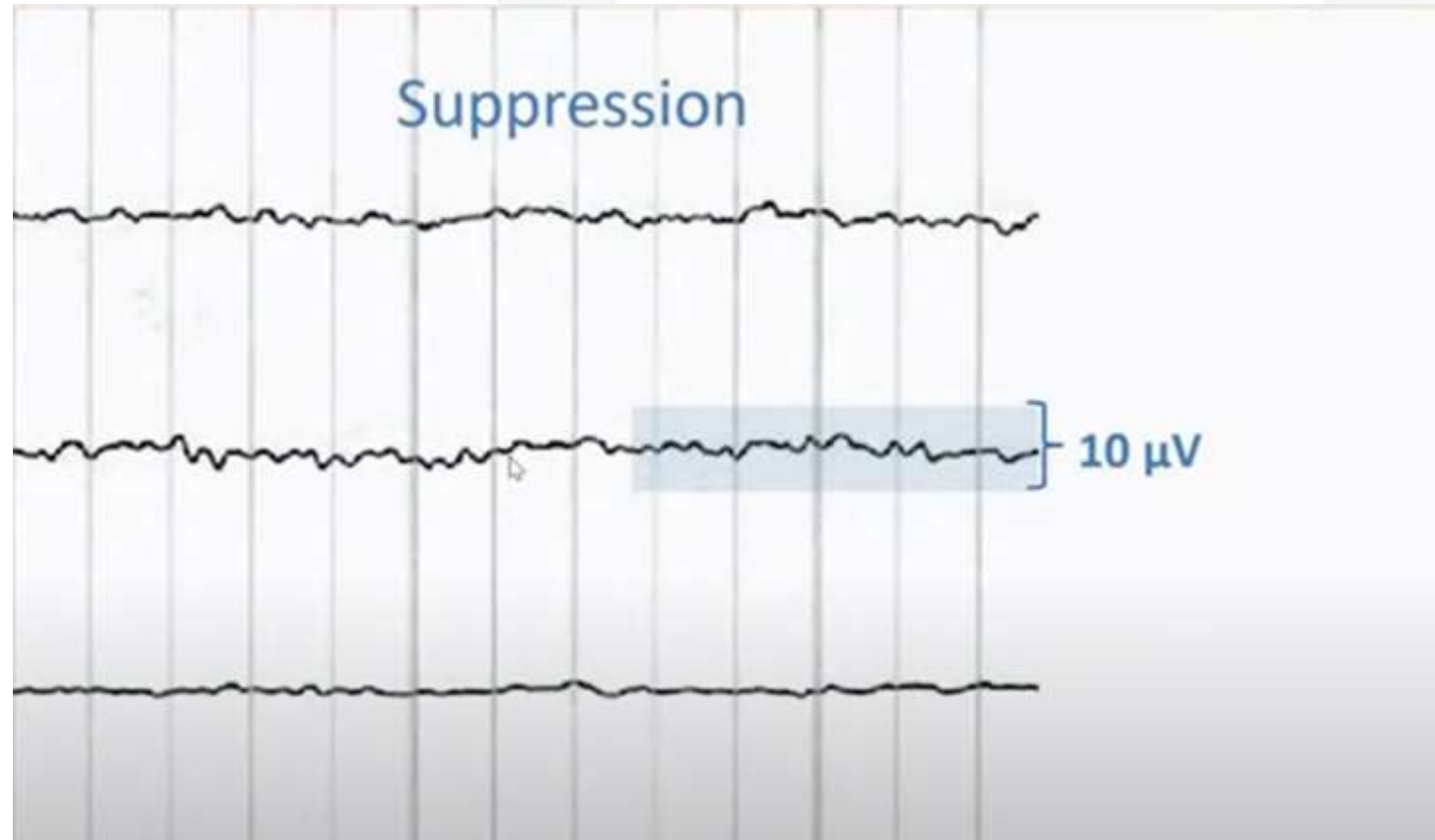
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Burst Suppression

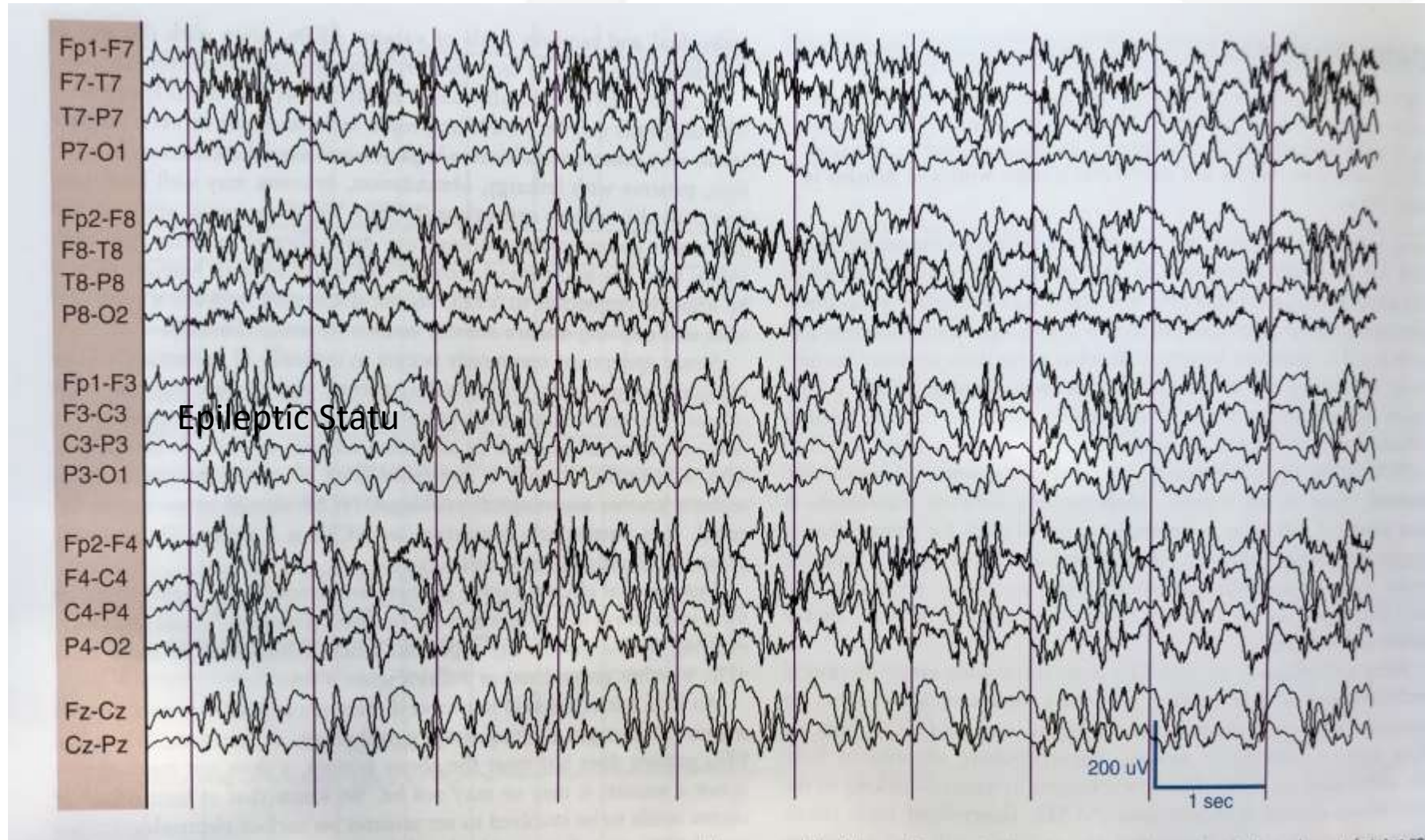


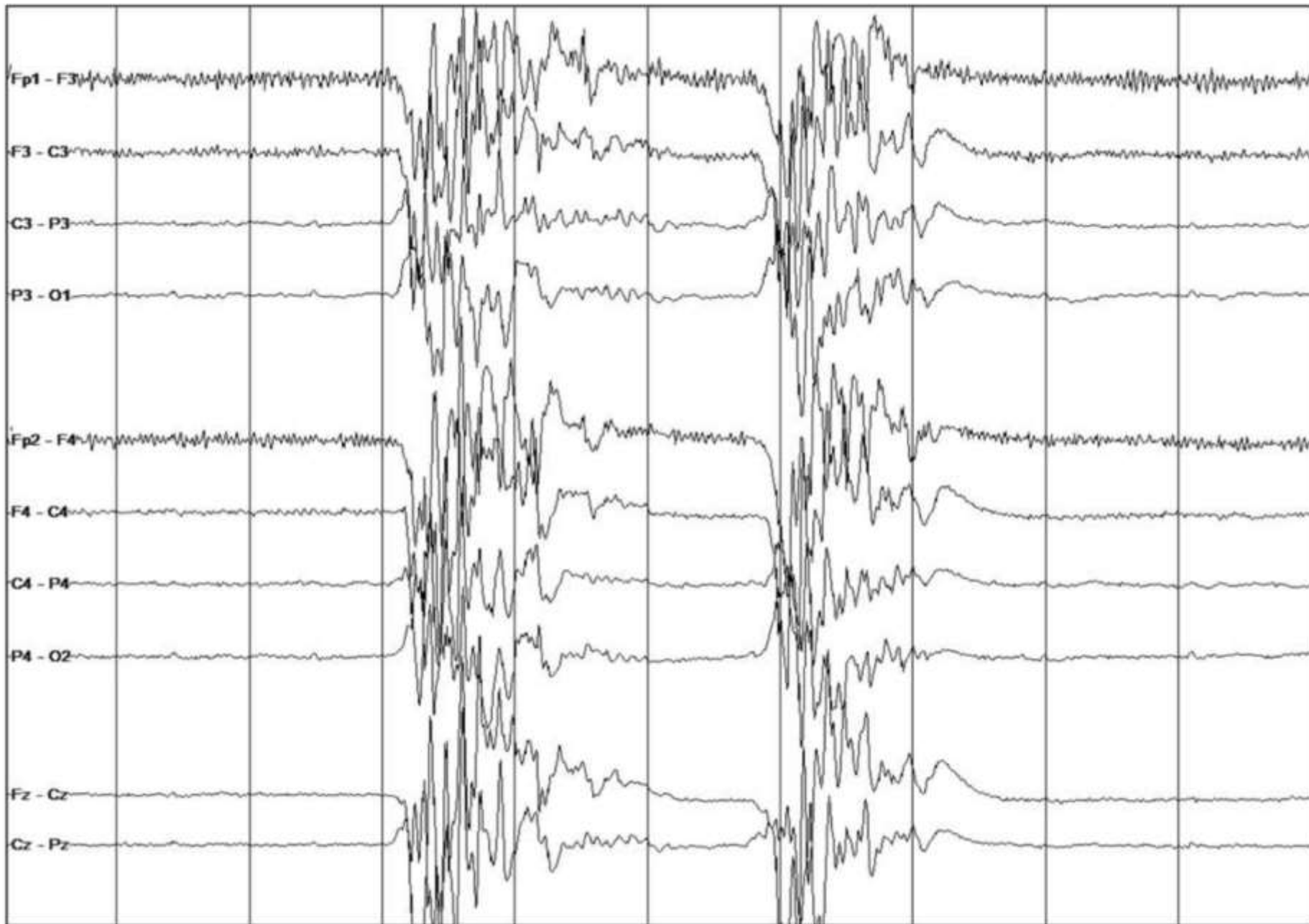
American Clinical Neurophysiology Society's Standardized Critical Care EEG Terminology: 2021 Version

Lawrence J. Hirsch[†], Michael W.K. Fong[†], Markus Leitinger[‡], Suzette M. LaRoche[§], Sandor



Epileptic Status





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SSO NAZIONALE IRC 2023



ANASSIDA
PENSARE

LA RIVOLUZIONE DEI SISTEMI

FP1-F3

F3-C3

C3-P3

P3-O1

FP2-F4

F4-C4

C4-P4

P4-O2

FP1-F7

F7-T3

T3-T5

T5-O1

FP2-F8

F8-T4

T4-T6

T6-O2

FZ-CZ

CZ-PZ



150 uV
1 sec



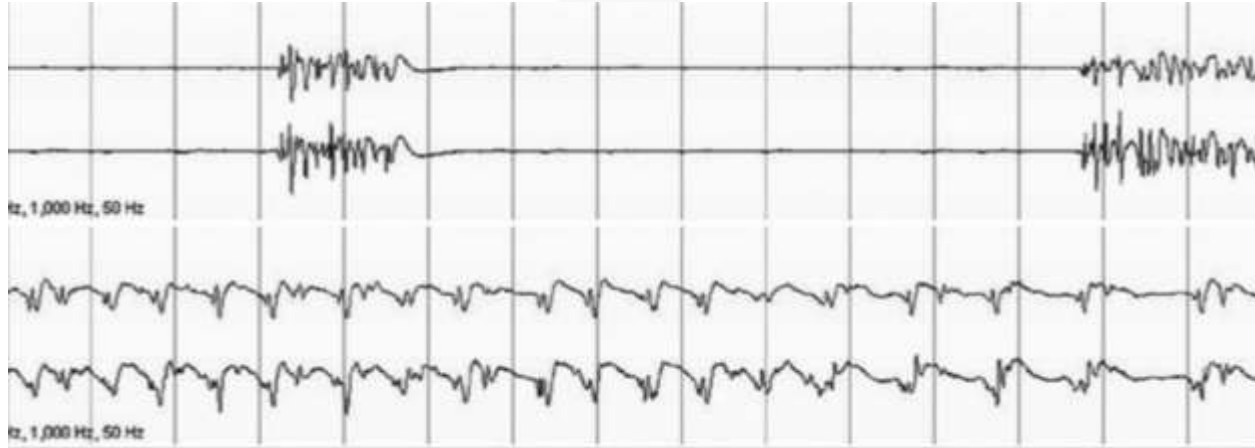
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LA RIVOLUZIONE DEI SISTEMI

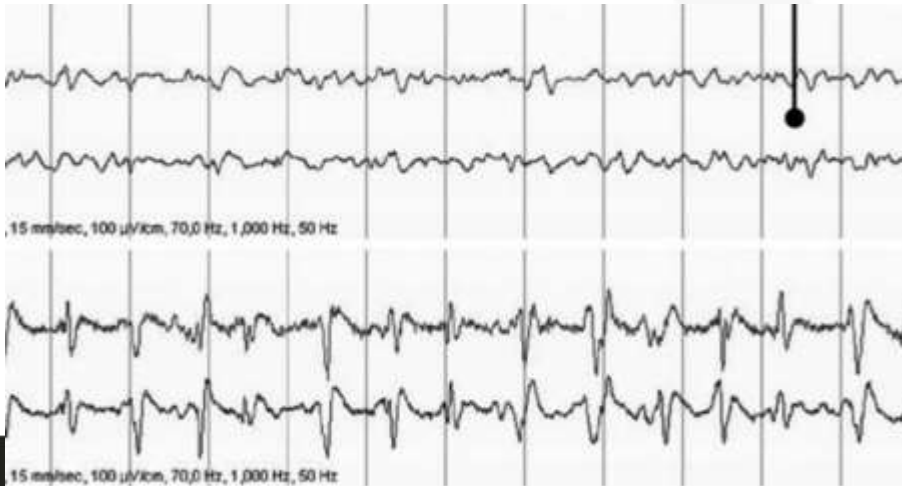
Importanza del background



SE da BS



0% risveglio



SE da EEG continuo

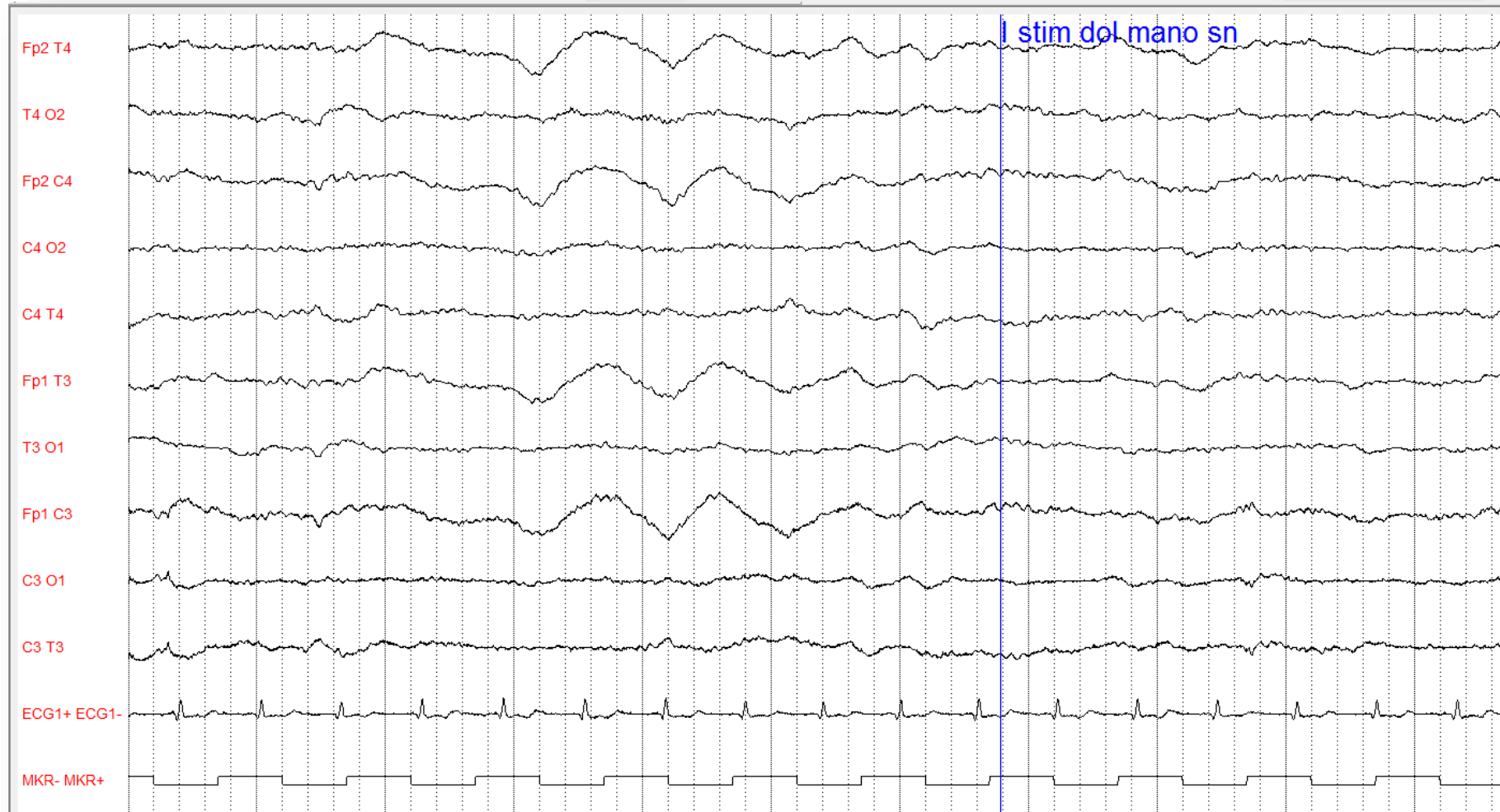


20% risveglio

Reattività EEG



56h after CA



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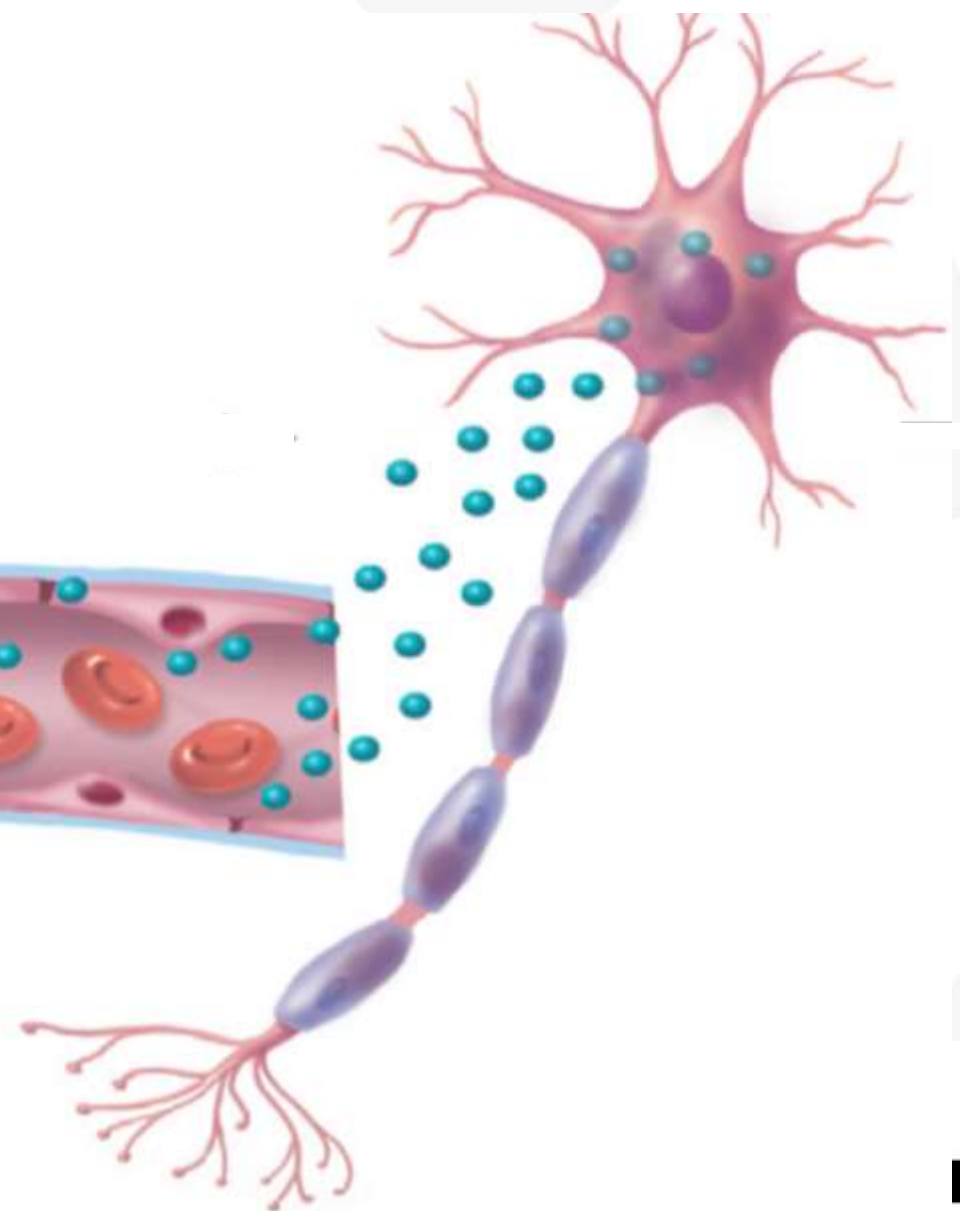
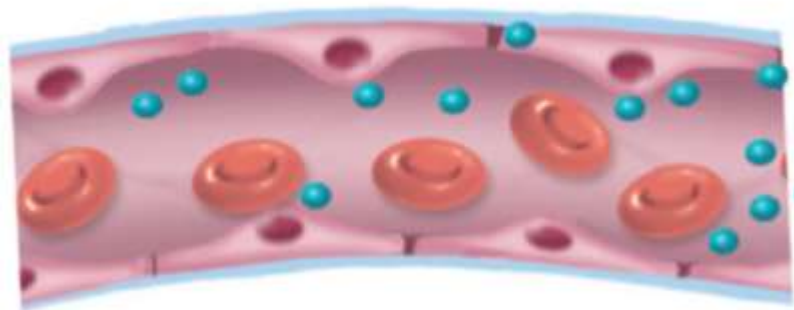
YES

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NO

Observe and re-evaluate

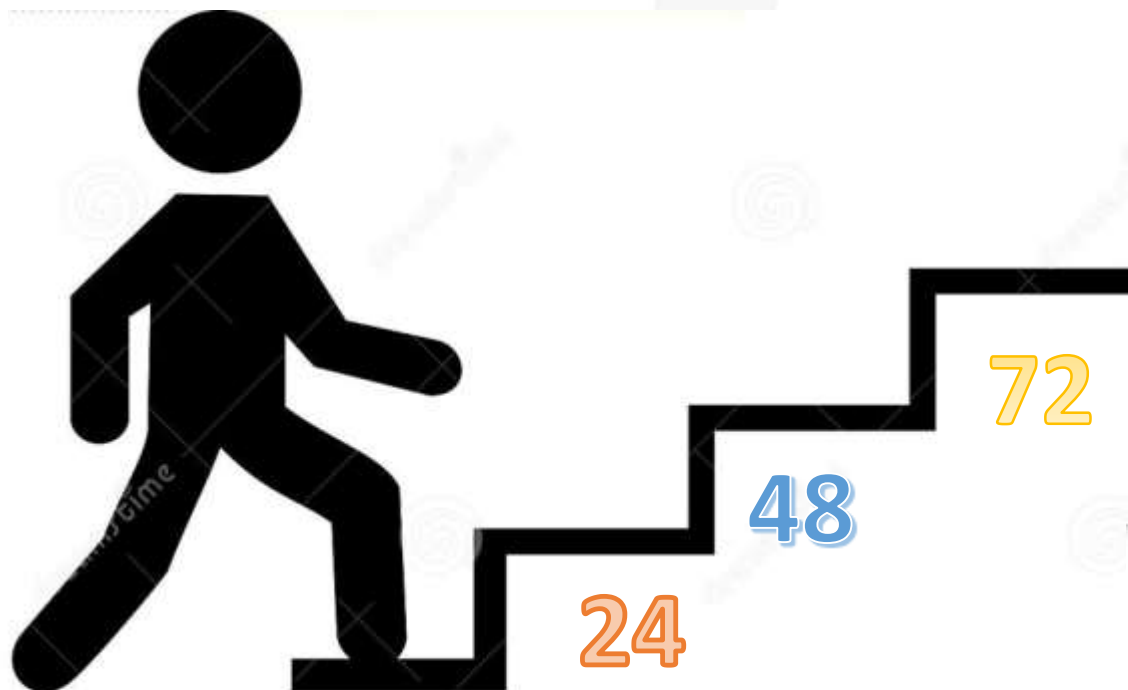
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Council



Trend enolasi



Biomarkers



NSE

PLOS ONE

RESEARCH ARTICLE

Single versus Serial Measurements of Neuron-Specific Enolase and Prediction of Poor Neurological Outcome in Persistently Unconscious Patients after Out-Of-Hospital Cardiac Arrest – A TTM-Trial Substudy

Sebastian Wiberg^{1*}, Christian Hassager¹, Pascal Stammet², Matilde Winther-Jensen¹, Jakob Hartvig Thomsen¹, David Erlinge³, Michael Wanscher¹, Niklas Nielsen⁴, Tommaso Pellis⁵, Anders Aneman⁶, Hans Friberg⁷, Jan Hovdenes⁸, Janneke Horn⁹, Jørn Wetterslev¹⁰, John Bro-Jeppesen¹, Matthew P. Wise¹¹, Michael Kuiper¹², Tobias Cronberg¹³, Yvan Gascho¹⁴, Yvan Devaux¹⁵, Jesper Kjaergaard¹



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Mioclono

- Contrazioni muscolari brevi, improvvise, involontarie (twitch o shock like contractions)
- Sono la manifestazione motoria più frequente in TI
- Spesso generalizzate ma possono essere focali o multifocali
 - Apertura occhi periodica
 - Deglutizione
 - Contrazioni diaframmatiche
- Da 'subtle' a intense e generalizzate
- Inducibili



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Mioclono

- La comparsa precoce è indicativa di prognosi infausta
- Possono avere una corrispondenza EEG corticale
- S. di Lance-Adams in chi riprende coscienza
 - Più comune dopo arresto asfittico
 - Interessa soprattutto gli arti
 - Indotto da movimento volontario o stimolazione

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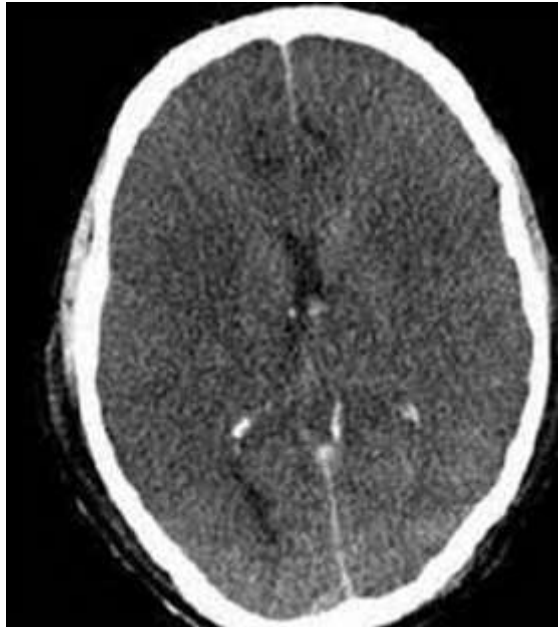
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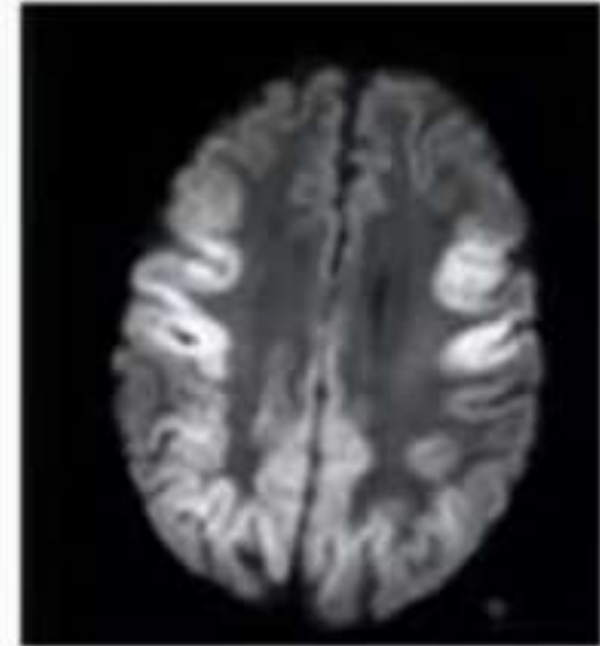
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Danno anossico diffuso ed esteso alla TC/RMN encefalo



Riduzione del rapporto GM/WM
entro 72 ore dal ROSC



Alterazioni diffuse (DWI o ADC)
entro 7 giorni dal ROSC

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Attenzione a test discordanti

Prognosi favorevole

SYSTEMATIC REVIEW

Prediction of good neurological outcome in comatose survivors of cardiac arrest: a systematic review



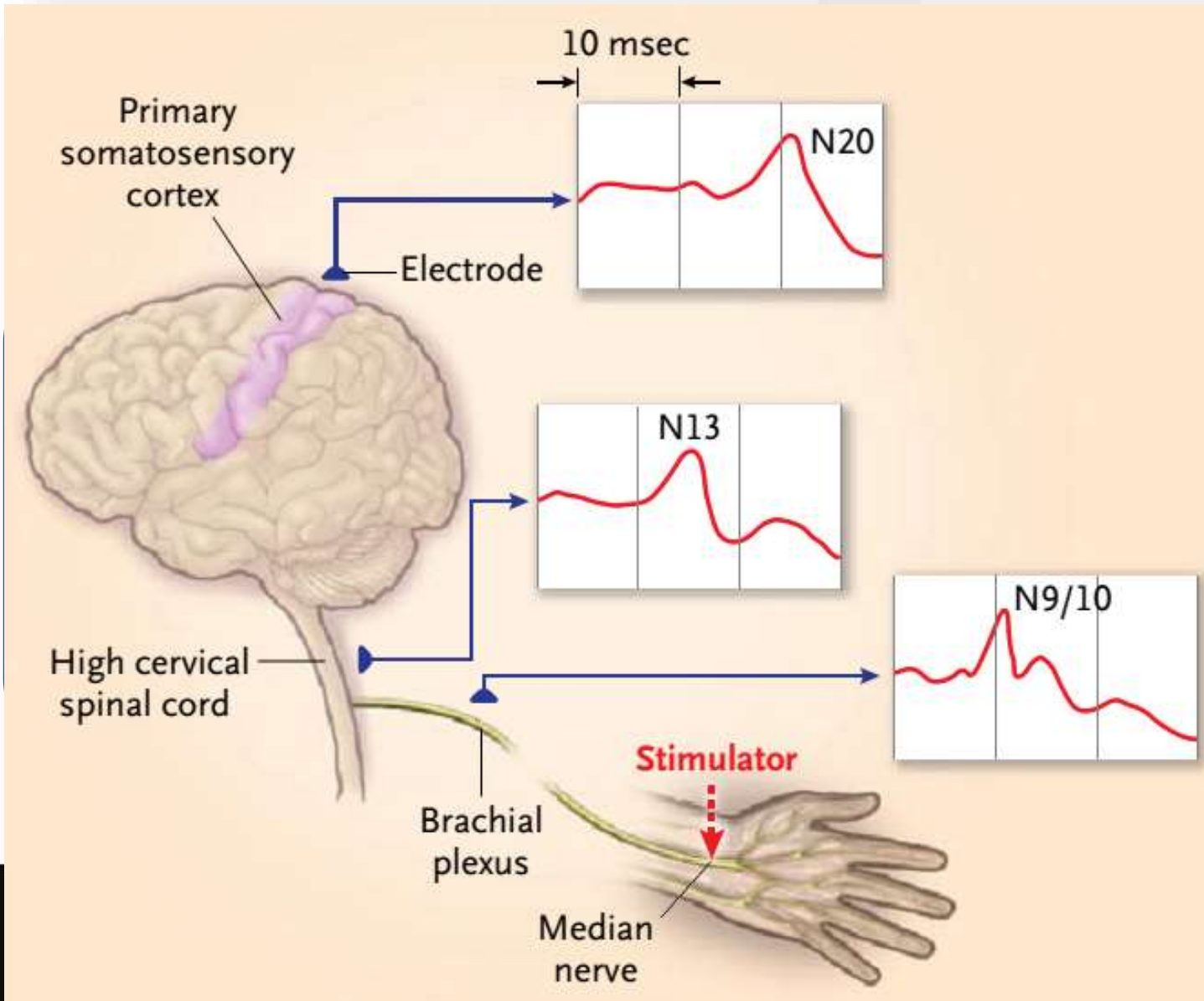
Claudio Sandroni^{1,2}, Sonia D'Arrigo^{1*}, Sofia Cacciola¹, Cornelia W. E. Hoedemaekers³, Erik Westhall⁴, Marlijn J. A. Kamps⁵, Fabio S. Taccone⁶, Daniele Poole⁷, Frederick J. A. Meijer⁸, Massimo Antonelli^{1,2}, Karen G. Hirsch⁹, Jasmeet Soar¹⁰, Jerry P. Nolan¹¹ and Tobias Cronberg¹²

- GCS Motor score 4 o 5 allo stimolo doloroso
- Pattern EEG continuo, con normale voltaggio e reattivo
- N20 presenti con un'ampiezza $\geq 4 \mu\text{V}$
- Bassi livelli o livelli decrementali di enolsi (NSE)
- RMN encefalo normale

Specificità > 80%
Sensibilità > 40%



Valutazione Neurofisiologiche



Reactivity

Changes in amplitude or frequency upon external stimulation



THANK YOU

TTM and rewarming

Unconscious, M₃ at ≥72 h without confounders



Almeno DUE di:

- Riflessi pupillare e corneale assente a ≥72 ore
- Onda N20 assente bilateralmente ai SSEP a ≥24 ore
- Pattern EEG altamente maligno a ≥ 24 ore
- Enolasi >60 μg/L a 48-72 ore
- Stato mioclonico entro le 72 ore
- Danno anossico diffuso ed esteso alla TC/RMN encefalo entro 7 giorni

→ si

Prognosi sfavorevole
altamente probabile
(FPR 5%)

no

Osserva e
rivaluta



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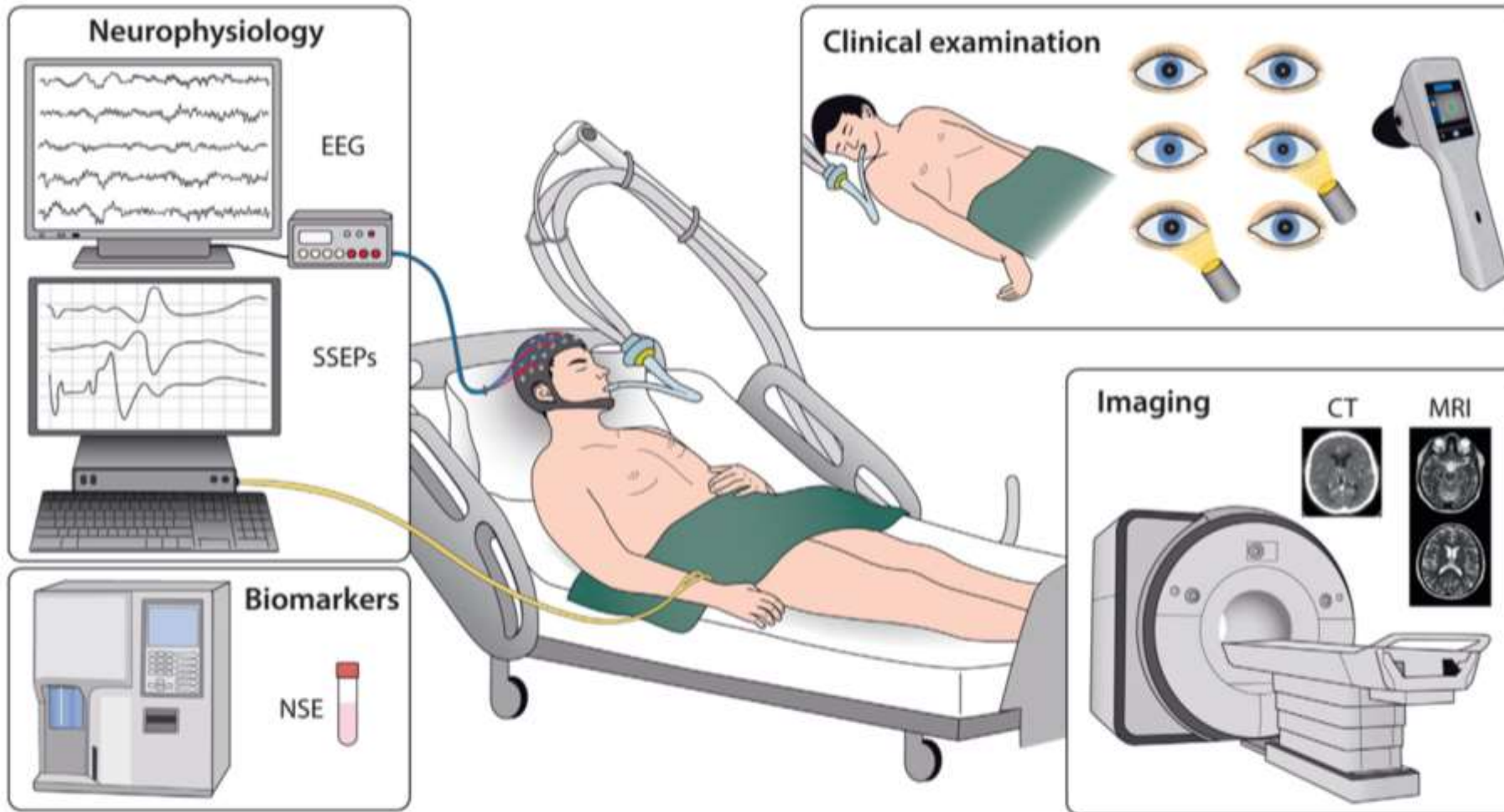
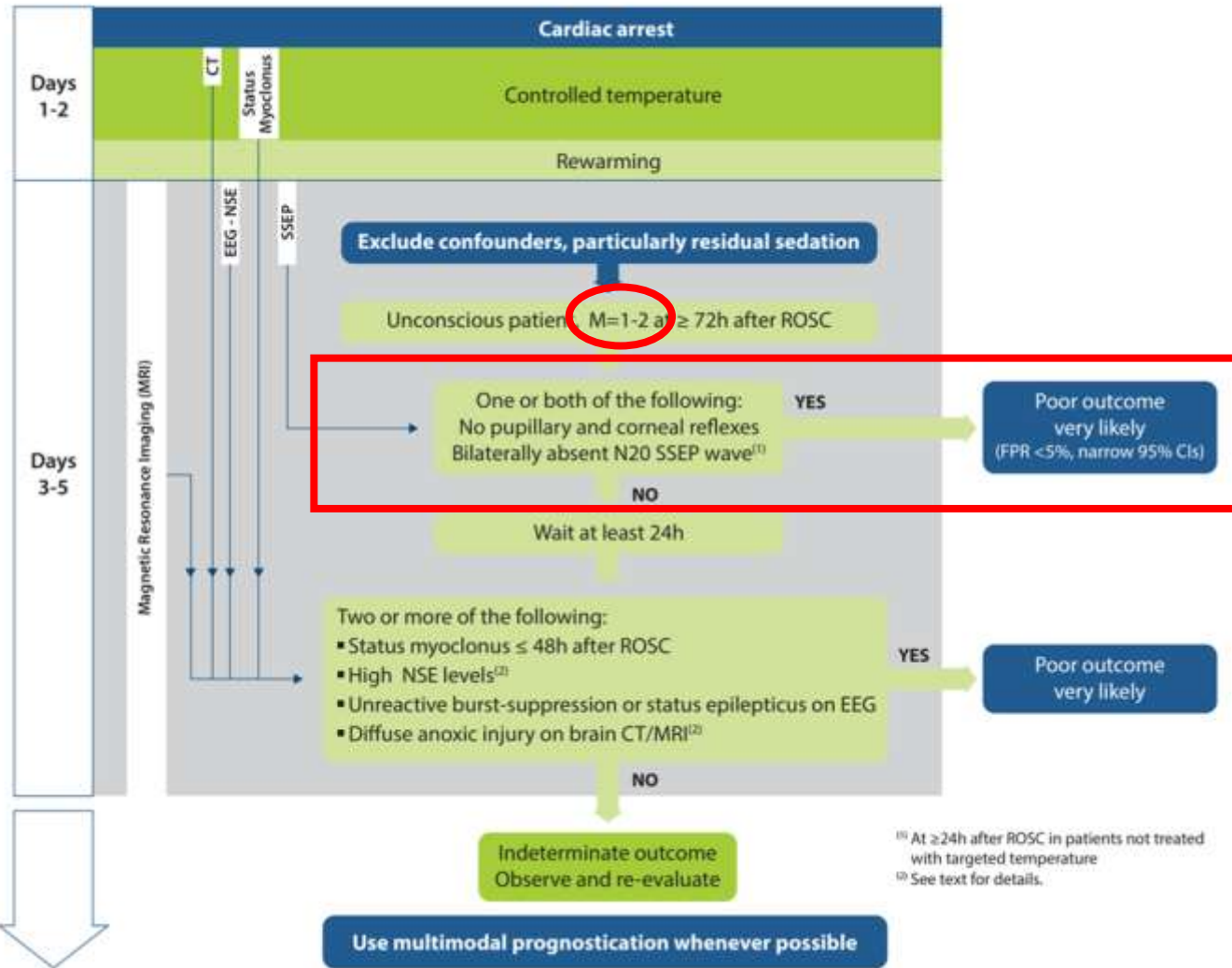
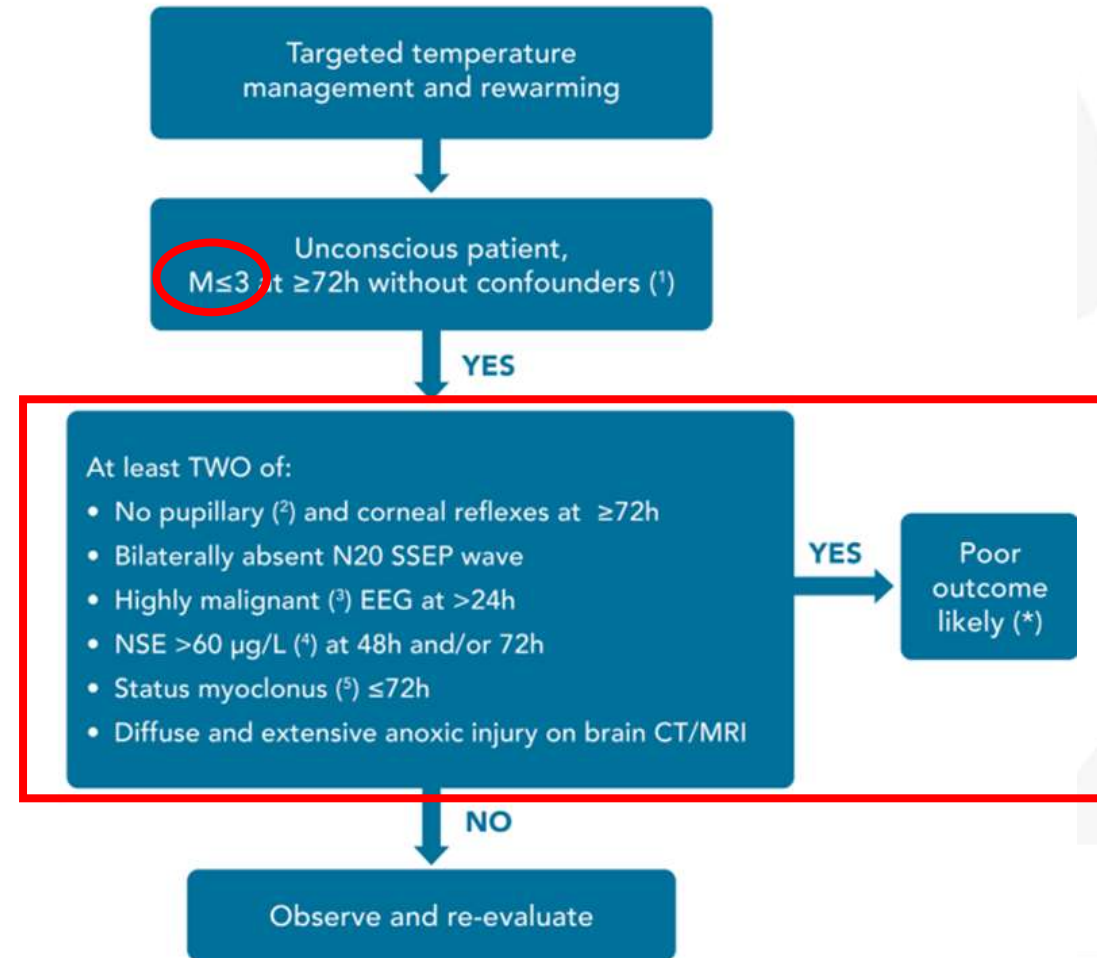


Fig. 4 - Prognostication modes. EEG electroencephalography; NSE neuron specific enolase; SSEP somatosensory evoked potential.

2015 Guidelines



2021 Guidelines



Prognosi favorevole

Intensive Care Med (2022) 48:389–413
<https://doi.org/10.1007/s00134-022-06618-z>


2022



SYSTEMATIC REVIEW

Prediction of good neurological outcome in comatose survivors of cardiac arrest: a systematic review



Claudio Sandroni^{1,2}, Sonia D'Arrigo^{1*} , Sofia Cacciola¹, Cornelia W. E. Hoedemaekers³, Erik Westhall⁴, Marlijn J. A. Kamps⁵, Fabio S. Taccone⁶, Daniele Poole⁷, Frederick J. A. Meijer⁸, Massimo Antonelli^{1,2}, Karen G. Hirsch⁹, Jasmeet Soar¹⁰, Jerry P. Nolan¹¹ and Tobias Cronberg¹²



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Prognosi favorevole

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- GCS Motor score 4 o 5 allo stimolo doloroso
- Pattern EEG continuo, con normale voltaggio e reattivo
- N20 presenti con un'ampiezza $\geq 4 \mu\text{V}$
- Bassi livelli o livelli decrementali di enolsi (NSE)
- RMN encefalo normale

Specificità > 80%
Sensibilità > 40%



Conclusioni

Massimizzare la sicurezza nella prognostication

- Scegliere il predittore più specifico (con basso FPR)
- Strategia multimodale (combinazione di più predittori)
- Non precoce, ma dopo 72-96 ore dall'arresto cardiaco
- Solo dopo aver eliminato tutti i fattori di confondimento
- Con cautela se sono presenti segni discordanti

Gemelli



Fondazione Policlinico Universitario A. Gemelli
Università Cattolica del Sacro Cuore



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