EXAMEN NEUROLOGIQUE DU PATIENT DE REANIMATION

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NEUROLOGICAL EXAMINATION

Admission
1. Neurological disease as cause for admission
2. Preexisting neurological disease (*interpretation of subsequent neurological complication*)

Critical illness
1. Detection of ICU-neurological complication
2. Prevention of ICU-neurological complication

Recovery of critical illness
1. Diagnosis of ICU-neurological complication
2. Treatment of ICU-neurological complication

Discharge
1. Follow-up of ICU-neurological complication
LE SYSTÈME NERVEUX CENTRAL

1. COMA
2. SYNDROME CONFUSIONNEL
3. EPILEPSIE
4. EXAMEN NEUROLOGIQUE DU PATIENT SEDATE
5. COMPORTEMENT DE MALADIE
6. TROUBLES COGNITIFS
7. SYNDROMES MEDULLAIRES
LE COMA

- Present in 25-60% of ICU patients
- Leading predictor of
  - Death
  - Length of mechanical ventilation
  - LOS
- Coma assessment (GCS) is an integral component in the most widely used intensive care scoring systems
  - APACHE
  - SAPS
  - SOFA

Stevens - Crit Care Med - 2006
Comatose patients are not sleeping
Comatose patients do not speak, do not move spontaneously and do not follow commands.
When provoked by a noxious stimulus, their eyes remain closed, vocalization is limited or absent, and motor activity is absent or abnormal and reflexive rather than purposeful or defensive.
NON-ORGANIC

Presence of avoidance
- Blinking to threat
- Do not let hand fall on his face

If any doubt, do an EEG
COMATOSE PATIENT

FOCAL SIGNS
Comparison between right and left body
1. Motor responses to order or painful stimulation
2. Limbs tone
3. Tendon reflexes
4. Plantar reflex

MYOCLONUS
1. Limbs
2. Lids

SCALE

Eyes response
Motor response
Verbal response

BRAINSTEM RESPONSES

Eyes spontaneous movement
Eyes position
Oculocephalogyre response
Oculovestibular response
Pupillar size
Pupillar light reflex
Corneal reflex
Grimace
Cough reflex
Oculocardiac response
Respiratory pattern
MOTOR RESPONSE

A Metabolic encephalopathy

B Diencephalic-midbrain damage

C Midbrain damage

External rotation of lower limb + Babinski
decortication « décérébration »
COMATOSE PATIENT

EYES POSITION

Bilateral hemispheric

Skew deviation (Cajal nuclei)

Hemispheric / pons

Thalamus / mesenceph

Wijdicks E.F.M.
Plum and Posner
COMATOSE PATIENT

A: roving
B: periodic alternating gaze (bi H., cereb.)
C: ping pong (bi H., cereb.)

D: convergence nystagmus (mesenceph.)
E: bobbing (pons)
F: dipping (bi H.)

Wijdicks E.F.M.
PUPILS

Adapted from Plum and Posner's Diagnosis of Stupor and Coma
SIXTH NERVE PALSY

No localisation value
Intracranial hypertension
THIRD NERVE PALSY
THIRD NERVE PALSY

Aneurysm I.C. or A.S.

Uncal herniation

Cavernous sinus thrombosis
HERNIATION

Engagement sous la faux (gyrus cingulare)
Engagement central (diencéphale)
Engagement temporal (uncus et hippocampe)
Engagement occipital (amygdale cérébelleuse)
CLAUDE BERNARD HORNER

Medulla (Wallenberg)

Spine

Cancer

Sympathetic nervous system

Dissection Catheter
- **Cheyne-Stokes**
  Respiratory centers are functioning
  (autre cause = Low cardiac output)

- **Hyperventilation**
  Acidosis, Sepsis +++

- **Apnea**

- **Gasps et Apnée**
  Respiratory centers are altered

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**Plum and Posner's Diagnosis of Stupor and Coma**
OTHER RESPIRATORY SIGNS

• Yawning
  – Low value for localisation (Bulbar, can be seen in Locked-in or during temporal seizure)

• Hick-up:
  – irritation of X/ medullar tegmentum bulbaire
  – corticosteroids…

• Vomiting:
  – Intracranial hypertension, lesion of medulla or pons…
VITAL SIGNS

• HYPERTENSION
  – Adrenergic storm +++
  – Intracranial hypertension
  – toxic (amphétamin, cocaine)
  – hypertensive encephalopathy (PRES)

• HYPOTENSION
  – shock, (can be the cause of the coma +++)
  – Neurogenic myocardiac dysfunction (ou « Tako-Tsubo »)

• RESPIRATORY DISTRESS
  – Can be cause of the coma +++
  – Medulla syndrome
  – Neurogenic pulmonary edema

• HYPERTHERMIA
  – Infection,: méningitis/encéphalitis/abscesses, paludism +++
  – Heat stroke
Patients with the lowest GCS score could be further distinguished using the FOUR score.

**FOUR & GLASGOW COMA SCALES**

<table>
<thead>
<tr>
<th>FOUR Score</th>
<th>Glasgow Coma Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Eye response</strong></td>
<td><strong>Eye response</strong></td>
</tr>
<tr>
<td>4 = eyelids open or opened, tracking, or blinking to command</td>
<td>4 = eyes open spontaneously</td>
</tr>
<tr>
<td>3 = eyelids open but not tracking</td>
<td>3 = eye opening to verbal command</td>
</tr>
<tr>
<td>2 = eyelids closed but open to loud voice</td>
<td>2 = eye opening to pain</td>
</tr>
<tr>
<td>1 = eyelids closed but open to pain</td>
<td>1 = no eye opening</td>
</tr>
<tr>
<td>0 = eyelids remain closed with pain</td>
<td></td>
</tr>
<tr>
<td><strong>Motor response</strong></td>
<td><strong>Motor response</strong></td>
</tr>
<tr>
<td>4 = thumbs-up, fist, or peace sign</td>
<td>6 = obeys commands</td>
</tr>
<tr>
<td>3 = localizing to pain</td>
<td>5 = localizing pain</td>
</tr>
<tr>
<td>2 = flexion response to pain</td>
<td>4 = withdrawal from pain</td>
</tr>
<tr>
<td>1 = extension response to pain</td>
<td>3 = flexion response to pain</td>
</tr>
<tr>
<td>0 = no response to pain or generalized myoclonus status</td>
<td>2 = extension response to pain</td>
</tr>
<tr>
<td></td>
<td>1 = no motor response</td>
</tr>
<tr>
<td><strong>Brainstem reflexes</strong></td>
<td><strong>Verbal response</strong></td>
</tr>
<tr>
<td>4 = pupil and corneal reflexes present</td>
<td>5 = oriented</td>
</tr>
<tr>
<td>3 = one pupil wide and fixed</td>
<td>4 = confused</td>
</tr>
<tr>
<td>2 = pupil or corneal reflexes absent</td>
<td>3 = inappropriate words</td>
</tr>
<tr>
<td>1 = pupil and corneal reflexes absent</td>
<td>2 = incomprehensible sounds</td>
</tr>
<tr>
<td>0 = absent pupil, corneal, and cough reflex</td>
<td>1 = no verbal response</td>
</tr>
<tr>
<td><strong>Respiration</strong></td>
<td><strong>FOUR</strong> = Full Outline of UnResponsiveness.</td>
</tr>
<tr>
<td>4 = not intubated, regular breathing pattern</td>
<td></td>
</tr>
<tr>
<td>3 = not intubated, Cheyne–Stokes breathing pattern</td>
<td></td>
</tr>
<tr>
<td>2 = not intubated, irregular breathing</td>
<td></td>
</tr>
<tr>
<td>1 = breathes above ventilator rate</td>
<td></td>
</tr>
<tr>
<td>0 = breathes at ventilator rate or apnea</td>
<td></td>
</tr>
</tbody>
</table>

*Wijdicks et al – Ann Neurol - 2005*
She is fine, she is sleeping...

- 27/11/10: 74 years old and aplastic patient
- 1-2/12/11: Pneumoniae and shock (Pseudomonas Aeruginosa et Stenotrophomonas Maltophilia)
- 5/12/11: Non sedated. The patient is sleeping...
She is fine, she is sleeping…
**Delirium / Confusion**

*DSM IV : Diagnostic Statistical Manual (of American Psychiatric Association)*

A. **Trouble de conscience** : diminution de la réactivité à l’environnement, difficultés attentionnelles, à se concentrer

B. **Atteinte d’une ou plusieurs fonctions cognitives** :
   - Trouble du langage
   - Troubles de mémoire
   - Désorientation temporelle et spatiale
   - Troubles du jugement et du raisonnement

C. **Apparition brutale ou rapidement progressive** (mn, heures ou jours), **fluctuation des symptômes au cours du temps**

D. **Le trouble est lié à un ou plusieurs des éléments suivants** :
   - Pathologie médicale
   - Prise médicamenteuse / intoxication
   - Sevrage

*Romain Sonneville*
## INCIDENCE

<table>
<thead>
<tr>
<th>Auteur, année</th>
<th>Population Réa, n</th>
<th>Critère (échelle)</th>
<th>Fréq.</th>
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</thead>
<tbody>
<tr>
<td>Dubois, ICM 2001</td>
<td>Med-chir, n=216</td>
<td>Delirium (ICDSC)</td>
<td>19%</td>
</tr>
<tr>
<td>Ely, CCM 2001</td>
<td>Med, n=48</td>
<td>Delirium (CAM-ICU)</td>
<td>60%</td>
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<tr>
<td>Ely, Crit care 2003</td>
<td>Med non ventilés, n=261</td>
<td>Delirium (CAM-ICU)</td>
<td>48%</td>
</tr>
<tr>
<td>Woods, ICM 2004</td>
<td>Med, n=143</td>
<td>Agitation (MAAS)</td>
<td>16%</td>
</tr>
<tr>
<td>Ely, JAMA 2004</td>
<td>Med et USIC, n=224</td>
<td>Delirium (CAM-ICU)</td>
<td>82%</td>
</tr>
<tr>
<td>Jaber, Chest 2005</td>
<td>Med-chir, n=211</td>
<td>Agitation (Ramsay)</td>
<td>52%</td>
</tr>
<tr>
<td>Ely, ICM 2007</td>
<td>Chir-Trauma, n=100</td>
<td>Delirium (CAM-ICU)</td>
<td>70%</td>
</tr>
<tr>
<td>Ely, JAMA 2007</td>
<td>Med-chir, n=106</td>
<td>Delirium (CAM-ICU)</td>
<td>80%</td>
</tr>
<tr>
<td>Ouimet, ICM 2007</td>
<td>Med-chir, n=820</td>
<td>Delirium (ICDSC)</td>
<td>32%</td>
</tr>
</tbody>
</table>
DISTRIBUTION

Figure 2. Daily Neurologic Status of 275 Patients in the ICU, Through the First 14 Days of the Study

Denominator is identical (N = 275) for all 14 days. ICU indicates intensive care unit.

Ely et al – JAMA - 2004
DELIRIUM TYPES

Hyperactive delirium: agitation, restlessness, emotional lability

Hypoactive delirium: withdrawal, flat affect, lethargy and decreased responsiveness
DELIRIUM SCALES

Sedation/Agitation:
- RAMSAY
- Richmond Agitation Sedation Scale (RASS)
- Adaptation to the Intensive Care Unit Environment (ATICE)

Delirium:
- Confusion Assessment Method for the ICU (CAM-ICU)
- Intensive Care Delirium Screening Check-list (ICDSC)

MUST BE COMPLETD BY
1. A FULL NEUROLOGICAL EXAMINATION (focal sign, neck stiffness…)
2. EEG
CAM-ICU : Échelle d'évaluation des états confusionnels en réanimation

Évaluation de la confusion (échelle CAM-ICU) : 1 et 2 et (3 ou 4)

1. Altération ou variation
   - Modification de l'état mental basal ?
   - Variation du RASS au cours des 24 dernières heures ?

2. Inattention
   - Lire les dix lettres suivantes : "ABRACADABRA"
   - Erreur : Si le patient ne serre pas la main sur une lettre "A" ou si il la serre sur tout autre lettre que "A".
   - En cas d'incertitude sur le résultat faire le test des images.

3. Niveau de conscience altéré (vrai « RASS »)
   - Si RASS = 0 aller à l'étape suivante.
   - si RASS ≠ 0

4. Pensée incohérente
   1. Est-ce qu'une pierre flotte sur l'eau ? (ou : Est-ce qu'une feuille flotte sur l'eau ?)
   2. Y a-t-il des poissons dans la mer ? (ou : Y a-t-il des éléphants dans la mer ?)
   3. Est-ce qu'un kilogramme pèse plus que 2 kilogrammes ? (ou : Est-ce que 2 kg pèsent plus que 1 kg ?)
   4. Peut-on utiliser un marteau pour écraser un clou ? (ou : Pouvez-vous utiliser un marteau pour couper du bois ?)
   5. Dire : "Montrez autant de doigts que moi" (en montrant 2 doigts au patient).
   - "Maintenant faites pareil avec l'autre main" (sans répéter le nombre de doigts). Si un bras est indisponible dire « Ajouter un doigt ».

RASS supérieure à -4 (entre -3 et +4)
Alier à l'étape 2
RASS égale -4 ou -5
Stop
Ré-évaluer le patient plus tard
Intensive Care Delirium Screening Checklist (ICDSC)

Réalisée une fois par 8 heures

Si total \( \geq 4 \) : DELIRIUM

1. Conscience altérée (Si A ou B, ne pas poursuivre évaluation)
   A. Pas de réponse à une stimulation : ne pas coter
   B. Réponse à une stimulation intense et répétée (voix, douleur) : idem
   C. Réponse à une stimulation modérée : 1
   D. Patient normalement éveillé : 0
   E. Réponse exagérée à la stimulation : 1

2. Inattention (0 ou 1)
3. Désorientation (0 ou 1)
4. Hallucinations (0 ou 1)
5. Agitation ou ralentissement psycho-moteur (0 ou 1)
6. Discours ou humeur inappropriés (0 ou 1)
7. Troubles du cycle veille-sommeil (0 ou 1)
8. Fluctuations des symptômes (0 ou 1)

Bergeron ICM, 2001
### FACTEURS DE RISQUE/CAUSES

<table>
<thead>
<tr>
<th>HOST FACTORS</th>
<th>CRITICAL ILLNESS FACTORS</th>
<th>IATROGENIC FACTORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (older)</td>
<td>Acidosis</td>
<td>Immobilization</td>
</tr>
<tr>
<td>Alcoholism</td>
<td>Anemia</td>
<td>Medications (opioids, bzd)</td>
</tr>
<tr>
<td>APOE4</td>
<td>Fever/infection/sepsis</td>
<td>Corticosteroid</td>
</tr>
<tr>
<td>Cognitive impairment</td>
<td>Hypotension</td>
<td>AB neurotoxicity</td>
</tr>
<tr>
<td>Depression</td>
<td>Metabolic disturbances (for example, sodium, calcium, BUN, bilirubin)</td>
<td>Sleep disturbances</td>
</tr>
<tr>
<td>Hypertension</td>
<td>Withdrawal syndrome</td>
<td>Dehydration, dyspnea</td>
</tr>
<tr>
<td>Smoking</td>
<td>Respiratory disease/congestive heart failure</td>
<td></td>
</tr>
<tr>
<td>Vision/hearing impairment</td>
<td>High severity of illness</td>
<td></td>
</tr>
</tbody>
</table>

**MULTIFACTORIAL**
CASE REPORT 2

A 55 years old man was hospitalised for a septic shock. Blood culture were positive to Staphylococcus aureus and CSF analysis showed an aseptic meningitis. At admission, neurological examination was normal as well as MRI of the brain and spine. Transoesophageal cardiac ultrasound only showed a thrombus in the left atria. He also underwent surgery for a septic arthritis of the right knee. A right jugular catheter could not be put. A goitre was also noticed. Vasopressor and mechanical ventilation were discontinued the 3rd and 5th days from admission. The patient was treated with methicillin and heparin.

Day 8, the patient developed agitation and delirium. Neurological examination showed a weakness of the right arm and slight right central facial palsy as well a ptosis and miosis of the right eye. The right arm was also oedematous. The brain CT scan and CSF analysis were normal. EEG showed a slow cortical activity. Biochemical screening showed a moderate renal insufficiency. Blood culture were negative.
Case report 2

1. Left pre-rolandic lesion
2. Thrombosis of right jugular vein
3. Orbenin overdose
Mme X..., âgée de 53 ans, traitée par CS et I- pour un LED, est hospitalisée pour une insuffisance rénale aiguë en rapport avec une Mat traité par EP compliqué d’un hématome de la cuisse. Survenue d’un état d’agitation et délirant: « on me vole mon enfant, les médecins me vole mon enfant... »
### CRISE D’ÉPILEPSIE

<table>
<thead>
<tr>
<th></th>
<th>Population</th>
<th>Monitoring</th>
<th>Seizure</th>
<th>CS</th>
<th>NCS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wijdicks 1996</strong></td>
<td>Liver transplant (n=630)</td>
<td>Clinical</td>
<td>28 (4%)</td>
<td>28 (4%)</td>
<td>-</td>
</tr>
<tr>
<td><strong>Navarro 2010</strong></td>
<td>Heart transplant (n=166)</td>
<td>Clinical</td>
<td>8 (4.8%)</td>
<td>8 (4.8%)</td>
<td>-</td>
</tr>
<tr>
<td><strong>Oddo 2009</strong></td>
<td>Critically ill (n=201)</td>
<td>cEEG</td>
<td>45 (22%)</td>
<td>10 (48%)</td>
<td>35 (78%)</td>
</tr>
<tr>
<td><strong>Claassen 2004</strong></td>
<td>Altered consciousness (n=570)</td>
<td>cEEG</td>
<td>110 (19%)</td>
<td>9 (1%)</td>
<td>101 (18%)</td>
</tr>
</tbody>
</table>

* CS: convulsive seizure ** NCS: non convulsive seizure
ETIOLOGY

Critical illness

Neurological pathology

Neurovascular
  Thrombo-embolic ischemic stroke
  Vascular malformations
  Hemorrhagic states resulting
    from the above
Tumor
  Primary
  Metastatic
CNS infection
  Abscess
  Meningitis
  Encephalitis
Inflammatory disease
  Vasculitis
  Acute disseminated
    encephalomyelitis
Trauma
  Contusion
  Hemorrhage
Primary epilepsy
Primary inherited CNS
  metabolic disturbance

Drug/substance toxicity
  Antibiotics
  Antidepressants
  Antipsychotics
  Bronchodilators
  Local anesthetics
  General anesthetics
  Opioids
  Immunosuppressives
  Cocaine, amphetamines
  Phencyclidine
Drug/substance withdrawals
  Barbiturates
  Benzodiazepines
  Opioids
  Alcohol
Infection/fever (febrile seizures)
Metabolic abnormalities
  Hyponatremia
  Hypocalcemia
  Hypophosphatemia
  Hypoglycemia
Renal/hepatic dysfunction
Surgical injury (craniotomy)

Varelas and Mirski – J Neurosurg Anesth - 2001
ETIOLOGY

Medical and surgical ICUs
Clinically symptomatic

<table>
<thead>
<tr>
<th>Causes of new onset seizures in critical illness</th>
<th>N = 55</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drug withdrawal (Morphine, midazolam…)</td>
<td>18 (32%)</td>
</tr>
<tr>
<td>Metabolic abnormalities (hypoNa, HypoCa2+…)</td>
<td>10 (18%)</td>
</tr>
<tr>
<td>Drug toxicity (antibiotics, antiarythmics…)</td>
<td>8 (14%)</td>
</tr>
<tr>
<td>Stroke</td>
<td>5 (9%)</td>
</tr>
<tr>
<td>Unknown</td>
<td>6 (11%)</td>
</tr>
</tbody>
</table>
WHEN DOING AN EEG?

- **Clinical suspicion of seizure**
  1. Abnormal limbs movement
  2. Abnormal ocular movement
  3. Facial myoclonia
  4. Unexplained coma
  5. Unexplained delirium

- **Diagnosis of coma (if doubt)**
- **Diagnosis of brain death**
- **Diagnosis of metabolic encephalopathy**
- **Monitoring (TBI, SHA, Hypothermia….)**
SEIZURE

- Seizure versus SE (emergency)
- CSE (emergency) versus NCSE
- Subtle SE (emergency) versus other NCSE

Melerkorp and Holtkamp – Lancet Neurology - 2007
DYSFONCTION NEUROLOGIQUE AIGUÈ CHEZ LE PATIENT SEDATE
A 52 years old and alcoholic man was hospitalised in ICU for an hypoxemic community-acquired pneumonia, with blood cultures positive to S. pneumoniae. At admission, neurological examination was normal and there was no neck stiffness.

One day later, he required mechanical ventilation and developed agitation, which was treated with Haloperidol.

Because he became more and more agitated, he was heavily sedated. Agitation was ascribed to alcohol withdrawal.

A week later, while the patient was sedated, bilateral large fixed pupils were observed.

CT scan showed diffuse brain oedema and lumbar puncture meningitis.
ERREURS

1. Absence d’interprétation clinique de l’agitation.
2. Absence de monitoring de la sédation.
3. Considérer que l’examen neurologique chez un patient sédaté est ininterprétable.
4. Rapporter l’agitation uniquement à un sevrage éthylique?
5. Ne pas avoir fait de PL lorsque le patient a été sédaté.
SEVRAGE ETHYLIQUE

By definition, the patient must have two or more of the following after cessation or reduction of alcohol use that has been heavy or prolonged:
1. autonomic hyperactivity (sweating, tachycardia);
2. increased hand tremor;
3. insomnia;
4. nausea or vomiting;
5. transient visual, tactile, or auditory hallucinations or illusions;
6. psychomotor agitation; anxiety and tonic-clonic seizures.

Treatment: BZD

DTS is characterised by a fluctuating disturbance of consciousness and change in cognition occurring over a short period of time. It is accompanied by a further exacerbation of autonomic symptoms (sweating, nausea, palpitations and tremor) and an exacerbation of psychological symptoms including anxiety.

Clinical Institute Withdrawal Assessment Scale for Alcohol,
EFFECTS OF SEDATION

• Severe septic or critically ill patients often require sedation
• Sedation is a risk factor for delirium
• How to detect acute brain dysfunction in sedated critically ill patients?
**DESIGN**

*Non brain injured critical ill patients*

- [12-24h] Every day Discontinuation of sedation Within 3 days
- 1st N.E N.E Coma/Delirium

Reproducibility of neurological examination was satisfactory

*Sharshar et al – Crit Care Med – 2011*
# NEUROLOGICAL EXAMINATION

## 12-24H OF SEDATION

<table>
<thead>
<tr>
<th></th>
<th>Fitting set</th>
<th>Validation set</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number of patients</strong></td>
<td>72</td>
<td>72</td>
</tr>
<tr>
<td><strong>Midazolam (mg/kg)</strong></td>
<td>0.9 (0.6 to 1.8)</td>
<td>1.3 (0.8 to 2.0)</td>
</tr>
<tr>
<td><strong>Subfentanyl (µg/kg)</strong></td>
<td>2.0 (0.8 to 4.0)</td>
<td>2.0 (0.7 to 4.6)</td>
</tr>
<tr>
<td><strong>sedation to inclusion (hours)</strong></td>
<td>12 (12-24)</td>
<td>12 (12-24)</td>
</tr>
<tr>
<td><strong>ATICE (from 0 to 20)</strong></td>
<td>9 (9 to 10)</td>
<td>9 (9 to 10)</td>
</tr>
<tr>
<td><strong>RASS</strong></td>
<td>Not tested</td>
<td>-4 (-4 to -2)</td>
</tr>
<tr>
<td><strong>Blinking to strong light (%)</strong></td>
<td>31 (43)</td>
<td>28 (39)</td>
</tr>
<tr>
<td><strong>Absent eye movement (%)</strong></td>
<td>66 (93)</td>
<td>67 (93)</td>
</tr>
<tr>
<td><strong>Myosis (%)</strong></td>
<td>45 (63)</td>
<td>38 (54)</td>
</tr>
<tr>
<td><strong>Pupillary light response (%)</strong></td>
<td>51 (71)</td>
<td>58 (82)</td>
</tr>
<tr>
<td><strong>Corneal reflex (%)</strong></td>
<td>65 (90)</td>
<td>66 (92)</td>
</tr>
<tr>
<td><strong>Oculocephalic response (%)</strong></td>
<td>32 (47)</td>
<td>33 (46)</td>
</tr>
<tr>
<td><strong>Cough response (%)</strong></td>
<td>36 (51)</td>
<td>60 (83)</td>
</tr>
<tr>
<td><strong>Grimacing (%)</strong></td>
<td>41 (57)</td>
<td>48 (69)</td>
</tr>
</tbody>
</table>
## 28-DAYS MORTALITY

### Multiple logistic model

**RESPONSES ASSESSED BETWEEN THE 12\textsuperscript{th} AND 24\textsuperscript{th} H OF SEDATION**

<table>
<thead>
<tr>
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<tr>
<td></td>
<td>OR (95%CI)</td>
<td>P</td>
<td>OR (95%CI)</td>
<td>P</td>
</tr>
<tr>
<td>SAPS-II at inclusion</td>
<td>1.06 (1.02 to 1.09)</td>
<td>0.003</td>
<td>1.03 (1.00 to 1.07)</td>
<td>0.051</td>
</tr>
<tr>
<td>Absent cough response</td>
<td>7.80 (2.00 to 30.4)</td>
<td>0.003</td>
<td>5.44 (1.35 to 22.0)</td>
<td>0.017</td>
</tr>
<tr>
<td>C-index (SE)</td>
<td>0.836 (0.055)</td>
<td></td>
<td>0.743 (0.067)</td>
<td></td>
</tr>
</tbody>
</table>

*Sharshar et al – Crit Care Med - 2011*
ALTERED MENTAL STATUS
(after discontinuation of sedation)

Multiple logistic model

RESPONSES ASSESSED BETWEEN THE 12<sup>th</sup> AND 24<sup>th</sup> hours of sedation

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Fitting set</th>
<th>Validation set</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Confusion or coma</td>
<td>Delirium or coma</td>
</tr>
<tr>
<td></td>
<td>OR (95%CI)</td>
<td>OR (95%CI)</td>
</tr>
<tr>
<td></td>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td>SAPS-II at inclusion</td>
<td>1.04 (1.00 to 1.07)</td>
<td>1.03 (0.99 to 1.08)</td>
</tr>
<tr>
<td></td>
<td>0.058</td>
<td>0.10</td>
</tr>
<tr>
<td>Absent oculocephalic response</td>
<td>4.49 (1.34 to 15.1)</td>
<td>5.64 (1.63 to 19.5)</td>
</tr>
<tr>
<td></td>
<td>0.015</td>
<td>0.006</td>
</tr>
</tbody>
</table>

*Sharshar et al – Crit Care Med - 2011*
1. Feasible, reproducible and interpretable
2. Enables to detect focal neurological sign
3. Enables to estimate critical illness severity (cough reflex)
4. Enables to identify patient at risk to develop delirium after sedation discontinuation (Oculocephalalogyre response) – Titration of sedation?

Sharshar et al – Crit Care Med - 2011
# NEUROLOGICAL PROFILES

<table>
<thead>
<tr>
<th></th>
<th>Class 1</th>
<th>Class 2</th>
<th>Class 3</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>68 (35%)</td>
<td>81 (41%)</td>
<td>48 (24%)</td>
<td></td>
</tr>
<tr>
<td>GCS Eyes response</td>
<td>1 (2 to 3)</td>
<td>1 (1 to 1)</td>
<td>1 (1 to 1)</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>GCS Motor response</td>
<td>4 (4 to 6)</td>
<td>1 (1 to 1)</td>
<td>1 (1 to 1)</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Myosis</td>
<td>30 (44)</td>
<td>46 (57)</td>
<td>39 (81)</td>
<td>0.026</td>
</tr>
<tr>
<td>Pupillar light reflex</td>
<td>64 (94)</td>
<td>70 (86)</td>
<td>28 (58)</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Corneal reflex</td>
<td>68 (100)</td>
<td>77 (95)</td>
<td>31 (65)</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Oculocephalogyre reflex</td>
<td>55 (81)</td>
<td>45 (56)</td>
<td>2 (4)</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Grimace</td>
<td>63 (93)</td>
<td>61 (75)</td>
<td>0 (0)</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Cough reflex</td>
<td>65 (96)</td>
<td>68 (84)</td>
<td>24 (50)</td>
<td>&lt; 0.0001</td>
</tr>
</tbody>
</table>

Rohaut et al - Submitted
## NEUROLOGICAL PROFILES

<table>
<thead>
<tr>
<th></th>
<th>Class 1</th>
<th>Class 2</th>
<th>Class 3</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median (IQR); n (%)</td>
<td>84 (48)</td>
<td>74 (33)</td>
<td>36 (19)</td>
<td></td>
</tr>
<tr>
<td>Midazolam infusion rate</td>
<td>4.9 (3.1)</td>
<td>6.1 (4.0)</td>
<td>6.0 (4.1)</td>
<td>0.17</td>
</tr>
<tr>
<td>Midazolam cumulative dose</td>
<td>1.7 (1.6)</td>
<td>1.6 (1.7)</td>
<td>1.5 (1.3)</td>
<td>0.83</td>
</tr>
<tr>
<td>Sufentanyl infusion rate</td>
<td>10.1 (7.6)</td>
<td>13.8 (11.0)</td>
<td>13.1 (10.6)</td>
<td>0.073</td>
</tr>
<tr>
<td>Sufentanyl cumulative dose</td>
<td>3.6 (3.1)</td>
<td>3.6 (4.3)</td>
<td>3.5 (3.3)</td>
<td>0.71</td>
</tr>
<tr>
<td>Age</td>
<td>61 (51 to 78)</td>
<td>68 (55 to 80)</td>
<td>74 (63 to 82)</td>
<td>0.009</td>
</tr>
<tr>
<td>Sexe (%)</td>
<td>32 (47)</td>
<td>30 (37)</td>
<td>18 (38)</td>
<td>0.42</td>
</tr>
<tr>
<td>SAPS-II</td>
<td>47 (33 to 60)</td>
<td>56 (40 to 75)</td>
<td>58 (47 to 72)</td>
<td>0.006</td>
</tr>
<tr>
<td>RASS</td>
<td>-2 (-4 to -2)</td>
<td>-5 (-5 to -4)</td>
<td>-5 (-5 to -5)</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Sepsis (%)</td>
<td>48 (71)</td>
<td>61 (77)</td>
<td>37 (79)</td>
<td>0.54</td>
</tr>
<tr>
<td>Coma (%)</td>
<td>7 (11)</td>
<td>13 (19)</td>
<td>11 (28)</td>
<td>0.08</td>
</tr>
<tr>
<td>Delirium (%)</td>
<td>25 (41)</td>
<td>35 (51)</td>
<td>19 (51)</td>
<td>0.45</td>
</tr>
<tr>
<td>Coma &amp; Delirium (%)</td>
<td>29 (47)</td>
<td>43 (62)</td>
<td>27 (71)</td>
<td>0.041</td>
</tr>
<tr>
<td>ICU mortality (%)</td>
<td>15 (22)</td>
<td>23 (30)</td>
<td>30 (62)</td>
<td>&lt; 0.0001</td>
</tr>
</tbody>
</table>
CASE REPORT

Abolition of the left patellar reflex in 72 years old man who needed to be sedated for a very severe ARDS
LONG-TERM COGNITIVE DECLINE
Cognitive outcomes during follow-up

<table>
<thead>
<tr>
<th>Outcome, % (n/total)</th>
<th>3 months (n=76)</th>
<th>12 months (n=52)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No impairment</td>
<td>21% (16/76)</td>
<td>29% (15/52)</td>
</tr>
<tr>
<td>Mild/moderate impairment</td>
<td>17% (13/76)</td>
<td>35% (18/52)</td>
</tr>
<tr>
<td>Severe impairment</td>
<td>62% (47/76)</td>
<td>36% (19/52)</td>
</tr>
</tbody>
</table>

77 Medical ICU patients

Memory
Attention
Concentration

Hippocampus
Frontal cortex

Girard et al – Crit Care Med - 2010
Long-Term Cognitive Impairment after Critical Illness

Global Cognition Scores in Survivors of Critical Illness.

*Pandharipande et al – NEJM - 2013*
COMPORTEMENT DE MALADIE
REPONSE À L’AGRESSION
ENCEPHALOPATHIE
• **Sickness behavior** is a major, highly preserved and adaptive component of response to stress.

• The **sickness behavior** includes stereotypical changes: anxiety, immobility, somnolence, starving, autonomic and neuroendocrine changes etc…

• It involves the amygdala and hippocampus and is mediating by specific structures: circumventricular organs and vagal nerve.

*Dantzer et al – Nat Neurosci Rev-2008*
PHYSIOLOGICAL BRAIN SIGNALLING

Sickness behavior
Adapted autonomic and neuroendocrine response

Circumventricular organs (no BBB)

Vagal nerve

Delirium

Dantzer et al – Nat Rev Sci - 2008
ANXIETY & FEAR
(patients with GBS)

Sharshar et al – BMJopen access-2012
PANICU PROJECT:
TO ASSESS THE PROGNOSIS VALUE OF ANXIETY AT ADMISSION IN ICU
Sickness behavior

Delirium

Coma

Sedation

Neuroendocrine system
Hippocampus
Limbic system

Psychologic disorders
(Anxiety, depression, PTSD)

Cognitive impairment
(Memory and executive functions)

Death

Brainstem

Frontal cortex

Hippocampus

Brain structures

Outcomes

Acute brain dysfunction
Non sedated

EXAMINATION

Normal

Monitoring

Discontinuation of sedation

Sedation necessary

Brainstem reflexes

Sedated

LUMBAR PUNCTURE IF ANY DOUBT

Focal sign

Brain imaging

Myoclonus

EEG - Biochemistry - Drugs

Antagonist?

Coma

EEG - Biochemistry - Drugs

Brain imaging

Delirium

Biochemistry - Drugs

Agitation

EEG

Brain imaging

UNCONTROLLED SEPSIS?

Sedation necessary

Monitoring
DYSFONCTIONS CEREBRALES AIGUÉS

Medical history (Alcohol, Epilepsia…)
Circonstances (CO…)

Glycemia

Fever
Neck stiffness
Focal sign
Seizure
Trauma

Imaging,
± AB ± CSF
Imaging
± AB ± CSF
Imaging
± CSF
EEG,
Imaging
± CSF
Imaging

EEG SI DOUTE OU ABSENCE DE CAUSE / BILAN STANDARD
SPINAL CORD SYNDROMES

Complete transection

Brown Séquard

Syringomyelic

Complete transection

ALS

Poliomyelitis

Posterior spinal artery

Anterior spinal artery

Subacute combined degeneration
LE SYSTÈME NERVEUX PERIPHERIQUE
## PERIPHERAL NERVOUS SYSTEM

<table>
<thead>
<tr>
<th>Symmetry</th>
<th>Neurono-neuropathy</th>
<th>Neuropathy</th>
<th>Myasthenic syndrome</th>
<th>Myopathy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bilateral ± symmetrical</td>
<td>Variable MM: asymmetrical PN: symmetrical PRN: symmetrical</td>
<td>Bilateral and symmetrical</td>
<td>Bilateral and symmetrical</td>
<td></td>
</tr>
<tr>
<td>Proximal vs distal</td>
<td>Proximal or distal</td>
<td>MM: distal PN: distal PRN: proximal</td>
<td>Proximal ++</td>
<td>Proximal ++</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Topography</th>
<th>MM: mononeuropathy multiplex; PN: polyneuropathy; polyradiculoneuropathy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limbs, Bulbar, respiratory</td>
<td>MM: ( \geq 1 ) nerve PN: limbs ± respiratory PRN: limbs, trunk, bulbar, facial, respiratory</td>
</tr>
<tr>
<td>Varied</td>
<td>Limbs, facial, bulbar, trunk or respiratory Ptosis (often unilateral) and diplopia</td>
</tr>
<tr>
<td>Varied</td>
<td>Limbs, facial, bulbar, trunk, respiratory</td>
</tr>
</tbody>
</table>
### PERIPHERAL NERVOUS SYSTEM

<table>
<thead>
<tr>
<th></th>
<th>Neurono-Neuropathy</th>
<th>Neuropathy</th>
<th>Myasthenic syndrome</th>
<th>Myopathy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tone</td>
<td>flaccidity</td>
<td>flaccidity</td>
<td>flaccidity</td>
<td>flaccidity</td>
</tr>
<tr>
<td>Tendon reflexes</td>
<td>Lost or pyramidal signs (ALS)</td>
<td>Lost or decreased</td>
<td>Preserved</td>
<td>Preserved</td>
</tr>
<tr>
<td>Idio-muscular response</td>
<td>Preserved</td>
<td>Preserved</td>
<td>Preserved</td>
<td>Absent</td>
</tr>
<tr>
<td>Atrophy</td>
<td>Pronounced</td>
<td>Pronounced</td>
<td>No</td>
<td>Variable</td>
</tr>
<tr>
<td>Other motor signs</td>
<td>Fasiculation</td>
<td>-</td>
<td>Fatigability Fluctuation</td>
<td>Myalgia Myotonia</td>
</tr>
<tr>
<td>Other neurological signs</td>
<td>Cramps</td>
<td>± sensory loss ± dysautonomia</td>
<td>No sensory loss (except L. Eaton)</td>
<td>No sensory loss</td>
</tr>
</tbody>
</table>
MRC SUM SCORE

Functions assessed
  Upper extremity: wrist flexion, forearm flexion, shoulder abduction
  Lower extremity: ankle dorsiflexion, knee extension, hip flexion
Score for each movement
  0–No visible contraction
  1–Visible muscle contraction, but no limb movement
  2–Active movement, but not against gravity
  3–Active movement against gravity
  4–Active movement against gravity and resistance
  5–Active movement against full resistance
Maximum score: 60 (four limbs, maximum of 15 points per limb)

Minimum score: 0 (quadriplegia)

Kleyweg et al. - Muscle Nerve - 1991
SEMIOLOGY

- Weakness
  - Bilateral et symmetric
  - Four limbs
  - Essentially proximal
  - Sparing the face
- ± sensory deficit
- ± Areflexia
- ± Amyotrophic

CSF: not helpful
CK: normal, slightly or highly increased (Status asthmaticus)

De Jonghe et al JAMA 2002
ICU-ACQUIRED PARESIS

Frequent and severe complication associated with

1. Increased mortality
2. Prolonged weaning and reintubation
3. Increased length of stay in ICU
4. Disability
ENTRAPMENT NEUROPATHY

Peroneal nerve

Radial nerve

Hypoesthesia in green area

Hypoesthesia
Neurosciences in Intensive Care International Symposium (NICIS)

Neuroscience of repair regeneration and recovery from critical illness

June 17-18-19 2015

Institut Pasteur Paris

Scientific Organizers
Pr Fernando Bozza - Oswaldo Cruz Foundation
Pr Jan Claassen - Columbia University College of Physicians & Surgeons
Pr Jean Mantz - University Paris Diderot
Pr Tarek Sharshar - University of Versailles, Institut Pasteur
Pr Robert D. Stevens - Johns Hopkins University

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Raymond Poincaré
Service de Réanimation
Pr Djillali Annane

Institut Pasteur
Fabrice Chrétien
Human Histopathology and Animal Models

MERCI
Long-term Cognitive Impairment and Functional Disability Among Survivors of Severe Sepsis

**Figure 2.** Cognitive Impairment Among Survivors of Severe Sepsis at Each Survey Time Point

<table>
<thead>
<tr>
<th>Time to sepsis admission, y</th>
<th>Cognitive impairment</th>
<th>No. of patients</th>
<th>Median (IQR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No sepsis before sepsis</td>
<td>Mild</td>
<td>484</td>
<td>-3.1 (-9.7 to -2.7)</td>
</tr>
<tr>
<td>No sepsis before sepsis</td>
<td>Moderate to severe</td>
<td>484</td>
<td>-1.1 (-1.7 to -0.7)</td>
</tr>
<tr>
<td>First survey after sepsis</td>
<td>Mild</td>
<td>623</td>
<td>0.9 (0.4 to 1.4)</td>
</tr>
<tr>
<td>First survey after sepsis</td>
<td>Moderate to severe</td>
<td>623</td>
<td>2.8 (2.3 to 3.4)</td>
</tr>
</tbody>
</table>

Error bars indicate 95% confidence intervals (CIs); IQR, interquartile range.

**Interpretive Example:** Compared with stable rates before severe sepsis, the prevalence of moderate to severe cognitive impairment increased from 6.1% (95% CI, 4.2%-8.0%) before severe sepsis to 16.7% (95% CI, 13.8%-19.7%) at the first survey after severe sepsis ($P < .001$ by $\chi^2$ test; Table 2).

*Iwashyna et al – JAMA - 2010*
Swallowing dysfunction?
ELECTROPHYSIOLOGY

Motor and sensory NCS (nerve)

Needle EMG (muscle)

Repeated stimulation (NMJ)

Supramaximal nerve stimulation (muscle strength and fatigue)

Direct muscle stimulation (excitability)

Eikermann et al-ICM-2006; Dhand - Resp Care - 2006
USEFULNESS

- Diagnosis of CINM
- Distinguishing CIM from CIP
- Predicting ICU-acquired paresis
- Predicting recovery
ANATOMY

A. Diffuse hemispheric lesion

B. Diencephalic lesion

C. Mesencephalic and diencephalic lesion

D. Mesencephalic and pons lesion

E. Pons lesion

Figure 1–8. Brain lesions that cause coma. (A) Diffuse hemispheric damage, for example, due to hypoxic-ischemic encephalopathy (see Patient 1-1). (B) Diencephalic injury, as in a patient with a tumor destroying the hypothalamus. (C) Damage to the paramedian portion of the upper midbrain and caudal diencephalon, as in a patient with a tip of the basilar embolus. (D) High pontine and lower midbrain paramedian tegmental injury (e.g., in a case of basilar artery occlusion). (E) Pontine hemorrhage, because it produces compression of the surrounding brainstem, can cause dysfunction that extends beyond the area of tissue loss. This case shows the residual area of injury at autopsy 7 months after a pontine hemorrhage. The patient was comatose during the first 2 months.

Plum and Posner
APPROACH

1. Diagnosis
2. Severity
3. Causes
4. Prognosis
Septic shock with ARDS and severe liver and renal failure in a aplasic 82 years old man.

1. Coma plus abolition of all brainstem reflexes
2. After discontinuation of sedation, recovery of cough and oculocephalic responses but not of corneal reflex and grimace.
CASE REPORT

A 65 years old man was hospitalised for an acute respiratory failure that required invasive mechanical ventilation and sedation. Respiratory failure was ascribed to amiodarone interstitial pneumonia, which was given with anticoagulant a month ago for an atrial fibrillation. He had also a severe arteritis and coronary disease.

A week later, while the patient was ventilated and lightly sedated, neurological examination showed no response of the left arm to painful stimulation, a greater hypotonia of the left arm and leg but also a decreased contraction of the right face to painful stimulation and right ptosis with small pupil.
Three days after discontinuation of sedation, the patient developed agitation and delirium. General and neurological examination was not changed. EEG was normal. Agitation and delirium was ascribed to discontinuation of sedation. Three days later, patient complained of pain of the legs and ankles that turned to be due to bacterial and ischemic myositis.

DELIRIUM WITHOUT (new) FOCAL NEUROLOGICAL SIGN IN A RECENTLY NON SEDATED PATIENT
Tendon reflex became brisk in 72 years old man heavily sedated and paralyzed for a very severe ARDS (Spinal cord MRI: normal)
CASE REPORT

Presence of corneopterygoidien reflex in 34 years old man who needed to be sedated for a very severe ARDS complicating a CO poisoning
## ROSTRAL-CAUDAL DETERIORATION

<table>
<thead>
<tr>
<th>Motor response</th>
<th>Brainstem functions</th>
<th>Pupils</th>
<th>Breath pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verbal response</td>
<td>Blinking to threat</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Localizing Withdrawal</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paratonic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Appropriate Motionless Arms flexed (decorticate)</td>
<td>Fronto-orbicular Fronto-palpebrae Mimic</td>
<td>Small pupils Small range of contraction Cheyne-stokes</td>
<td></td>
</tr>
</tbody>
</table>

Cortical

Sub-cortical

Diencephalic
<table>
<thead>
<tr>
<th>Location</th>
<th>Motor response</th>
<th>Brainstem functions</th>
<th>Pupils</th>
<th>Breath pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Midbrain</strong></td>
<td>Motionless and legs extended (decerebrate)</td>
<td>Light pupillary reflex OCR, OVR (vertical)</td>
<td>Unilateral fixed large (3rd nerve)</td>
<td>Eupneic or ataxic</td>
</tr>
<tr>
<td><strong>Pons</strong></td>
<td>Motionless and flaccid or lower limbs flexion</td>
<td>Corneal reflex OCR, OVR (horizontal) Corneal pterygoid reflex</td>
<td>pinpoint</td>
<td>Ataxic</td>
</tr>
<tr>
<td><strong>Medulla</strong></td>
<td>Motionless and flaccid or lower limbs flexion</td>
<td>Cough reflex Oculo-cardiac reflex</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ROSTRAL-CAUDAL DETERIORATION
Continuum: process posteriorly spreading from the area postrema (deprived from BBB, neuro-inflammatory signaling)

HYPOTHESES

Continuum? Reversibility?
HYPOTHESES

- Difference in SAPS-II
- Neuro-inflammatory process starting at the level of the area postrema (posterior localization, no BBB)
- No difference in term of sedatives dose
- Effect of sedation reduction on profil C or D?

- Animal studies

- Difference in age
- Aging? Animal studies?

Neuro-inflammation
Sensitivity to sedation
Neuro-degeneration
NEUROLOGICAL ASSESSMENT

GLASGOW COMA SCALE

- Eyes response
- Motor response
- Verbal response

FOCAL SIGNS
Comparison between right and left body
1. Motor responses to order or painful stimulation
2. Limbs tone
3. Tendon reflexes
4. Plantar reflex

BRAINSTEM RESPONSES
1. Eyes spontaneous movement
2. Eyes position
3. Oculocephalogyre response
4. Pupilar size
5. Pupilar light reflex
6. Corneal reflex
7. Grimace
8. Cough reflex
## Predicting mortality of intensive care unit patients

The importance of coma

Daniel Teres, MD; Richard B. Brown, MD; Stanley Lemeshow, PhD

<table>
<thead>
<tr>
<th></th>
<th>OR death</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>1.38</td>
<td>1.16-1.65</td>
</tr>
<tr>
<td>Shock</td>
<td>3.87</td>
<td>1.96-7.65</td>
</tr>
<tr>
<td>Coma</td>
<td>20.22</td>
<td>9.42-54.09</td>
</tr>
<tr>
<td>CPR</td>
<td>13.4</td>
<td>5.18-34.63</td>
</tr>
</tbody>
</table>

CRITICAL CARE MEDICINE
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CONCEPT OF BRAINSTEM DYSFUNCTION

Abolition of oculocephalic response
Neuronal apoptosis of LC
Multifocal necrotizing leukoencephalopathy

Abolition of cough reflex
Impaired HR/BP variability
Neuronal apoptosis

RAAS dysfunction
Delirium

Autonomic dysfunction
Death
Hemodynamic failure
Maladaptive immune response

DIFFERENTIAL DIAGNOSIS OF PARAPLEGIA

Areflexic and flaccid paraplegia

Think about injury of the spinal cord, conus medullaris syndrome or a cauda equina syndrome, especially if there is a sensory level, urinary retention or pelvic hypoesthesia

Doubt: usefulness of MRI, electrophysiological testing
DELIRIUM

PREVALENCE

MORTALITY

- On Admission: 26.8%
- By End of ICU Period: 66.7%
- By End of Post-ICU Period: 86.1%

- Without Dementia: □
- With Dementia: ■

- Probability of Survival,
  Months After Enrollment:
  - No Delirium: Dashed Line
  - Delirium: Solid Line
Formula for PRE-DELIRIC model

Risk of delirium = $1/(1+\exp(-6.31))$

+ 0.04 × age
+ 0.06 × APACHE-II score
+ 0 for non-coma or 0.55 for drug induced coma or 2.70 for miscellaneous coma or 2.84 for combination coma
+ 0 for surgical patients or 0.31 for medical patients or 1.13 for trauma patients or 1.38 for neurology/neurosurgical patients
+ 1.05 for infection
+ 0.29 for metabolic acidosis
+ 0 for no morphine use or 0.41 for 0.01-7.1 mg/24 h morphine use or 0.13 for 7.2-18.6 mg/24 h morphine use or 0.51 for >18.6 mg/24 h morphine use
+ 1.39 for use of sedatives
+ 0.03 × urea concentration (mmol/L)
+ 0.40 for urgent admission)

The scoring system’s intercept is expressed as –6.31; the other numbers represent the shrunken regression coefficients (weight) of each risk factor.

Van den Bogaard et al – BMJ - 2012
ELECTROENCEPHALOGRAM

- Standard EEG in 110 septic patients - Septic shock: 45 (41%); sedation: 46 (42%)
- EEG within the 72h from admission

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>n=110</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dominant frequency – n (%)</td>
<td></td>
</tr>
<tr>
<td>alpha</td>
<td>21 (19)</td>
</tr>
<tr>
<td>delta</td>
<td>36 (33)</td>
</tr>
<tr>
<td>theta</td>
<td>53 (48)</td>
</tr>
<tr>
<td>Amplitude – n (%)</td>
<td></td>
</tr>
<tr>
<td>low-voltage</td>
<td>71 (65)</td>
</tr>
<tr>
<td>Absence of reactivity – n (%)</td>
<td>27 (25)</td>
</tr>
<tr>
<td>Electrographic seizure – n (%)</td>
<td>17 (15)</td>
</tr>
<tr>
<td>Triphasic waves – n (%)</td>
<td>7 (6)</td>
</tr>
<tr>
<td>PEDs – n (%)</td>
<td>21 (19)</td>
</tr>
<tr>
<td>Synek’s classification ≥ 3 – n (%)</td>
<td>34 (31)</td>
</tr>
<tr>
<td>Young’s classification &gt; 1 – n (%)</td>
<td>41 (37)</td>
</tr>
</tbody>
</table>

Azabou et al - Submitted
MECHANISMS OF LONG-TERM COGNITIVE DECLINE IN SEPSIS
# Diagnostics Differentiels

## Table 1 | Differentiating features of conditions that mimic delirium

<table>
<thead>
<tr>
<th>Feature</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dellium</td>
</tr>
<tr>
<td>Descriptive features</td>
<td>Confusion and inattention</td>
</tr>
<tr>
<td>Onset</td>
<td>Acute</td>
</tr>
<tr>
<td>Course</td>
<td>Fluctuating, often worse at night</td>
</tr>
<tr>
<td>Duration</td>
<td>Hours to months</td>
</tr>
<tr>
<td>Consciousness</td>
<td>Altered</td>
</tr>
<tr>
<td>Attention</td>
<td>Impaired</td>
</tr>
<tr>
<td>Orientation</td>
<td>Fluctuates</td>
</tr>
<tr>
<td>Speech</td>
<td>Incoherent</td>
</tr>
<tr>
<td>Thought</td>
<td>Disorganized</td>
</tr>
<tr>
<td>Illusions and hallucinations</td>
<td>Common (often visual)</td>
</tr>
<tr>
<td>Perceptions</td>
<td>Altered</td>
</tr>
<tr>
<td>Psychomotor changes</td>
<td>Yes</td>
</tr>
<tr>
<td>Reversibility</td>
<td>Usually</td>
</tr>
<tr>
<td>EEG reading</td>
<td>Moderate to severe background slowing</td>
</tr>
<tr>
<td>CIBLE</td>
<td>FAISCEAU LONGITUDINAL MÉDIAL</td>
</tr>
<tr>
<td>-------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td></td>
<td>Muscle droit externe</td>
</tr>
<tr>
<td></td>
<td>Muscle droit interne</td>
</tr>
</tbody>
</table>

**OCULO-CEPHALOLOGYRE RESPONSE**

<table>
<thead>
<tr>
<th>Tronc cérébral intact</th>
<th>H₂O froid</th>
<th>H₂O froid</th>
<th>H₂O froid</th>
<th>H₂O chaud</th>
</tr>
</thead>
<tbody>
<tr>
<td>BLP (Lésions bilatérales)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H₂O froid</td>
<td>H₂O froid</td>
<td>H₂O froid</td>
<td>H₂O chaud</td>
<td></td>
</tr>
<tr>
<td>Lésion du tronc cérébral inférieur</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H₂O froid</td>
<td>H₂O froid</td>
<td>H₂O froid</td>
<td>H₂O chaud</td>
<td></td>
</tr>
</tbody>
</table>
OPHTALMOPLEGIE
INTERNUCLAIRE ANTERIEURE

Fig 60