



# LE SOMMEIL DES PATIENTS DE RÉANIMATION

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INSERM CIC 1402 (Axe ALIVE)

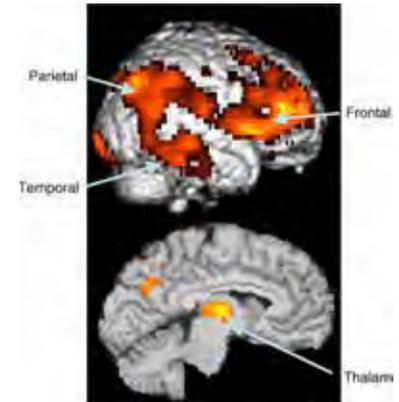
Pr René Robert

*Conflicts of Interest: Obligation regarding French Law L4113-13 for Public Health  
Code Dr.....Xavier DROUOT.....*

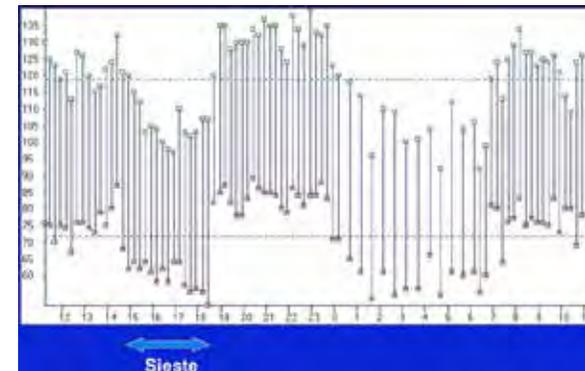
2015-2017	Pharmaceutical Comp., Health care providers, Health Industry
Study Coordonnator	
Investigator	SOS Oxygene, Orkyn
Consultant	UCB Pharma,
Meeting travels	Orkyn, UCB Pharma,
Speaker bureau	UCB
Divers	Bon dormeur, pas de séjour en USI

- Comportement actif de repos cérébral et physique, nécessaire à la vie...

- Restauration des ressources énergétiques cérébrale et physique  
dépensées durant la veille



- Rôle hormonal,
- Rôle psychologique (rêve = «soupape psychologique»...)
- Rôle de consolidation de la mémoire,
- Rôle immunologique
- ...



# SOMMEIL : GENERALITÉS



## Sleep Drives Metabolite Clearance from the Adult Brain

Lulu Xie *et al.*

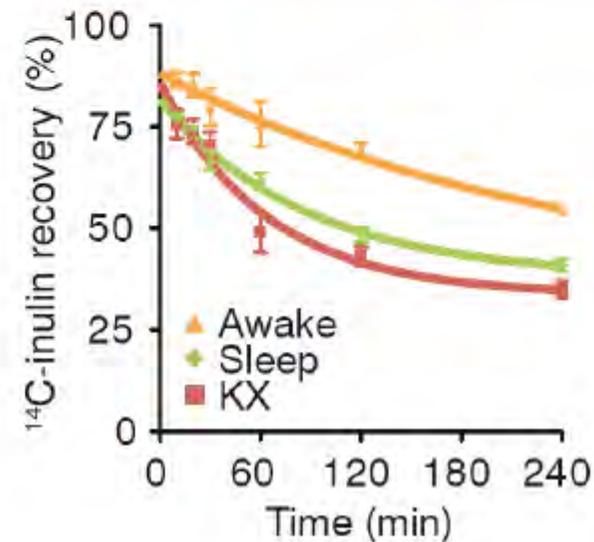
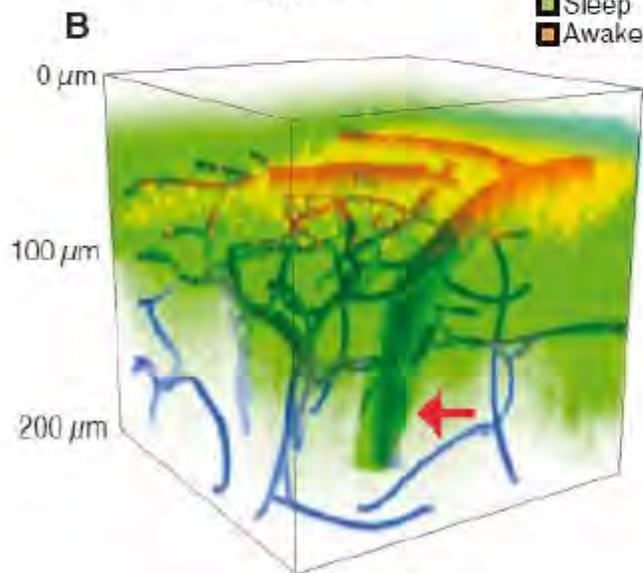
*Science* **342**, 373 (2013);

DOI: 10.1126/science.1241224

2013

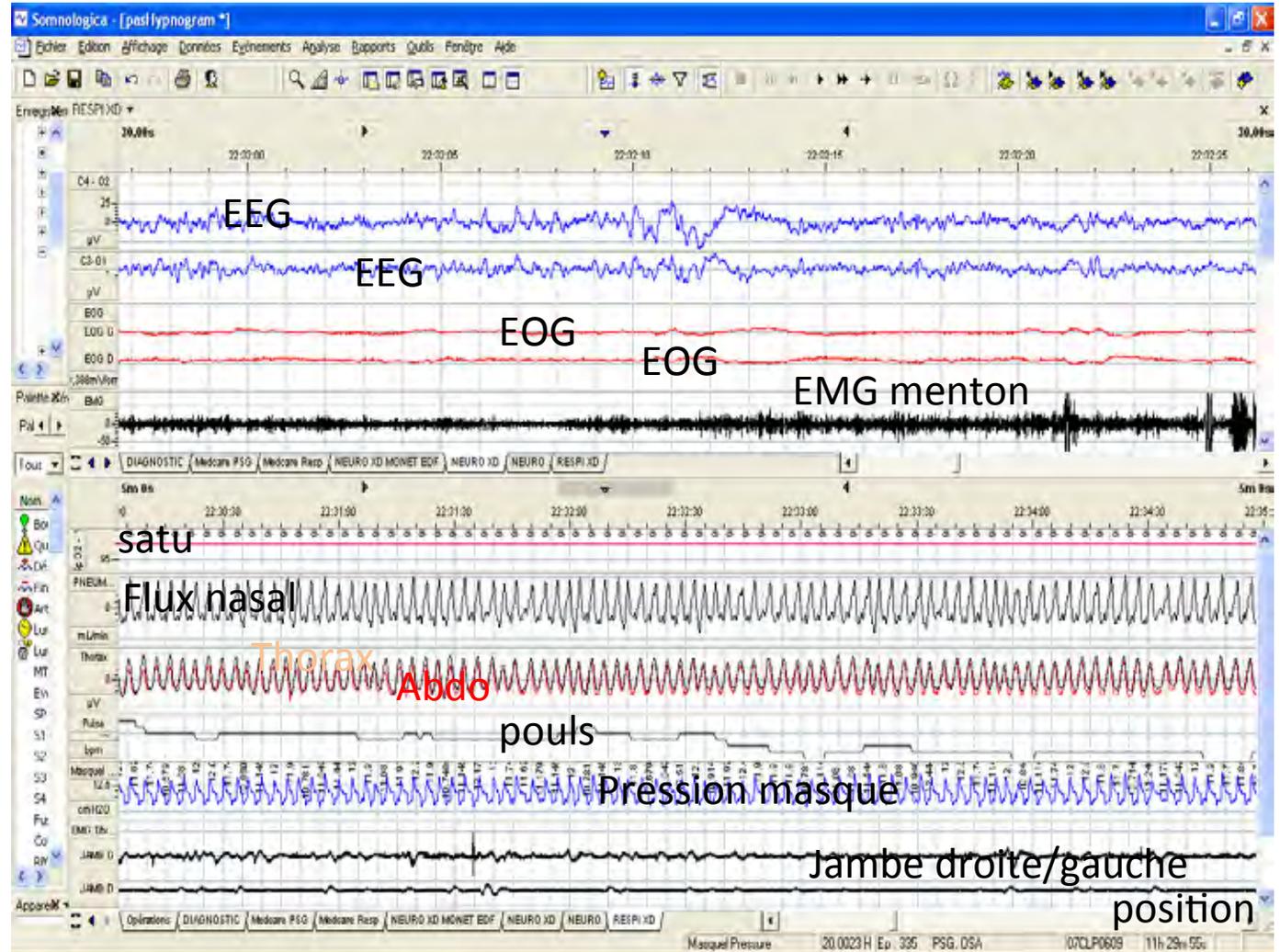
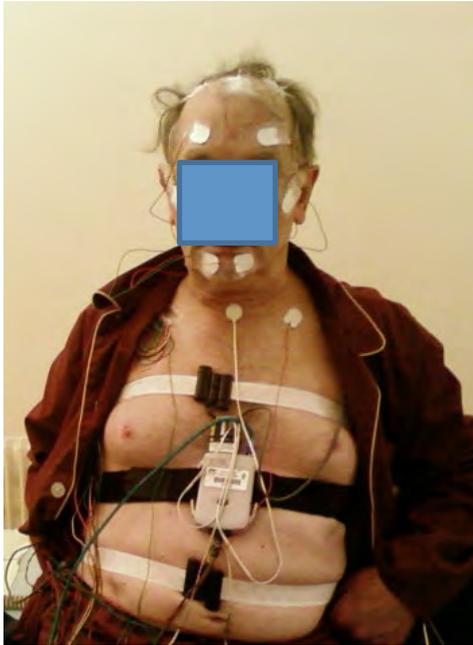


**Sommeil lent profond  
= Rôle possible de  
détoxificateur  
cérébral**



# SOMMEIL : TECHNIQUES D'ETUDES

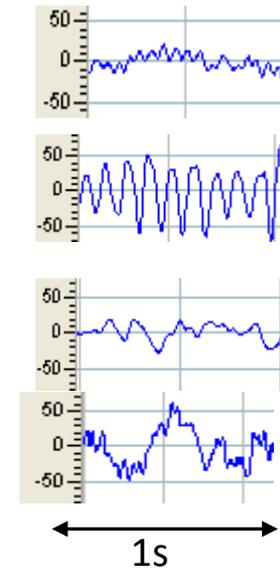
## POLYSOMNOGRAPHIE



# ANALYSE DU SOMMEIL

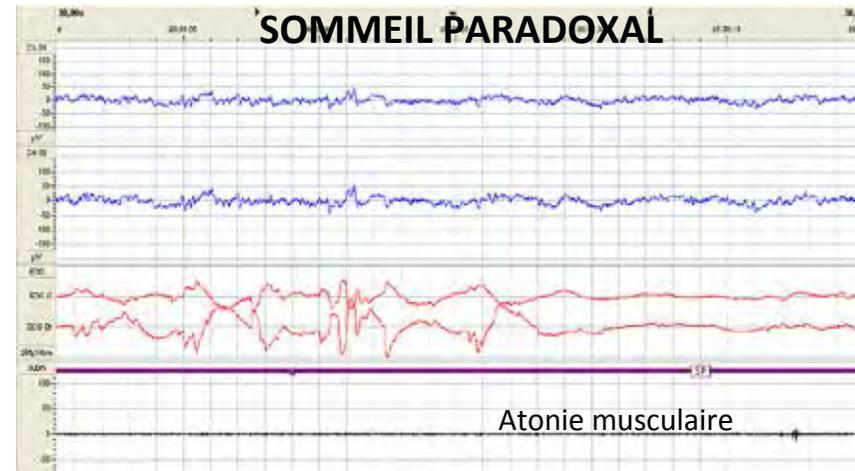
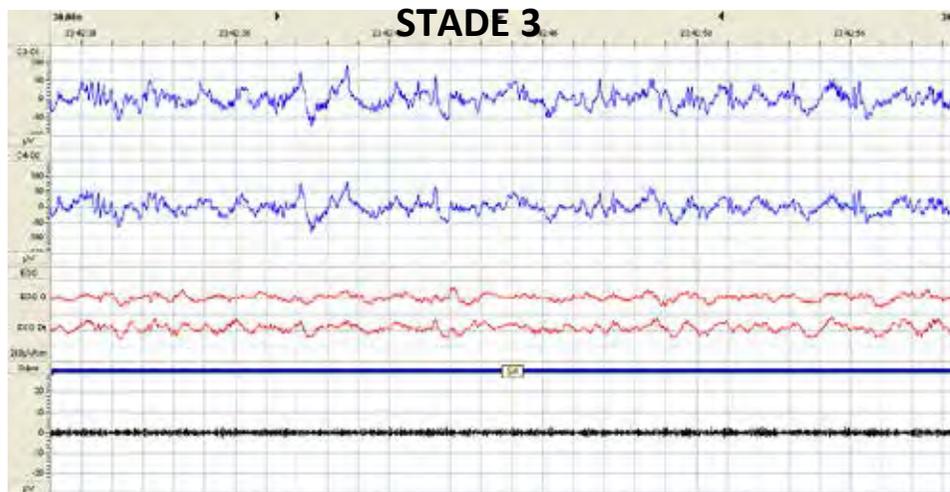
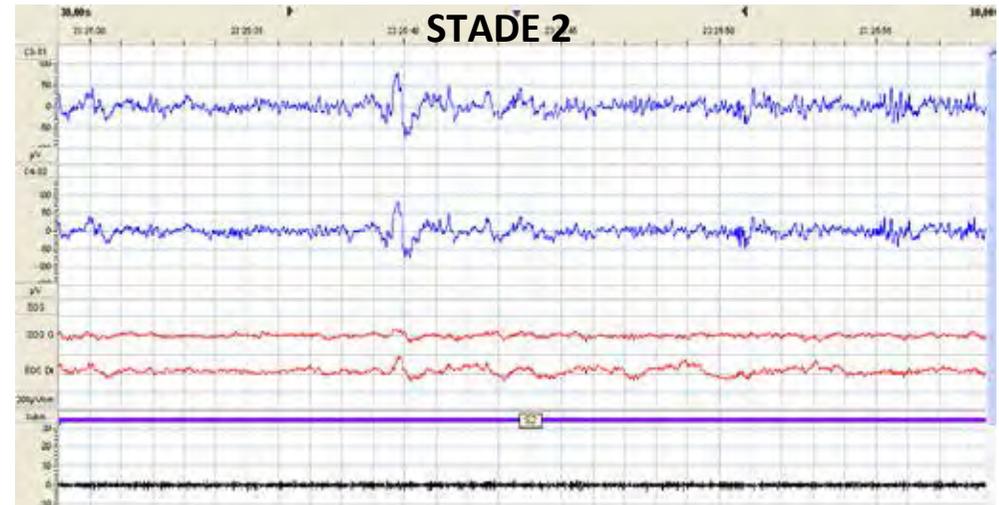
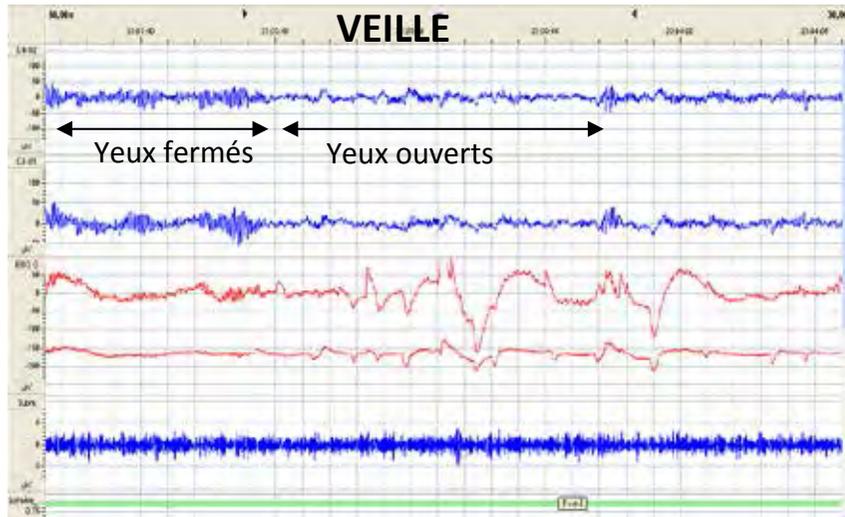
- Analyse de l'EEG +++++ (EOG et EMG menton pour le sommeil paradoxal)
- Rythmes cérébraux : nombre de cycles par seconde

veille	}	Rythmes rapides: beta et gamma	>18Hz
		Rythmes alpha	8 -12 Hz
Sommeil	}	Rythmes lents (ondes lentes)	Théta 4 - 8 Hz Delta 0,5 – 4 Hz

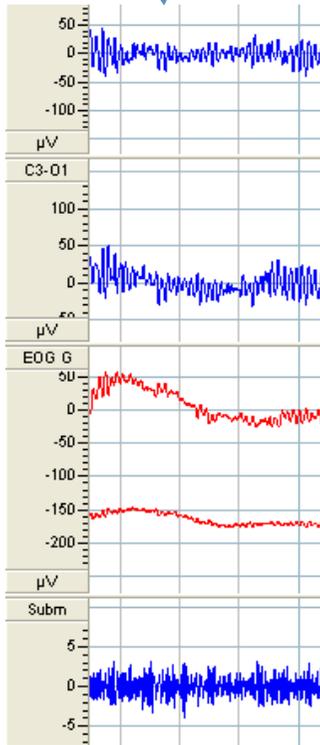
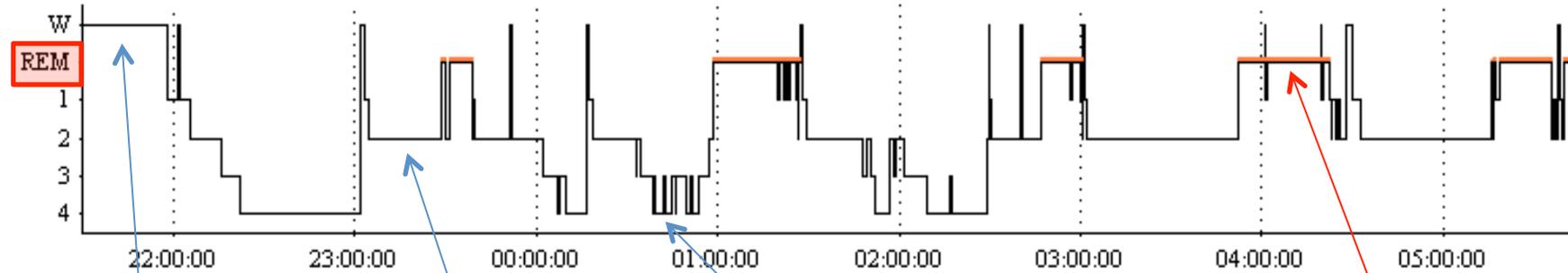


- Attribuer un stade à chaque époque de 30s

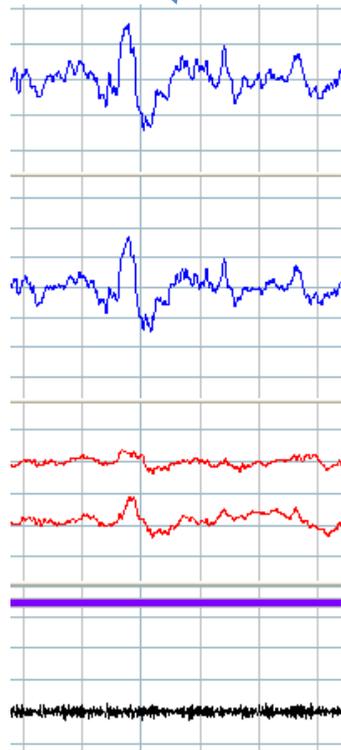
# STADES DE VIGILANCE



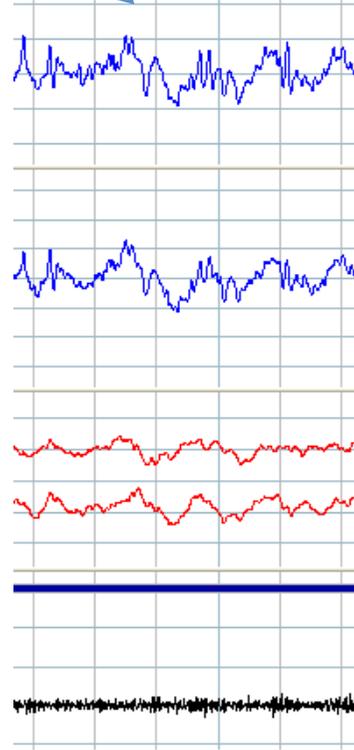
# STADES DU SOMMEIL



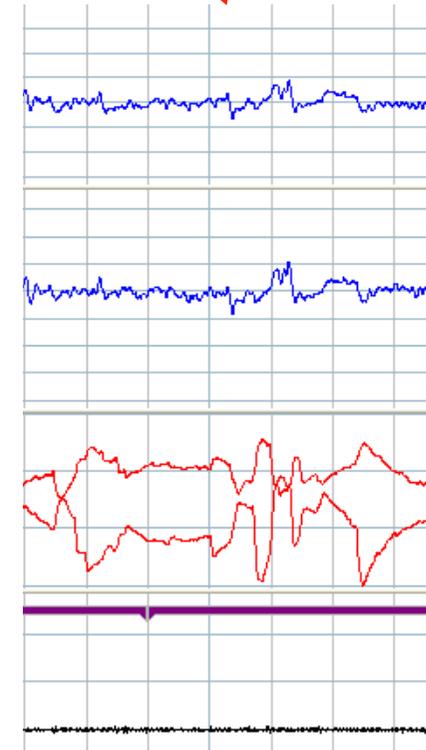
Veille



Sommeil lent léger N2



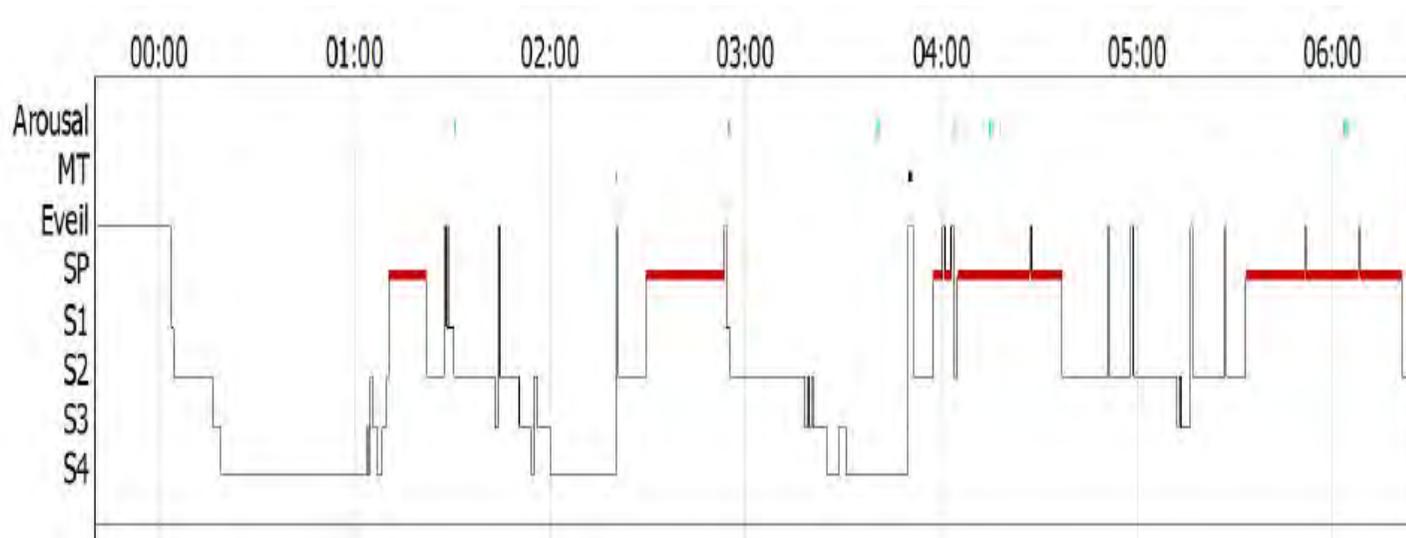
Sommeil lent profond N3



Sommeil paradoxal

Enregistrements 8 h (ambulatoire, diagnostic du syndrome d'apnées du sommeil)  
12 à 24 heures (réanimation)

Hypnogramme:

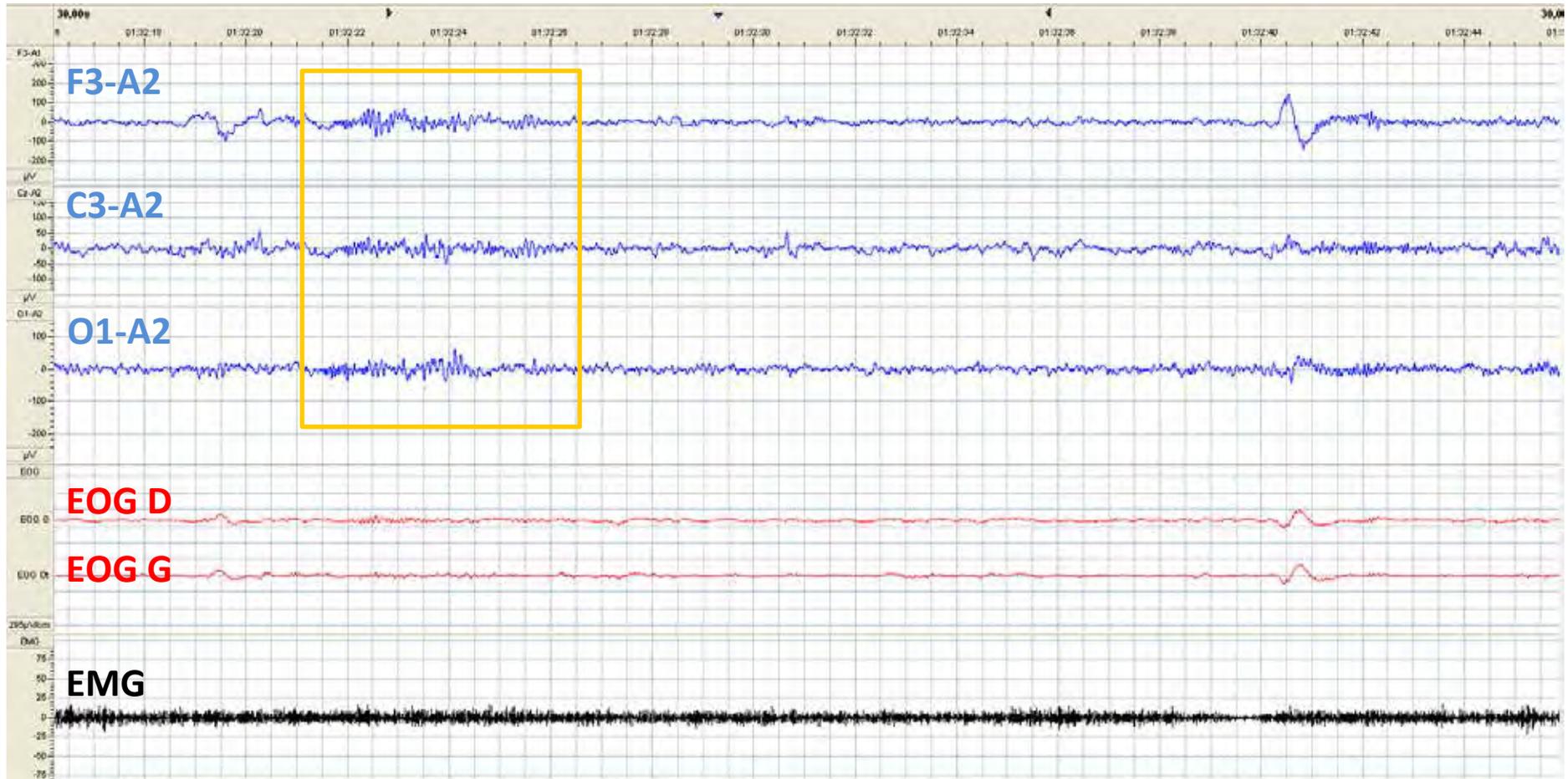


Sommeil Leger (N1+N2) : 50% du temps de sommeil

Sommeil Profond : Récupération physique 100 min (25-35%)

Sommeil Paradoxal : Equilibre psychique 20% du temps sommeil

# MICRO-EVEILS



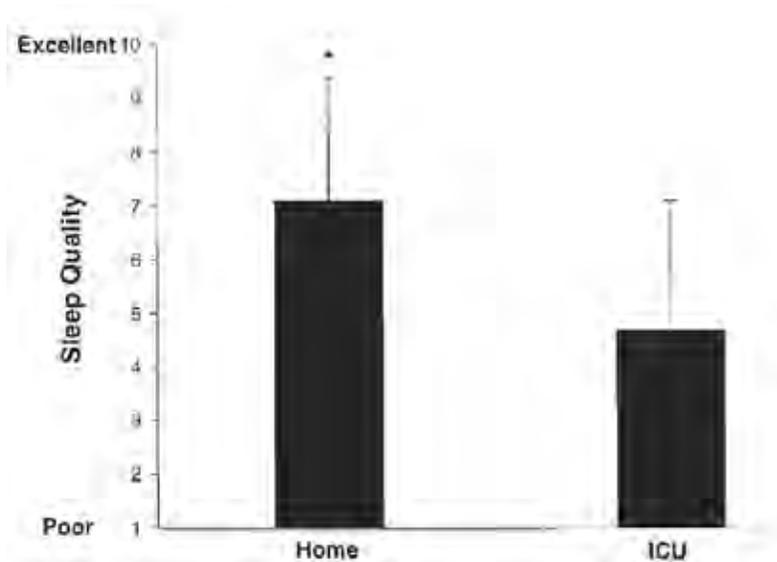


80% patients: très mauvais sommeil (Simini 1999)

39% incapable de dormir (Rotondi 2002)

Impossibilité de trouver le sommeil = second facteur de stress

(Novaes, 1997)

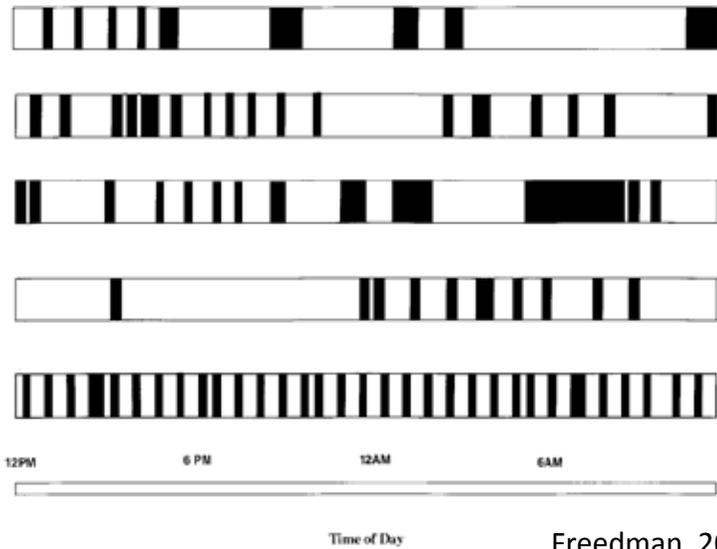


Ranking	Description
01	Have pain
02	Not being able to sleep
03	Having tubes in your nose or mouth
04	Not being in control of yourself
05	Being tied down by tubes
06	Not having treatments explained to you
07	Not being able to move your hands because of i. v. line
08	Not knowing when to expect things will be done to you
09	Being stuck with needles
10	Being thirsty

Cauchemars

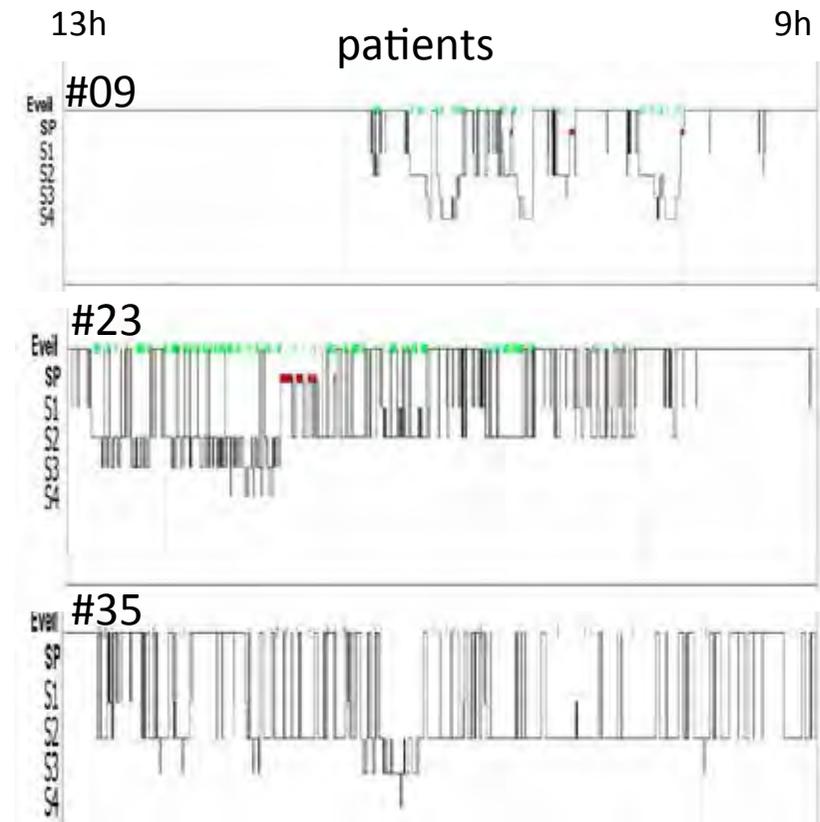
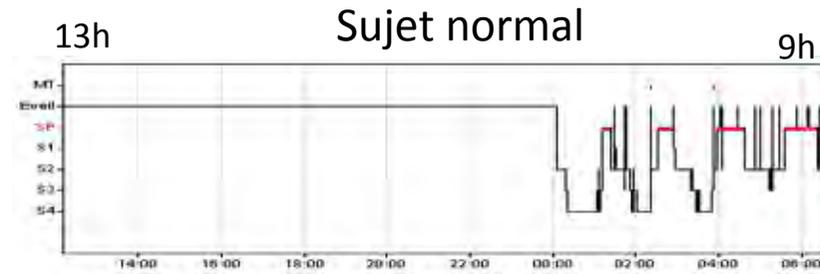
Rêves éveillés

Synd. stress post-traumatique (insomnie)



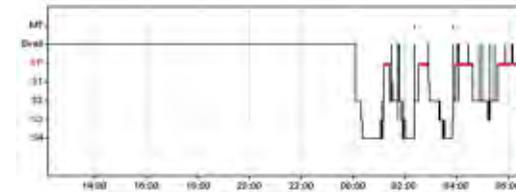
Freedman, 2001

- Distribution anormale sur le nycthémère
- Sommeil « polyphasique »



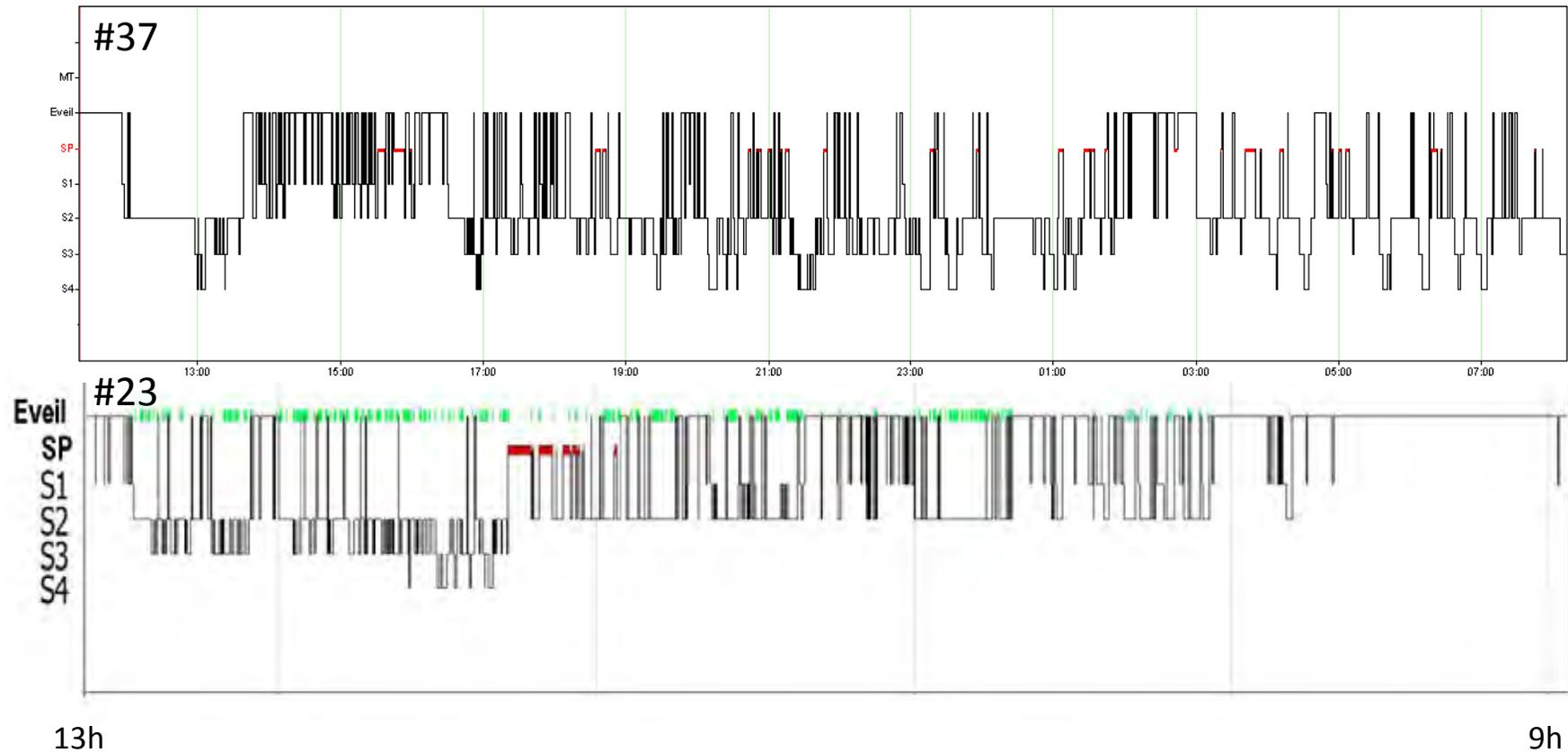
- Disparition alternance sommeil lent – sommeil paradoxal
- Disparition des cycles

Sujet normal



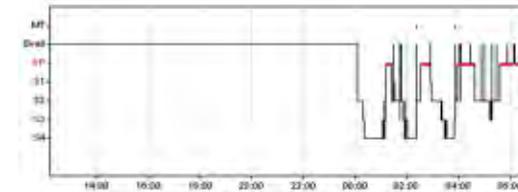
13h

9h



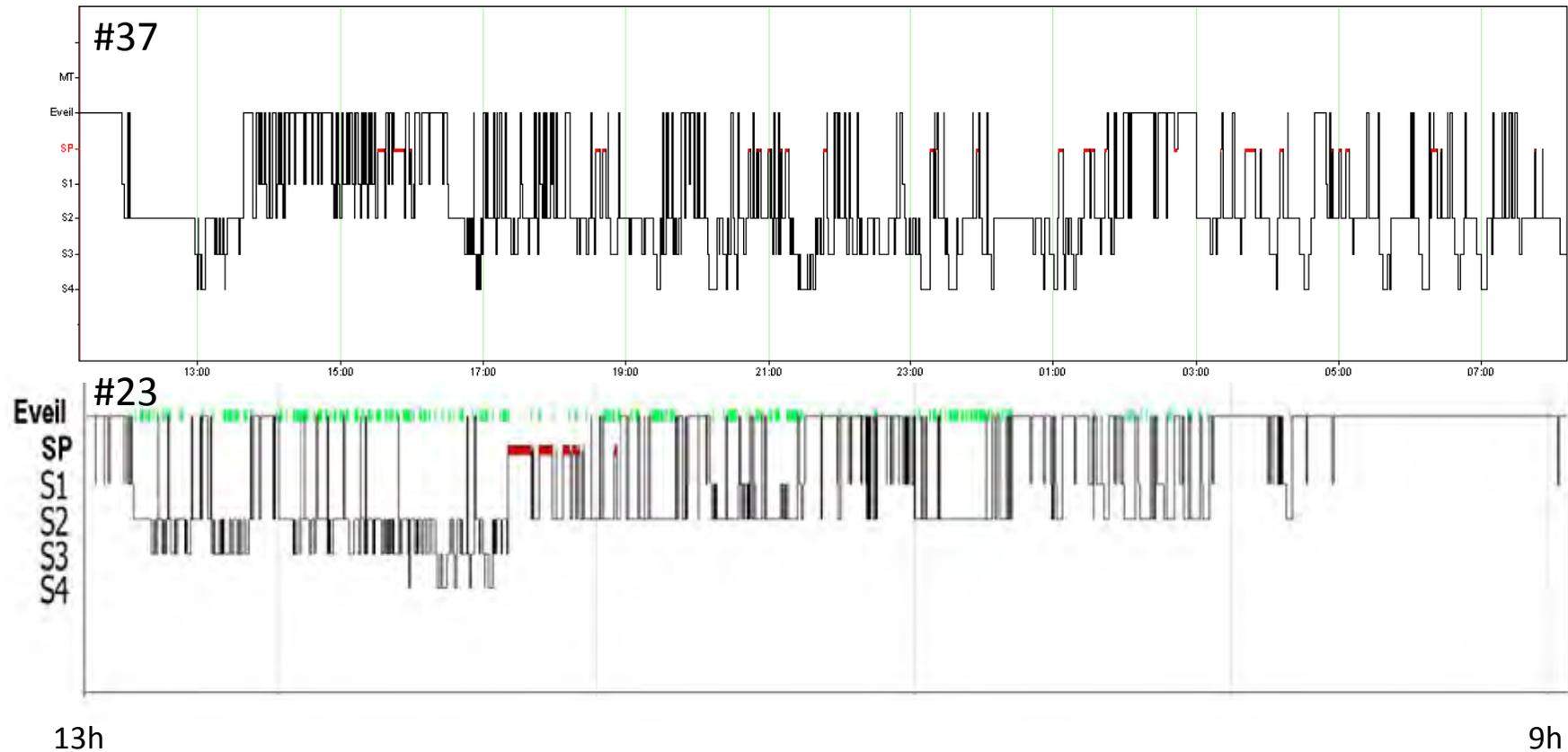
- Episodes de sommeil très bref +++
- Episode de sommeil prolongés rares

Sujet normal



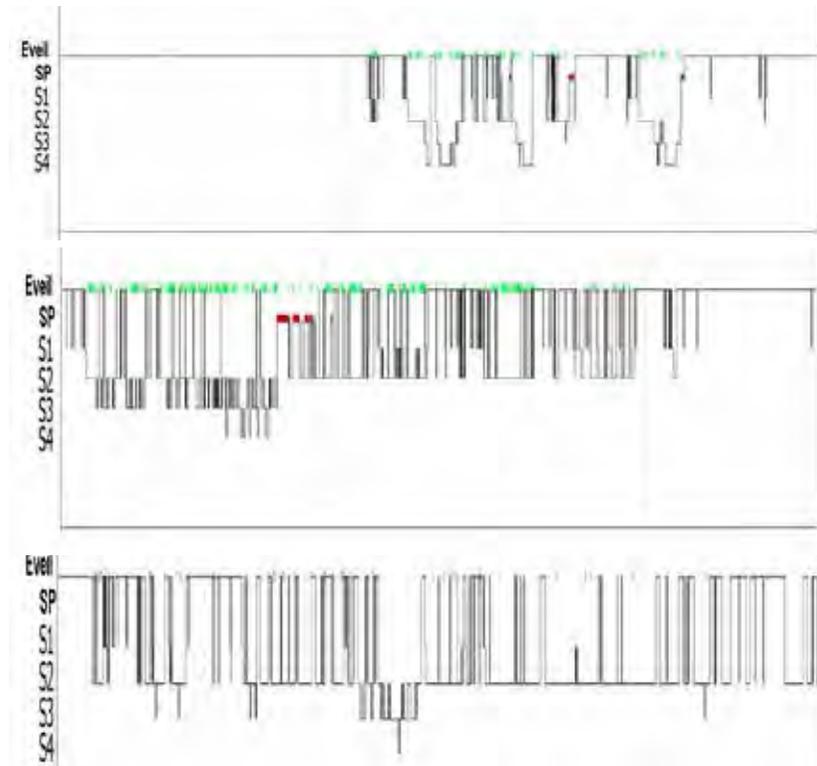
13h

9h



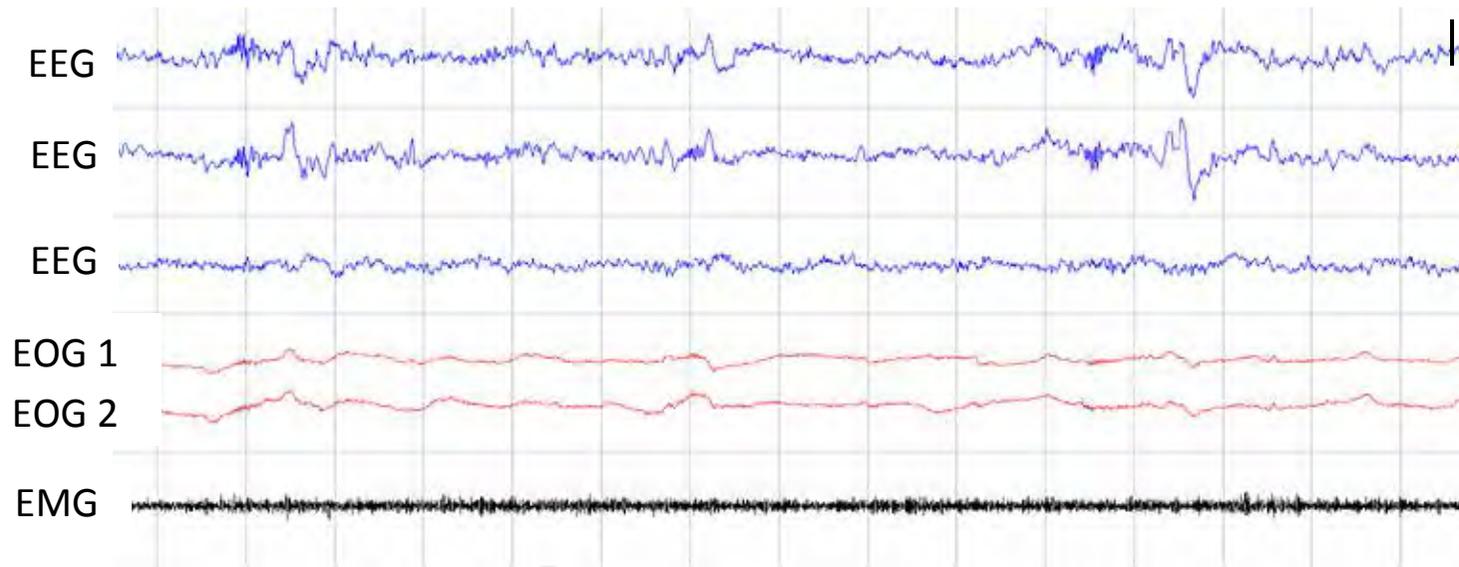
# QUANTITÉ DE SOMMEIL

- Temps total de sommeil (PSG 24h)
  - Réduit (3,6 - 6,2h /24h) (Hilton 1976; Aurell 1985; Gabor 2003)
  - **Normal** (7 - 10,4h /24h) (Gottschich 1994; Cooper 2000; Freedman 2001)
  - **Augmenté (5,3 - 16,2 h)** (Fanfulla 2011, Knauert, 2013, Boesen, 2014)

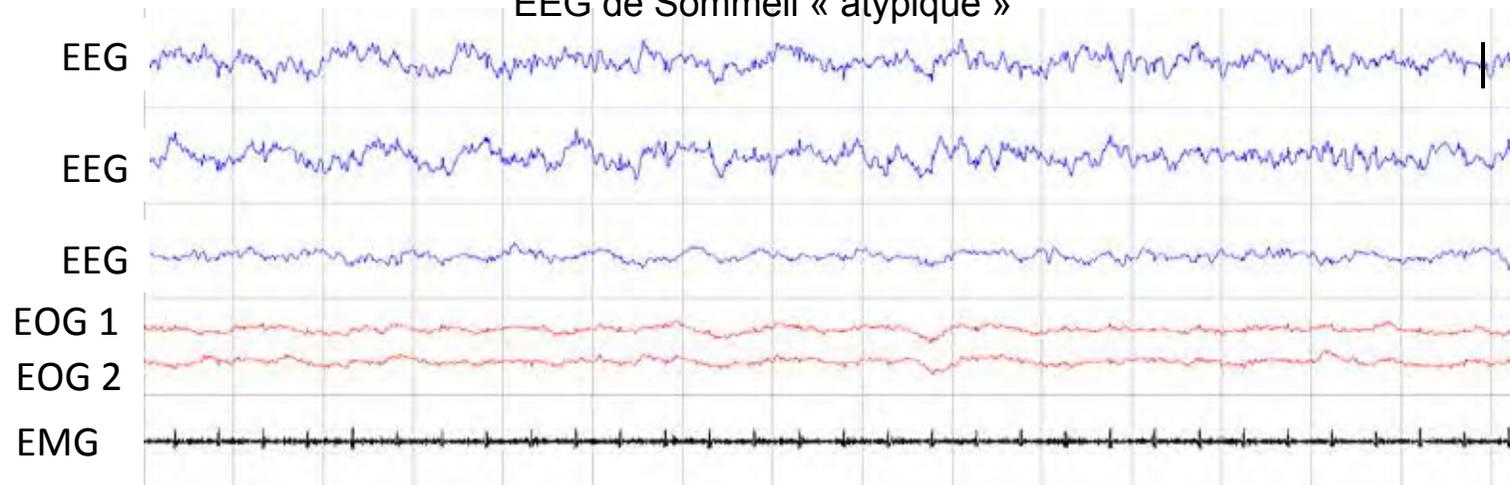




## EEG de Sommeil Normal

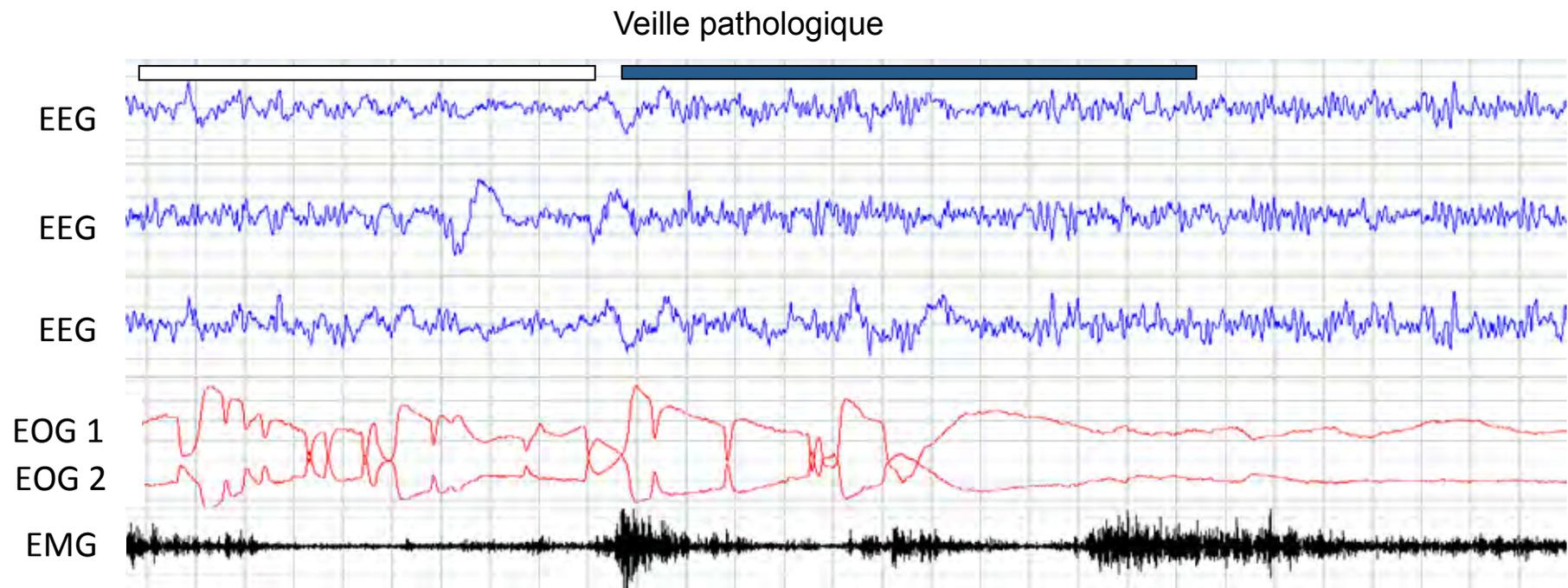
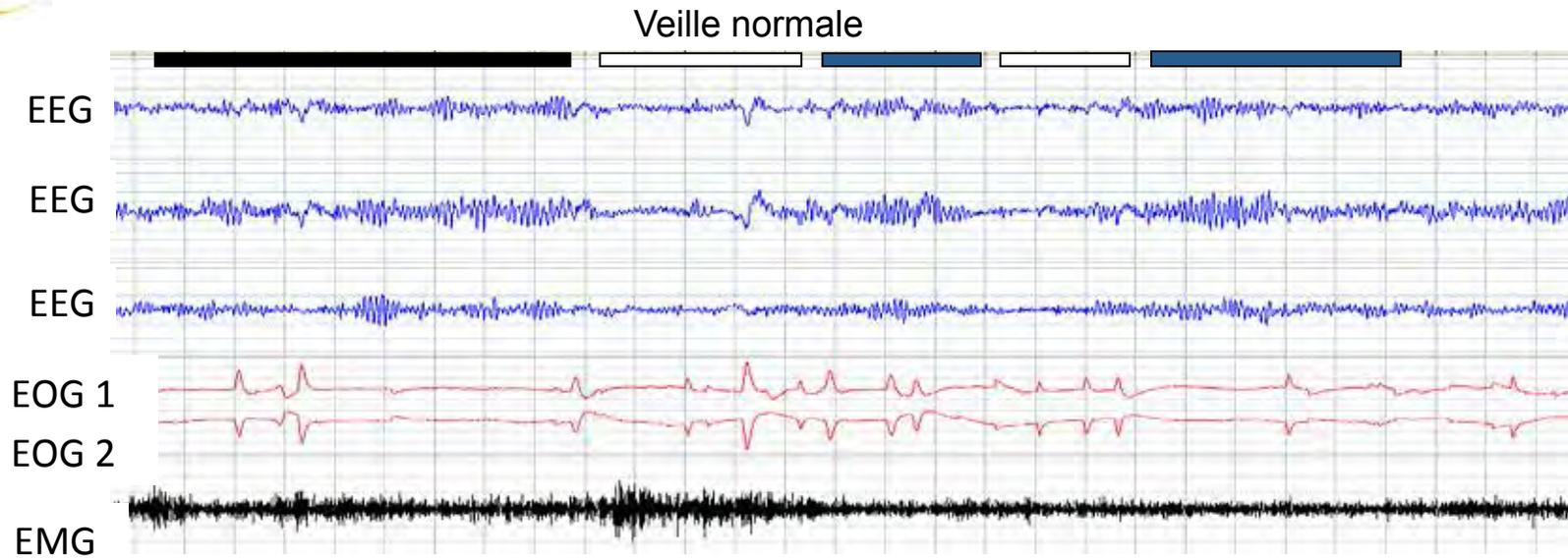


## EEG de Sommeil « atypique »



**30% patients conscients non sédatis**

Absence de fuseaux  
Absence de complexes K



# SOMMEIL ATYPIQUE

## Nouvelle classification

Original Article

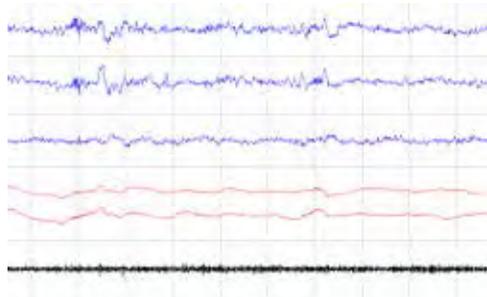
### A new classification for sleep analysis in critically ill patients ☆

Xavier Drouot <sup>a,b,\*</sup>, Ferran Roche-Campo <sup>c,d,1</sup>, Arnaud W. Thille <sup>c,1</sup>, Belen Cabello <sup>c,d</sup>, Fabrice Galia <sup>c</sup>,  
Laurent Margarit <sup>a</sup>, Marie-Pia d'Ortho <sup>a,f</sup>, Laurent Brochard <sup>c,e</sup>

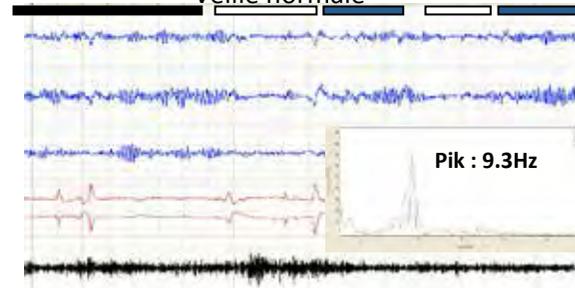
n=57 polysomnographies

Echelle de réactivité EEG

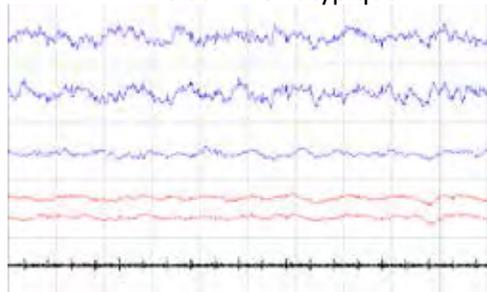
EEG sommeil normal



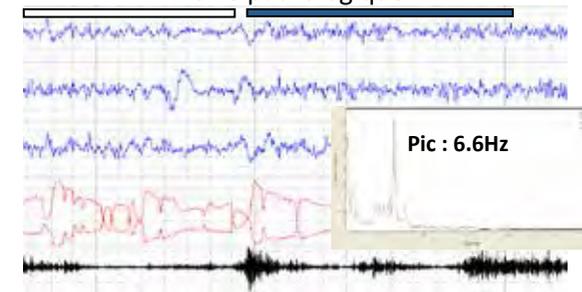
Veille normale



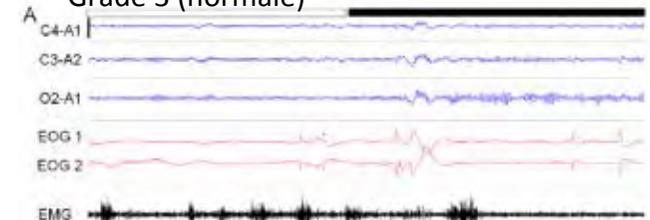
EEG sommeil atypique



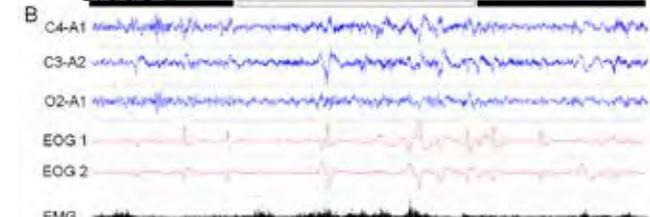
Veille pathologique



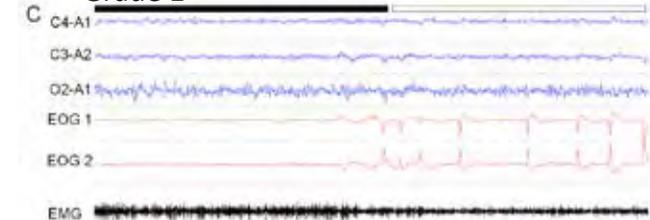
Grade 3 (normale)



Grade 2



Grade 1



Editorial

Sleep in the critically ill: An epoch adventure

Drouot, Sleep med 2011



# CAUSES DES ALTERATIONS DU SOMMEIL



**Inserm**

*faculté de  
médecine et  
de pharmacie*



- Des points communs
  
- Des différences ++++: le sommeil est
  - spontané
  - circadien
  - totalement réversible par stimulus externes
  - fonction biologique essentielle
  
- Impact de TOUS les sédatifs
  - benzodiazepines : une catastrophe
  - propofol : pas mieux
  - morphine : peu d'impact
  - dexmedetomidine

## Sommeil et anesthésie

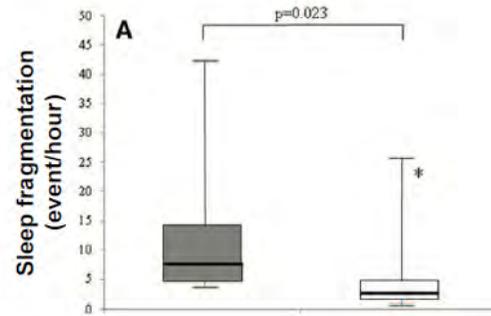
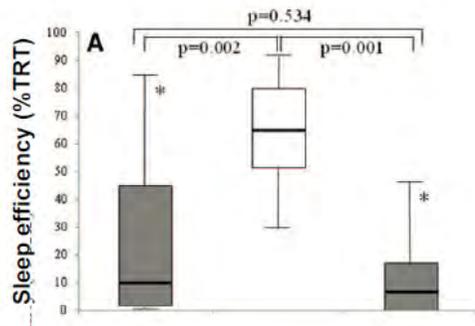
Des différences évidentes...  
... et des similitudes troublantes

Pr Xavier Drouot

## ROLE DE LA SEDATION propofol

	Without propofol	With propofol	<i>p</i> value
TST (min)	214 (40–285)	260 (113–417)	0.37
Sleep efficiency ( % TST)	62.6 (13.1–85.9)	76.3 (28.4–96.9)	0.37
Stage 1 ( % TST)	30.7 (4.6–66.7)	20.8 (5.6–80.6)	1.00
Stage 2 ( % TST)	46.1 (3.0–80.4)	48.9 (4.8–84.0)	0.66
SWS ( % TST)	0 (0–0)	0 (0–5.8)	0.75
REM ( % TST)	1.4 (0–13.0)	0 (0–0)	0.04
TSFI (events/h)	8.1 (2.9–16.2)	4.8 (1.3–14.6)	0.33
Stage shifts	21 (7–48)	22 (11–28)	0.69
Intersleep awake ( % TST)	11.4 (3.1–42.9)	6.8 (1.2–43.5)	0.79

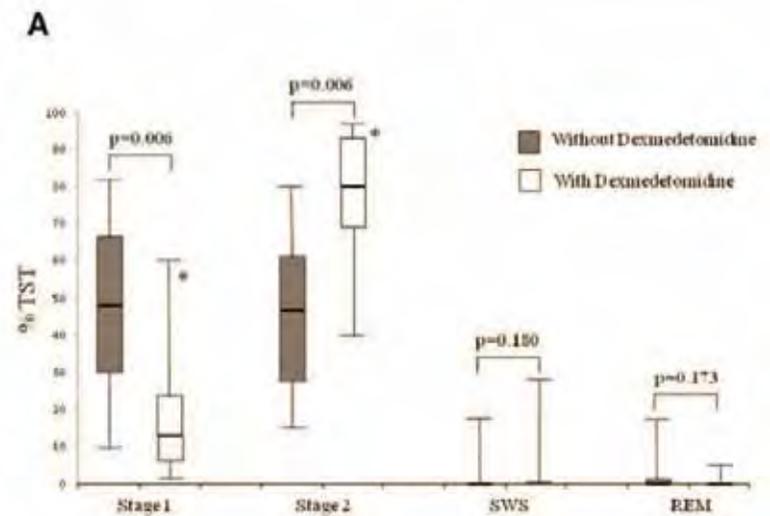
# ROLE DE LA SEDATION Dexmedetomidine



1 <sup>st</sup> night No sedation	1 <sup>st</sup> day No sedation	2 <sup>nd</sup> night Dex sedation	1 <sup>st</sup> day No sedation	3 <sup>rd</sup> night No sedation
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6:00 AM 9:00 PM 6:00 AM 9:00 PM 6:00 AM 9:00 PM

Alexopoulou et Coll. Anesthesiology 2014



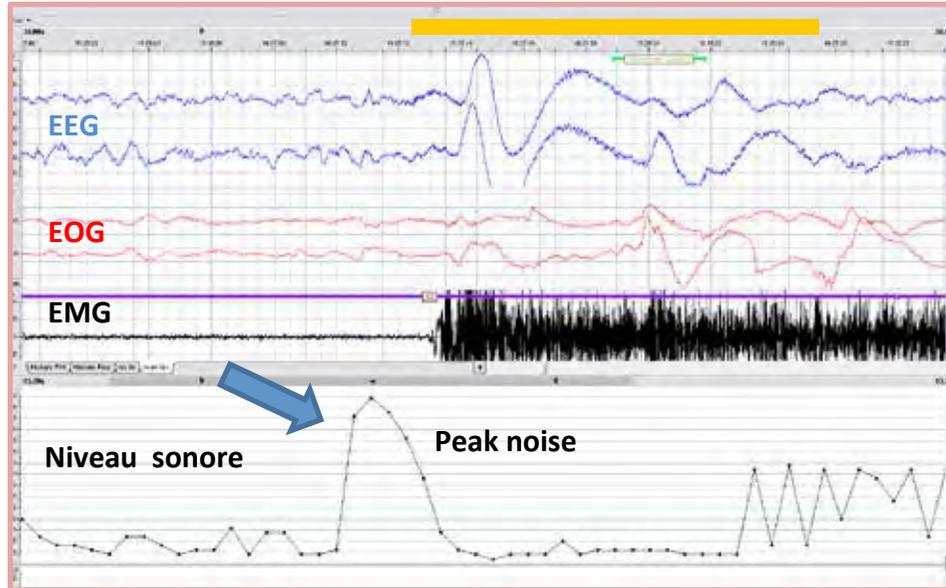
# ROLE DES MEDICAMENTS

**Table 2** Effects of ICU drugs on sleep.

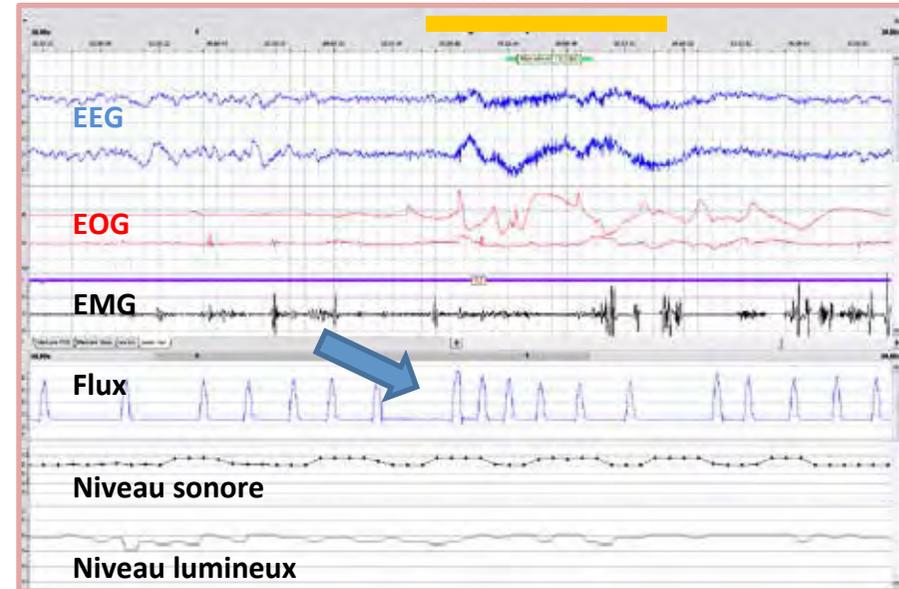
	TST	SWS	REM
<b>Sedative/hypnotics</b>			
Benzodiazepines <sup>63</sup>	↑	↓	↓
Propofol <sup>83</sup>	NE	NE	NE
Haloperidol <sup>71</sup>	NE	NE	NE
Olanzapine <sup>71</sup>	↑	↑	↑
Risperidone <sup>71</sup>	NE	NE	↓
<b>Analgesics</b>			
Opiates <sup>75</sup>	↓	↓	↓
<b>Antidepressant<sup>69</sup></b>			
Tricyclic	↑	↑	↓
SSRI	↓	↓	↓
<b>Cardiovascular</b>			
Beta blockers <sup>121</sup>	↓	↓	↓
Clonidine <sup>78</sup>	↑	NE	↓
<b>Anticonvulsivants<sup>73,74</sup></b>			
Phenobarbital	NE	NE	↓
Phenytoin	NE	↓	↓
Carbamazepine	↑	↑	↓

TST: total sleep time; SWS: slow wave sleep; REM: rapid eye movements sleep; SSRI: selective serotonin recapture inhibitor; NE: no effect.

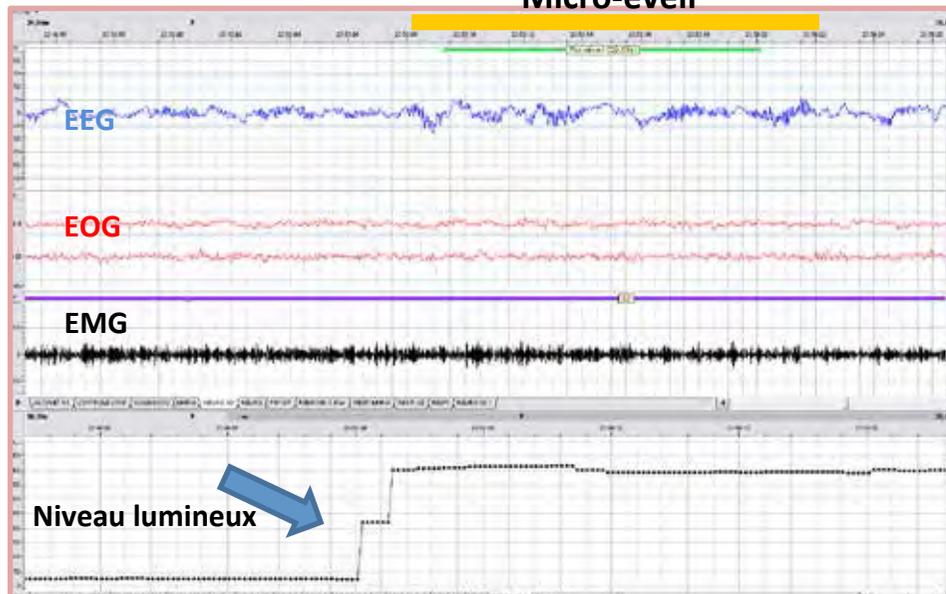
### Micro-eveil



### Micro-eveil

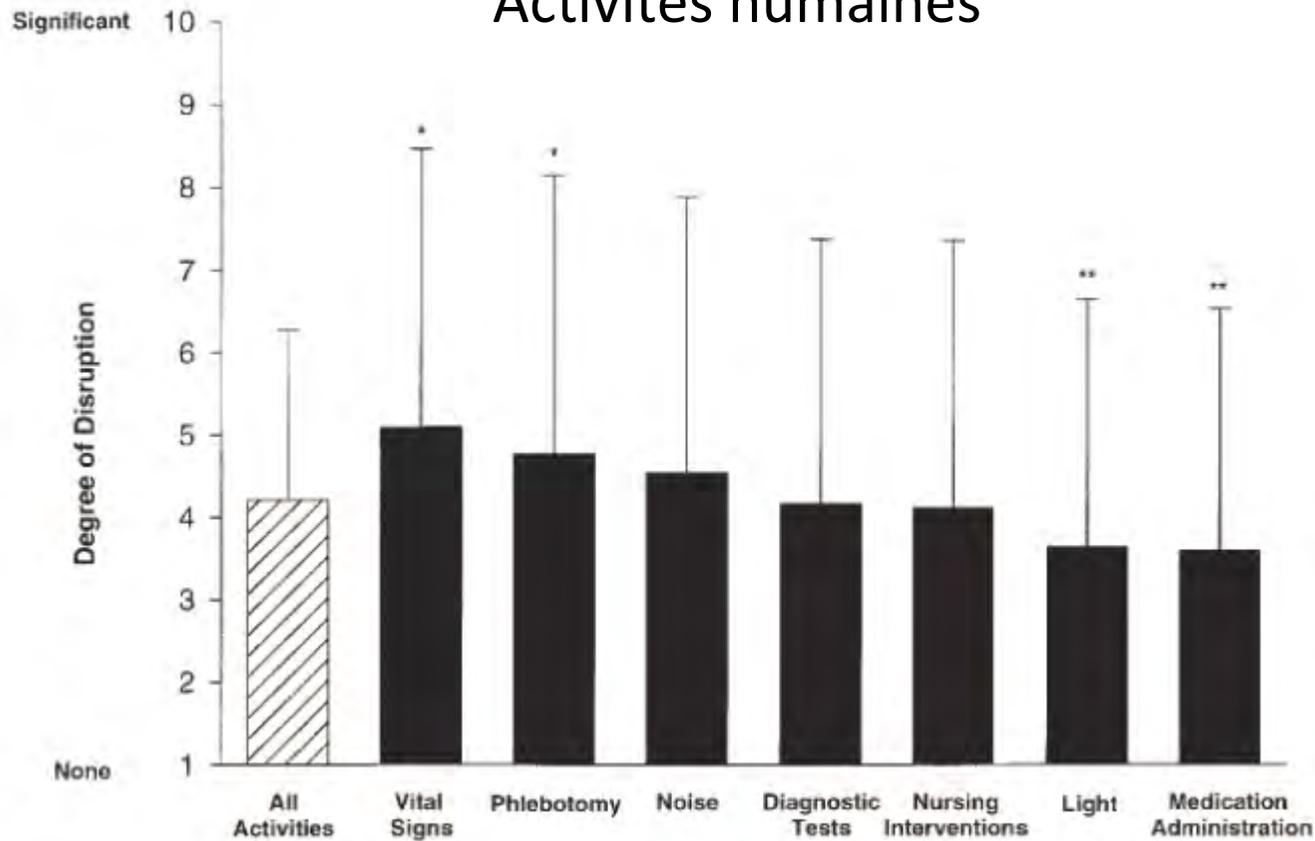


### Micro-eveil



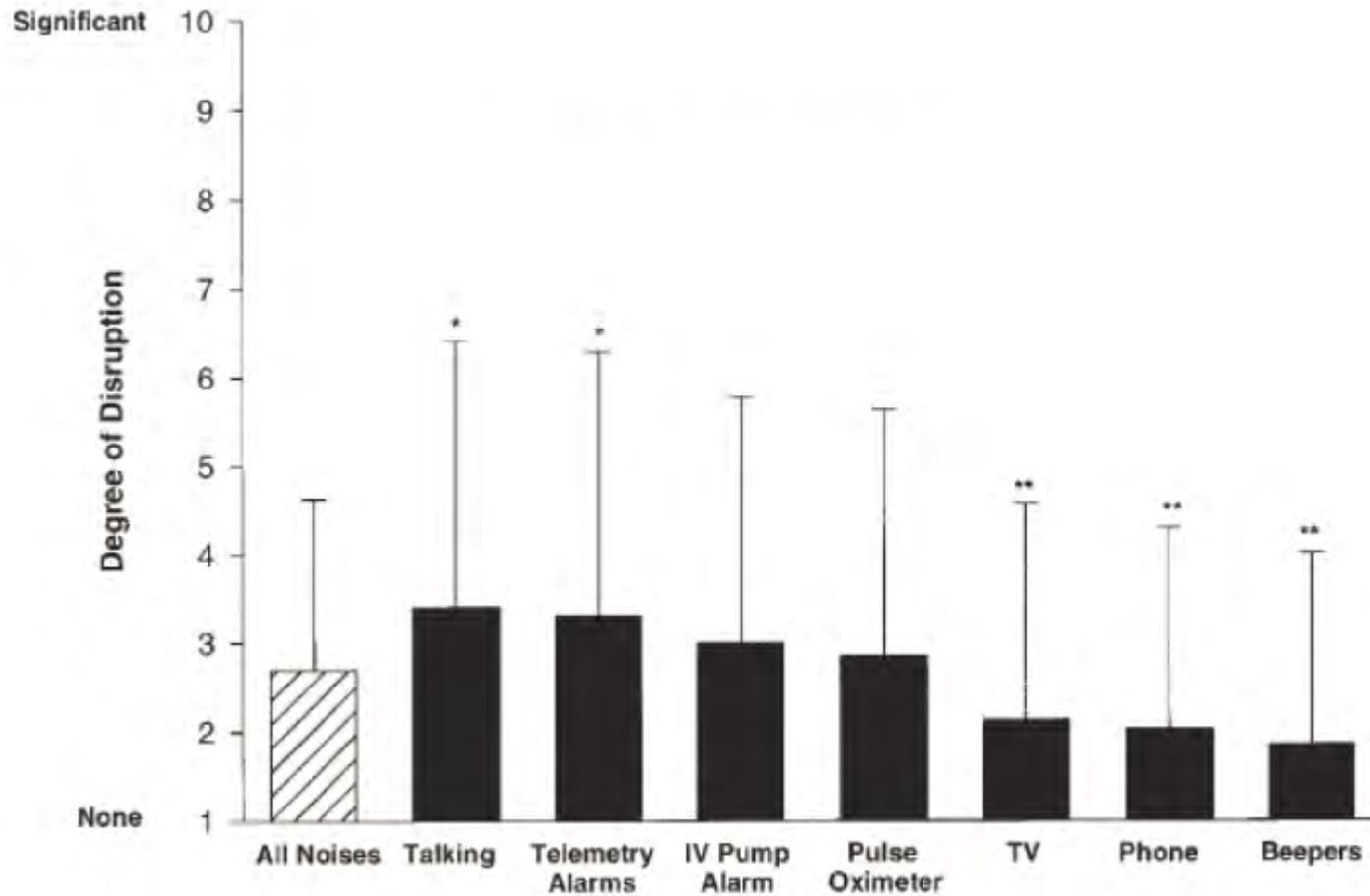
# FRAGMENTATION DU SOMMEIL ROLE ENVIRONNEMENT

## Activités humaines



*Freedman et Coll. Am J Respir Crit Care Med 1999*

# FRAGMENTATION DU SOMMEIL ROLE BRUITS



*Freedman et Coll. Am J Respir Crit Care Med 1999*

# FRAGMENTATION DU SOMMEIL ROLE ENVIRONNEMENT

- Facteurs externes :
  - Niveau sonore
  - Niveau lumineux
  - Soins infirmiers

## Contribution of the Intensive Care Unit Environment to Sleep Disruption in Mechanically Ventilated Patients and Healthy Subjects

Jonathan Y. Gabor, Andrew B. Cooper, Shelley A. Crombach, Bert Lee, Nisha Kadikar, Harald E. Bettger, and Patrick J. Hanly

Department of Medicine, St. Michael's Hospital; Department of Critical Care Medicine, Sunnybrook and Women's College Health Sciences Centre, University of Toronto, Toronto, Ontario, Canada

TABLE 5. IMPACT OF PATIENT-CARE ACTIVITIES ON SLEEP DISRUPTION

Event Type	No. per hr of Sleep	Percentage Causing Disruption	Percentage of Total Disruption
Sound	36.5 ± 20.1	11.7 ± 8.3	20.9 ± 11.3
Family visits	0.7 ± 0.7	38.6 ± 39.3	1.0 ± 1.3
Resp/Physio	0.4 ± 0.5	30.7 ± 32.6	0.5 ± 0.7
Suctioning	0.2 ± 0.8	62.5 ± 47.9	0.6 ± 0.8
RN visits	3.5 ± 1.8	21.7 ± 11.6	4.1 ± 3.5
Assess vitals	0.3 ± 0.4	51.4 ± 34.4	0.7 ± 0.9
Mx admin	2.7 ± 3.1	49.4 ± 25.6	0.9 ± 1.0
All medical care	7.8 ± 4.2	17.7 ± 5.4	7.1 ± 4.4
Apparatus/tech.	1.1 ± 1.0	21.6 ± 26.3	1.4 ± 1.8
Unidentifiable	—	—	68.1 ± 9.7

(Gabor AJRCCM, 2003)

- Facteurs intrinsèques :
  - Sévérité maladie
  - Douleur
  - Anxiété

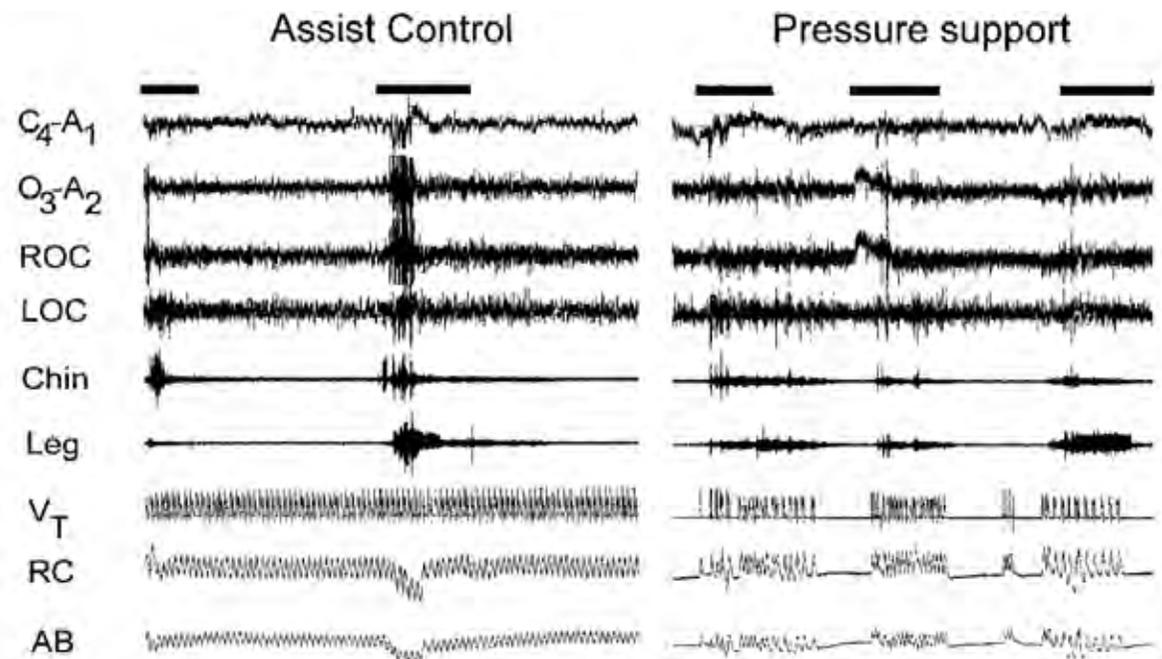
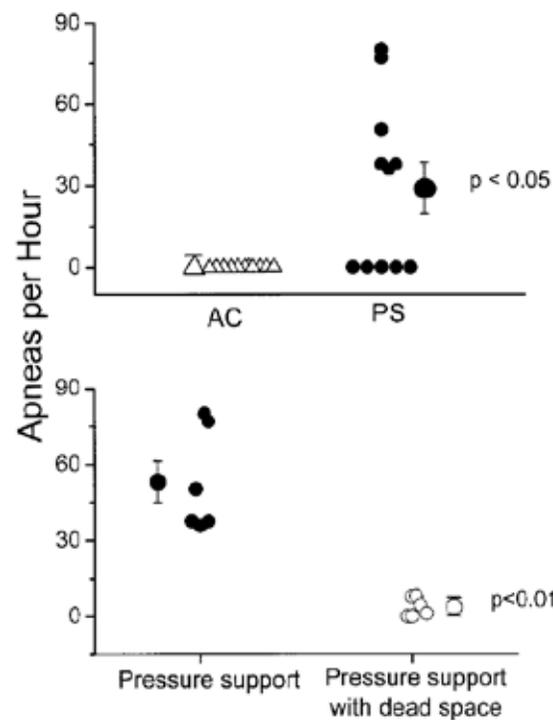
Causes des micro-éveils et réveils :

- 20% pics sonores
- 15% asynchronies patient-ventilateur
- <1% Lumière
- <1% soins infirmiers

## Effect of Ventilator Mode on Sleep Quality in Critically Ill Patients

Sairam Parthasarathy and Martin J. Tobin

Division of Pulmonary and Critical Care Medicine, Edward Hines, Jr. Veterans Administrative Hospital, Hines, Illinois; and Loyola University of Chicago Stritch School of Medicine, Maywood, Illinois





Nuttapol Rittayamai  
Elizabeth Wilcox  
Xavier Drouot  
Sangeeta Mehta  
Alberto Goffi  
Laurent Brochard

## Positive and negative effects of mechanical ventilation on sleep in the ICU: a review with clinical recommendations

- Ventilation contrôlée (volume / pression) serait moins délétère sur la qualité du sommeil
- L'aide inspiratoire (différents réglages) serait générateur de micro-éveils
- Les modes proportionnels pourrait être plus protecteurs (NAVA)
- La ventilation non-invasive pourrait préserver le sommeil

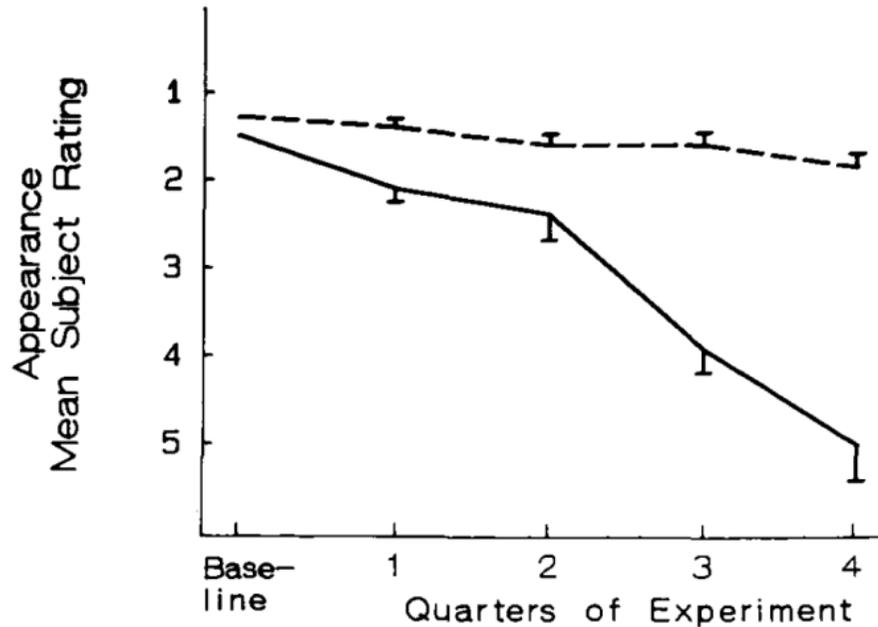
### Mais débats ++++

- Etudes de patients très hétérogènes entre elles (sur groupe de patients hétérogène)
- Différentes phases du séjours (admission, sevrage...)



## IMPACTS DES TROUBLES DU SOMMEIL SUR MORBIDITÉ

## Rongeurs



1. **Mortality** Unless deprivation was halted, all TSD rats died or showed signs of impending death—usually in about two to three weeks.<sup>2-10</sup> The deaths (after about four to six weeks) of PSD rats were also confirmed.<sup>11,12</sup>

2. TSD and PSD rats **lost weight** in spite of increased food intake. The large rise in energy expenditure (EE), calculated from the caloric values of food intake and weight loss) was confirmed.<sup>2,4-9,13-17</sup>

3. The development of scrawny, **debilitated appeared** was confirmed.<sup>2,4-7,11</sup>

4. The severe ulcerative and hyperkeratotic **skin lesions** localized to the paws and tails of TSD and PSD rats were confirmed.<sup>2,4-7,9,11</sup>

5. As in the original studies, TSD rats showed an initial rise and subsequent **decline in waking intraperitoneal temperature** ( $T_{ip}$ ).<sup>2,4,5,10,11,14,16</sup> As before, PSD rats showed only the  $T_{ip}$  decline.<sup>11,12</sup>

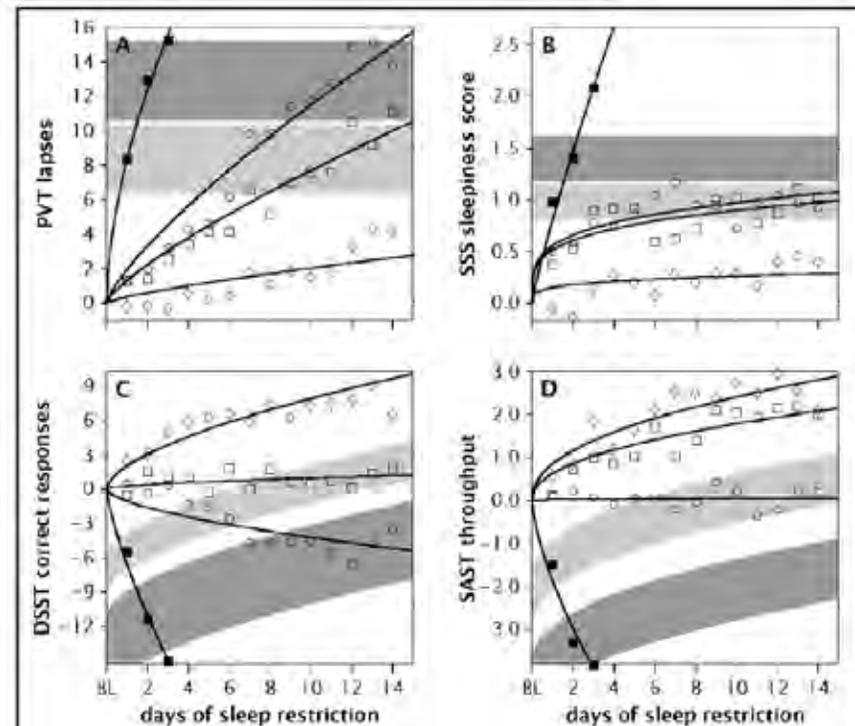
## PRIVATION DE SOMMEIL SUJETS SAINS

### Consequences comportementales :

Somnolence

Deficits attentionnel

Deficit cognitif étendu



# EFFETS PRIVATION DE SOMMEIL

## SUJETS SAINS

### fonctions cognitives: Hallucinations



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H. BABKOFF, ET AL.

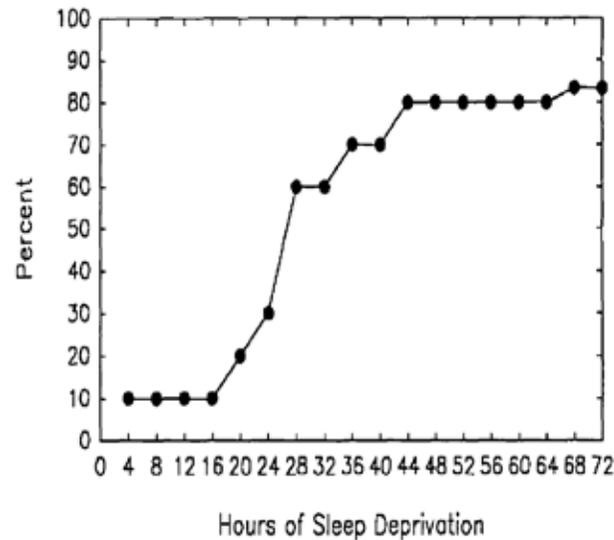


FIG. 1. Cumulative percent of subjects (N = 10) reporting their first visual distortion or hallucination as a function of hours of sleep deprivation

TABLE 1

EXAMPLES OF PERCEPTUAL DISTORTIONS AND HALLUCINATIONS

Types of Examples	Subjects' Descriptions
1. Task-related Visual Distortions	"... the video monitor is swimming around." "... the monitor screen is growing sprouts of grey and green hair all over."
2. Hallucinations (nontask related)	"... the decaying corpse of Barbara (assistant) interfered with vision during the (administration of) oral mood scale." "... Helena (assistant) was camouflaged as a fire hydrant."

Trouble du niveau de *vigilance* avec capacité réduite de concentration et d'attention

Développement d'un trouble de perception (hallucinations)

une apparition rapide de ces symptômes et une fluctuation dans le temps ;

# EFFETS PRIVATION DE SOMMEIL

## SUJETS SAINS

### Endurance inspiratoire:

#### METHODES

#### Matériel et Epreuve d'endurance

Charge inspiratoire constante 30%PI<sub>max</sub>

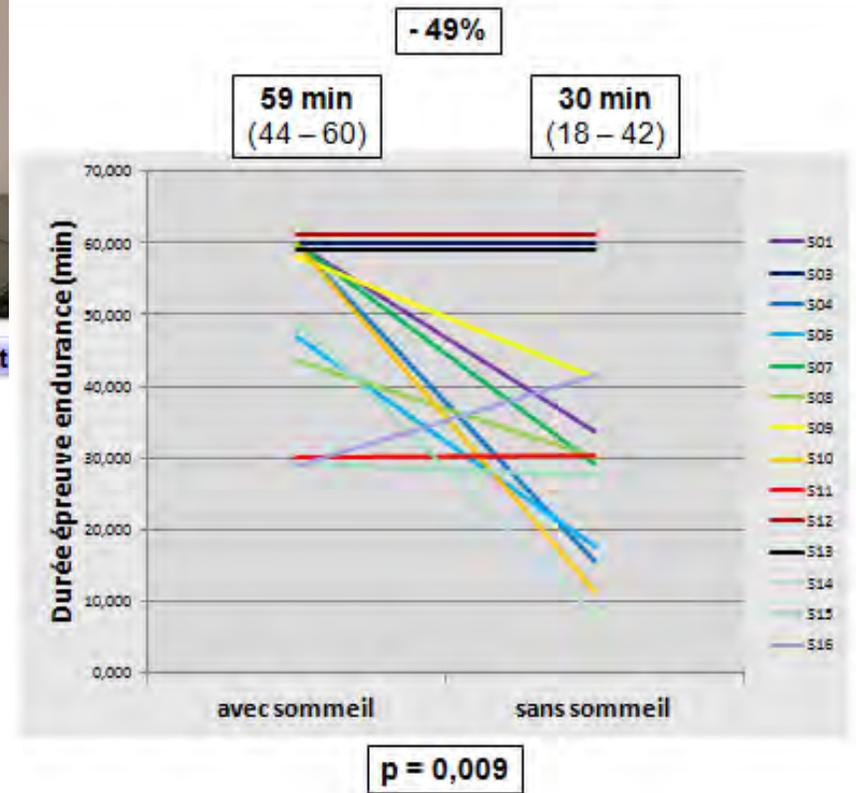


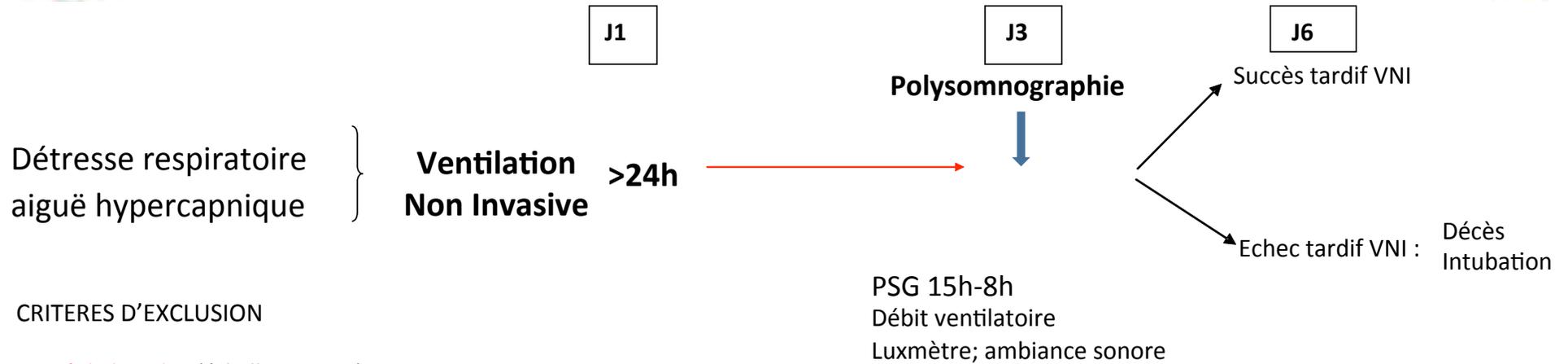
1H max



Endurance = temps de respiration contre charge jusqu'à épuisement

#### Temps jusqu'à épuisement

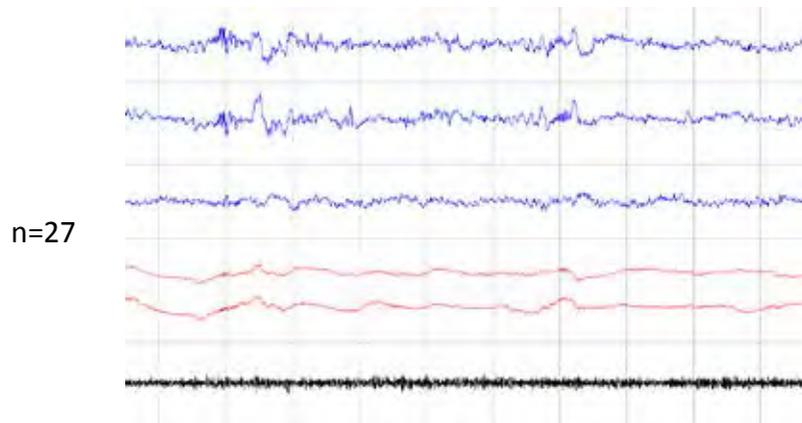




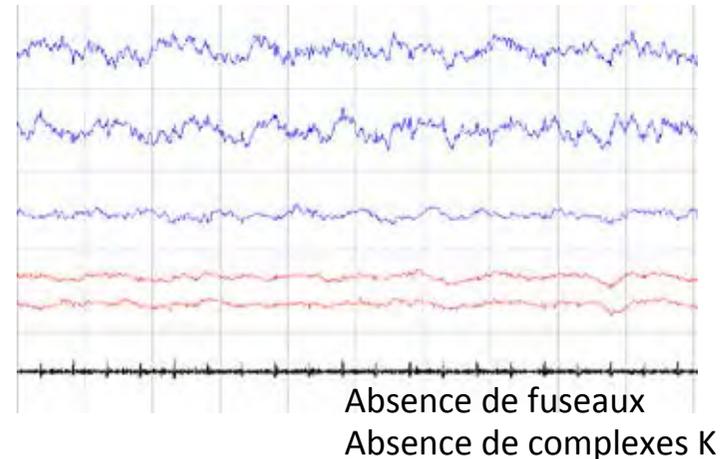
### CRITERES D'EXCLUSION

- **Encéphalopathie** (échelle RASS <1)
- Antécédent de pathologie neuro-psy
- **Prise de médicaments neurotropes** (aucune sédation)
- Instabilité hemodynamique
- **Sepsis** / pneumopathie

70%  
EEG Sommeil Normal

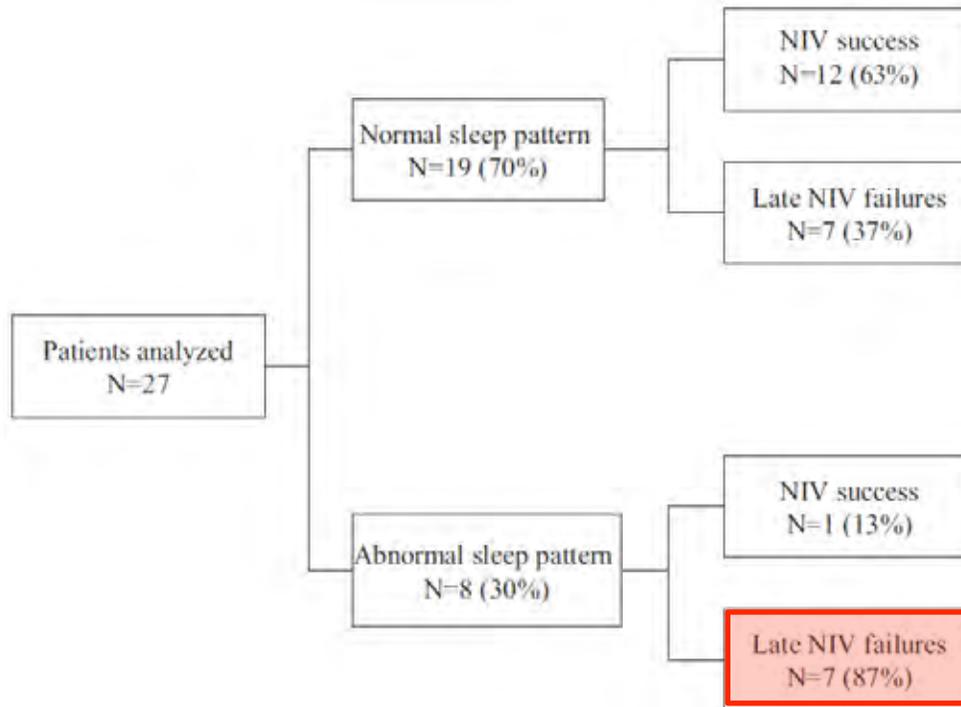


30%  
EEG Sommeil « atypique »



## Poor sleep quality is associated with late noninvasive ventilation failure in patients with acute hypercapnic respiratory failure\*

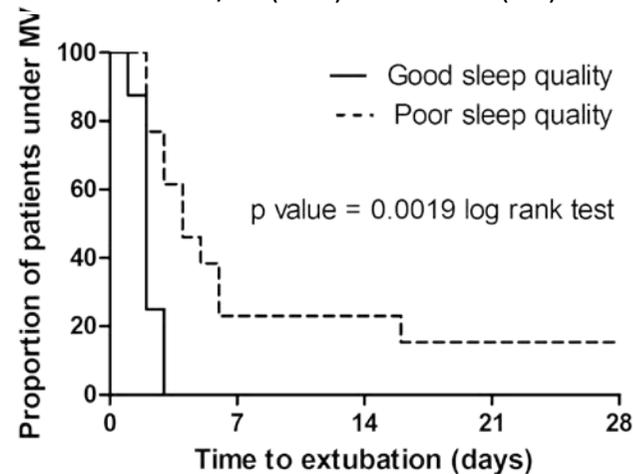
Ferran Roche Campo, MD; Xavier Drouot, MD; Arnaud W. Thille, MD; Fabrice Galia, MSBE; Belen Cabello, MD; Marie-Pia d'Ortho, MD; Laurent Brochard, MD



## Impact sur la durée de sevrage

**Table 2: Comparaison du sommeil selon la durée de sevrage de ventilation mécanique**

Caractéristiques du sommeil	Sevrage ≥ 3 j N = 12	Sevrage < 3 j N = 9	p
Temps total de sommeil (TTS), h	282 [126-710]	364 [149-441]	0.72
Index microréveils, N/heure	11 [3-23]	13 [8-21]	0.86
Durée Stade 1, en % du TTS	5% [1-15]	14% [9-18]	0.24
Durée Stade 2, en % du TTS	82% [43-99]	47% [36-57]	0.06
Durée Stade 3, min	0 [0-69]	47 [21-129]	0.10
Durée REM, en % du TTS	0% [0-1]	8% [6-14]	<b>0.01</b>
Présence de sommeil atypique ou veille pathologique, n (%)	8/12 (67%)	2/9 (22%)	<b>0.08</b>
Absence de réactivité à l'EEG, n (%)	8/12 (67%)	0 (0%)	<b>&lt;0.01</b>



- **Anomalies nombreuses**

- Organisation du sommeil très perturbée
- Répartition du sommeil anormale / rythmes circadiens anormaux
- Fragmentation majeure
- EEG de sommeil atypique, veille pathologique

Déficit de sommeil normal et de sommeil restaurateur

- **Conséquences physiologiques très probables**

- **Endurance inspiratoire**
- **Troubles cognitifs (delirium...synd post traumatique)**

- **Conséquences morbides ...**

- **Comment les prévenir ou les corriger...?**

## CONCLUSIONS

- Drouot et coll, Sleep in intensive care unit, sleep medicine reviews, 2008
- Pisani et coll, Sleep in intensive care unit AMJCRRM 2015
- X. Drouot and S. Quentin : Sleep neurobiology in critical care illness, in Sleep and Circadian Rhythms in the ICU, V Malik and RW Carlson editors. Critical care clinic 2015; 31:379-391.
- X.Drouot et A.Thille. Le sommeil en unité de soins intensifs. Réanimation. 2013.



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*In memoriam*



Marie-Pia d'Ortho