Sleep and nocturnal polyuria

Johan Vande Walle, L. Dossche,
1) Sleep ?
2) Sleep and enuresis in children?
3) Sleep and nocturia in the elderly?

Vande Walle J, Safepedrug, Uzgent. Belgium
Circadian sleep/wake disorder

- The two process model
  - Central homeostatic system: sleep homeostasis: process S
    - Maintains duration and sleep intensity (sleep pressure) within boundaries
  - Circadian rhythm: sleep/wake cycle: process C
    - Determines the sleep window or the optimal sleep timing
    - Acts independent from previous nights
Sleep physiology
Process C: circadian rhythm

- 23-25 hour sleep/wake cycle
- Regulated by SCN = masterclock (‘one way’tract)
- Input:
  - light = the most powerful environmental factor
  - food,
  - position, etc..

- Output
  - melatonin
    - Most prominent endocrin signal
    - For regulation of sleep induction
  - hormonal production
    - Cortisol
    - AVP
  - temperature
  - mood
Physiological parameters
• Sleep dependent
  • Growth hormone
  • Prolactin
  • PTH
• Sleep independent
  • Stress hormones
  • Temperature
  • Melatonin

Circadian rhythms
Sleep physiology

Process S: Sleep homeostasis/propensity

- Determinates appropriate structure and duration of sleep
- The hour glass of prior wakefullness
- Neurotransmitters:
  - wake or sleep promoting

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>NUCLEUS</th>
<th>NEUROTRANSMITTER</th>
<th>LEVEL OF ACTIVITY during arousal</th>
<th>LEVEL OF ACTIVITY during sleep</th>
</tr>
</thead>
<tbody>
<tr>
<td>sleep-promoting</td>
<td>VLPO</td>
<td>GABA</td>
<td>0</td>
<td>++</td>
</tr>
<tr>
<td>arousal-promoting</td>
<td>LC</td>
<td>norepinephrine</td>
<td>++</td>
<td>0</td>
</tr>
<tr>
<td>arousal-promoting</td>
<td>Raphe</td>
<td>serotonin</td>
<td>++</td>
<td>0</td>
</tr>
<tr>
<td>arousal-promoting</td>
<td>TMN</td>
<td>histamine</td>
<td>++</td>
<td>0</td>
</tr>
<tr>
<td>orexin-releasing</td>
<td>LHA</td>
<td>orexin</td>
<td>++</td>
<td>0</td>
</tr>
</tbody>
</table>
Sleep physiology

- REM sleep and non-REM sleep (SWS)
  - ultradian rhythm of about 90-100 minutes

- Cortical arousals
  - Cortical activation noticed by changed EEG frequency
  - Markers of sleep disruption (Shift from deep to light sleep)
  - Can result in awakening when > 15 seconds

- But also elements taking part of the normal sleep process
  - Varies with age
Integrated model of sleep physiology

Opponent process model

Anatomy

Close to pontine micturition centre
Connection with vasopressin producing neurons hypothalamus
1) Sleep?
2) Sleep and enuresis in children?
3) Sleep and nocturia in the elderly?
Are children with NE deep sleepers?
Psychology
ADHD
Circadian rhythm
sleep
bladder
Brain
neurotransmitter
Kidney
Hormones, caffeine, sleep deprivation. Do you feel lucky?
Ghent: study 1 refractory enuresis

- 29 patients with NE: Polysomnography
  - 15 desmopressin resistant
  - 14 desmopressin dependent

Plms-index > 5

Desmopressin melt improves sleep and psychological functioning in patients with monosymptomatic nocturnal enuresis
Prospective study

C. Van Herzele, K. Dhondt, A. Raes, A. Groen, S. Roels, P. Hoebeke, J. Vande Walle
Results: Enuretic parameters

30 children, 6-16y

- Response desmopressin melt (ICCS)
Moment of alarm
Results: Sleep

- PLMS index

PLMS-index (p<.001)
Results: Sleep

- Cortical arousals

**Arousal-index ↓**

\( p < 0.01 \)

**Arousal Awakening-index ↓**

\( p < 0.05 \)
Results: Psychology

- Attention problems
  (parents, p<.01)

- Internalizing problems
  (parents, p<.05)

- Externalizing problems
  (parents, p<.01); (teacher, p<.05)

- QoL
  (child + parents, p<.01)

- Executive functioning
  (child, parents, teacher; p<0.05* – p<0.01**) 

- Auditive memory
  (child, p<.01)
Conclusion

Comorbidity

Enuresis
Sleep
Nocturnal polyuria
ADHD
Cognitive function

Treatment with desmopressin melt

Enuresis
Sleep
Nocturnal polyuria
ADHD
Cognitive function

2. Dhondt K et al. 2014 ESPU, 25th Anniversary congress, Abstracts

ADHD, attention deficit hyperactivity disorder
1) Sleep?
2) Sleep and enuresis in children?
3) Sleep and nocturia in the elderly?
Disrupted Sleep & Health Consequences of Nocturia

Donald L. Bliwise, Ph.D.
Professor of Neurology
Emory University School of Medicine
Atlanta, Georgia (USA)
Nocturia Is the Leading Cause of Sleep Disturbance in Older Adults

How often do the following disturb your sleep?

N = 1424; aged 55-84 years
- Nocturia
- Headache
- Physical pain
- Money problems
- Caregiving
- Family problems
- Health concerns
- Uncomfortable bed
- Cough
- Frequency of Disturbed Sleep
- Nighttime heartburn

Frequency of Disturbed Sleep

SWS May Be Interrupted by Nocturia

The first nocturia episode occurs within 2 to 3 hours on average.
**Short FUSP Associated with Worse Whole-night Sleep in Nocturia Patients**

PSQI scores indicate that the shorter the FUSP, the worse the patient’s rating of depth, length, and quality of their sleep for the entire night.

### Nocturia Disrupts SWS (N3): Analysis by Timing of First Void

<table>
<thead>
<tr>
<th>Sleep Measure</th>
<th>First Void <em>During</em> First 2 Sleep Cycles</th>
<th>First Void <em>After</em> First 2 Sleep Cycles</th>
<th>( P )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total sleep, min (± SD)</td>
<td>306 (54)</td>
<td>330 (47)</td>
<td>NS</td>
</tr>
<tr>
<td>N1/N2 sleep, min (± SD)</td>
<td>170 (41)</td>
<td>171 (33)</td>
<td>NS</td>
</tr>
<tr>
<td>N3 sleep, min (± SD)</td>
<td>37 (24)</td>
<td>56 (22)</td>
<td>0.023</td>
</tr>
<tr>
<td>REM sleep, min (± SD)</td>
<td>95 (35)</td>
<td>103 (25)</td>
<td>NS</td>
</tr>
</tbody>
</table>

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Conclusion

Comorbidity

- Enuresis
- Sleep
- Nocturnal polyuria
- ADHD
  - Cognitive function

Treatment with desmopressin melt

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- Sleep
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