Is Sleep Deprivation an Important Problem in the ICU?

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Disclosures

None relevant to this talk
Is Sleep Deprivation an Important Problem in the ICU?

“Yes, it is.”
Clinical Practice Guidelines for the Management of Pain, Agitation, and Delirium in Adult Patients in the Intensive Care Unit

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Clinical Practice Guidelines for the Prevention and Management of Pain, Agitation/Sedation, Delirium, Immobility, and Sleep Disruption in Adult Patients in the ICU

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Is Sleep Deprivation an Important Problem in the ICU?

“Yes, it is.”

Why is sleep deprivation an important problem in the ICU?
Sleep: a Vital Need

- Sleep is one of the 7 basic needs of humans
- Physiologic effects of sleep deprivation:
  - ↑cortisol, ↑norepinephrine
  - Impaired glucose metabolism
  - ↓thyroxine
  - ↓body temperature
  - Suppressed immune response

Sleep 1989: 12(1):13-21
Sleep Deprivation in Rats

• 10 rats subjected to **total sleep deprivation (TSD)** by disk over water method
• All 10 died within 11-32 days
• No anatomical cause of death identified
Sleep Deprivation in Humans

- Impairs respiratory muscle endurance in healthy males
  - Muscle strength (MIP, MEP) FEV1, FVC not affected
- Depresses immune function in healthy adults
- Blunts ventilatory response to hypercapnia and hypoxia
- Associated with late NIV failure
  - Campo, F. Crit Care Med, 2010; 38
Why do we sleep?

“Sleep drives metabolite clearance from the adult brain”

• During natural sleep or anesthesia,
  • 60% increase in interstitial space
  • Increased convective exchange of CSF with interstitial fluid
  • Increased rate of β-amyloid clearance during sleep
  • Enhanced removal of potentially neurotoxic waste products that accumulate in the CNS during wakefulness

Science. 2013 Oct 18;342(6156):373-7
1) Wakefulness is associated with synaptic potentiation in several cortical circuits
2) Synaptic potentiation is tied to the homeostatic regulation of slow wave activity
3) Slow wave activity is associated with synaptic downscaling
4) Synaptic downscaling is tied to the beneficial effects of sleep on neural function and indirectly on performance
Fig. 2  The synaptic homeostasis hypothesis.
Slow Wave Sleep
Stage N3 (deep sleep)
• minimum of 20% delta waves (0.5–2 Hz), hardest to arouse
• Thought to be important for declarative memory processing (facts and knowledge)

REM Sleep
• Rapid eye movements, low amplitude, mixed frequency EEG
• Accounts for 18-22% of total sleep time
• Elaborate, vivid dreams occur
• Loss of skeletal muscle tone
• Thought to be important for consolidation of procedural memory (learning complex tasks)
Cognitive Impacts

**Acute TSD**
Impairs:
- Attention
- Working memory
- Long-term memory
- Decision-making

**Chronic Partial SD**
Impairs:
- Attention
- Vigilance
- ?more demanding cognitive recovery processes
Sleep Deprivation

- Inattention
- Delusions
- Hallucinations
- Impaired memory
- Slurred speech
- Discoordination
- Moodiness/ irritability
- Decreased reaction time
- Complete recovery after sleep

Delirium

- Inattention
- Delusions
- Hallucinations
- Fluctuating mental status
- Incoherent thought and speech
- Reduced awareness of environment
- Hyper or hypoactive
- Longterm neurocognitive sequelae in some patients
Sleep deprivation may be just one of “multiple insults” to the brain, thereby amplifying risk of delirium (hypothesis).
Is Sleep Deprivation an Important Problem in the ICU?

“Yes, it is.”

Why is sleep deprivation an important problem?

“Because the brain is a really important organ and our brains need sleep.”
Is Sleep Deprivation an Important Problem in the ICU?  

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Why is sleep deprivation an important problem?  

“Because the brain is a really important organ and our brains need sleep.”

Is it an important problem in the ICU?
Sleep in ICU

- 61% of ICU patients reported sleep deprivation
  - Simini, B. THE LANCET 1999; 354 : 571-2
- Being unable to sleep ranked among the highest stressors by patients
  - Biancofiore, G. Liver Transplantation, 2005;11(8): 967-972
“But the worst part of being in the hospital was the nights. I never slept. I wouldn't allow myself to nap in the day so I'd be tired at night but it didn't help…. I probably had a maximum of 2 hours a night the whole time I was there. The doctors were concerned when they came every morning but I just could not sleep. The nights would drag; I'd be lying there listening to the night shift nurses talking (quietly) about their Xmas shopping etc and I’d just lie there. The few times I did drop off I was woken up by the nurse doing their regular observation checks!”

-Kay, 27 years old, admitted to ICU with H1N1 and pneumonia, intubated, ventilated, tracheostomy, eventually weaned off MV and discharged home
Sleep Quality in the ICU

- Highly fragmented
  - 20-80 arousals and awakenings per hour sleep
- Abnormal sleep architecture
  - severely reduced slow wave sleep
  - Reduced to absent REM sleep
- Disruption of circadian rhythm
  - 50% of sleep occurs during the day in short bouts
Characterization: Critically Ill vs. Healthy
(Descriptive Question 1)

Question:
How does sleep in critically ill adults differ from normal sleep in healthy adults?

Ungraded Statement:
• Total sleep time (TST) and sleep efficiency are often normal
• Sleep fragmentation, the proportion of time spent in light sleep (stage N1+N2) and time spent sleeping during day (vs. night) is higher
• The proportion of time of time spent in deep sleep (stage N3+REM) is lower
• Subjective sleep quality is reduced
Characterization: Delirium vs. No Delirium

(Descriptive Question 2)

Question:
Is sleep different in critically ill adults if delirium (vs. no delirium) is present?

Ungraded Statement:
• The presence of delirium may not affect TST, sleep efficiency or sleep fragmentation
• The influence of delirium on the proportion of time spent in light (N1+N2) sleep vs. deeper (N3) sleep is unknown
• REM sleep is lower if delirium is present
• Delirium is associated with greater circadian sleep-cycle disruption and increased daytime sleep
• Whether delirium affects reported subjective sleep quality remains unclear
Does Sleep Quantity and Quality Differ in ICU Patients With and Without Delirium?

Karen J. Bosma, Daniel Ovakim, Mithu Sen, George Dresser, Philip Jones
The University of Western Ontario, London, Canada; London Health Sciences Center, London, Canada

21 adult medical-surgical patients with 11 ± 4 hrs of PSG recording
Figure 5. Characteristic Hypnograms

(a) Delirious, Primarily Wake, No REM; (b) Delirious, Many Awakenings, some REM;
(c) Non-delirious, More REM, More SWS; (d) Non-delirious, Consolidated sleep, REM rebound
<table>
<thead>
<tr>
<th></th>
<th>Non-Delirious (n=15)</th>
<th>Delirious (n=6)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sleep Maintenance Efficiency (%)</td>
<td>70 (56-86)</td>
<td>42 (36-49)</td>
<td>0.04</td>
</tr>
<tr>
<td>Awakenings after Sleep Onset (n)</td>
<td>27 (14-30)</td>
<td>44 (36-49)</td>
<td>0.02</td>
</tr>
<tr>
<td>Stage 1 Sleep (min)</td>
<td>28 (21-48)</td>
<td>97 (54-146)</td>
<td>0.03</td>
</tr>
<tr>
<td>% Stage 1 Sleep (% of total sleep)</td>
<td>9 (7-16)</td>
<td>31 (16-69)</td>
<td>0.006</td>
</tr>
</tbody>
</table>

Data expressed as median (IQR); P value based on Independent Samples Mann-Whitney U test.
Conclusions: Delirium

- Inability to consolidate sleep
- Multiple awakenings, more stage 1 light sleep
- Extended sleep period, equal TST
- Reduced sleep maintenance efficiency
- Limitation: 24 hr PSG would enhance data but was not possible due to daily activities
Sleep Quality in the ICU

- Up to 2/3 of ICU patients do not have EEG patterns consistent with typical “sleep”, but rather coma, encephalopathy or suppression due to sedation

- In patients who have periods of wakefulness and sleep, pattern is very abnormal
Prevalence of Unusual/Dissociated Sleep Patterns
(Descriptive Question 4)

Question:
What is the prevalence of unusual or dissociative sleep patterns in critically ill adults?

Atypical sleep:
- θ + δ waves (evocative of sleep) seen on EEG in a behaviorally awake patient.
- α + β waves (evocative of wakefulness) seen on EEG in a comatose patient.
- Factors (ie., sedation, sepsis, delirium) also known to influence EEG patterns have been poorly controlled for in ICU studies reporting atypical sleep.

Ungraded Statement:
The prevalence of unusual or dissociative sleep patterns is highly variable and depends on patient characteristics.
November 9, 2018

Is Sleep Deprivation an Important Problem in the ICU?

“Yes, it is.”

**Why is sleep deprivation an important problem?**

“Because the brain is a really important organ and our brains need sleep.”

Is it an important problem in the ICU?

“It is common and it is important to patients.”

What are the short-term and long-term consequences?
Outcomes During and After the ICU Admission
(Descriptive Question 7)

Question:
Do sleep and circadian rhythm alterations ‘during” an ICU admission affect outcomes during and/or after the ICU stay in critically ill adults?

Ungraded Statement:
1. Although an association between sleep quality and delirium occurrence exists in critically ill adults, a cause-effect relationship has not been established.
2. An association between sleep quality and duration of mechanical ventilation, length of ICU stay, and ICU mortality in critically ill adults remains unclear.
3. The effects of sleep quality and circadian rhythm alterations on outcomes in critically ill patients after ICU discharge are unknown.
Summary

- Poor sleep is a common complaint and a source of distress for many critically ill patients.
- Sleep disruption in the critically ill can be severe and is characterized by:
  - Sleep fragmentation
  - Abnormal circadian rhythms
  - Increased light sleep (stage N1 and N2)
  - Decreased deep sleep (stage N3 or “slow wave sleep”) and REM sleep
- Sleep is considered a potentially modifiable risk factor influencing recovery in critically ill adults.
- The interplay of medications, critical illness, delirium, cerebral perfusion, and sleep is complex, but an important area of current research
THIS IS A BRAIN

THIS IS A BRAIN WITHOUT SLEEP.

ANY QUESTIONS?

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Slide content of some slides has been provided by the PADIS Guideline Leadership.
For more information on how to implement the 2018 PADIS guidelines, please visit the [ICU Liberation Campaign website](#).