



Mechanical Ventilation and Sleep

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Objectives

1. NORMAL SLEEP PATTERN
2. SLEEP IN ICU
3. CURRENT UNDERSTANDING AND FACTORS AFFECTING SLEEP IN ICU
4. INFLUENCE OF MODES OF VENTILATION ON SLEEP PATTERN
5. HOW TO IMPROVE SLEEP IN PATIENTS RECEIVING MECHANICAL VENTILATION



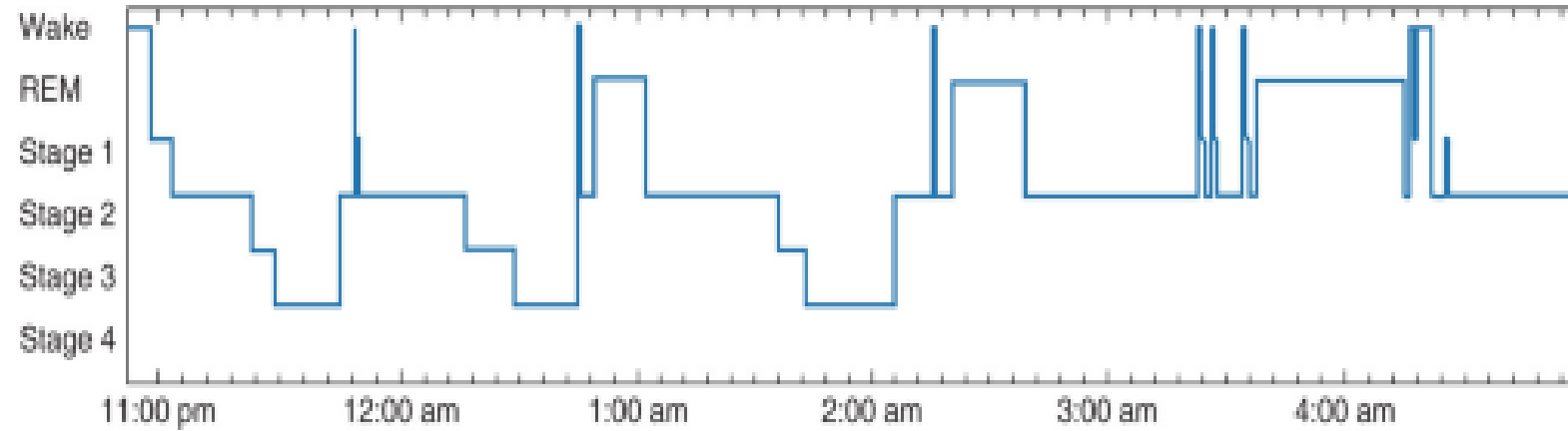
Architecture of sleep

- Normal sleep duration: 7-8 hours,
- Up to 10 arousals per hour of sleep
- Sleep disruption: increased frequency of arousals and awakenings

| Stage | Time |
|-----------------------|-------|
| Stage 1 | 5-10% |
| Stage 2 | 50% |
| Slow wave sleep (SWS) | 15% |
| REM | 25 % |



Normal sleep pattern



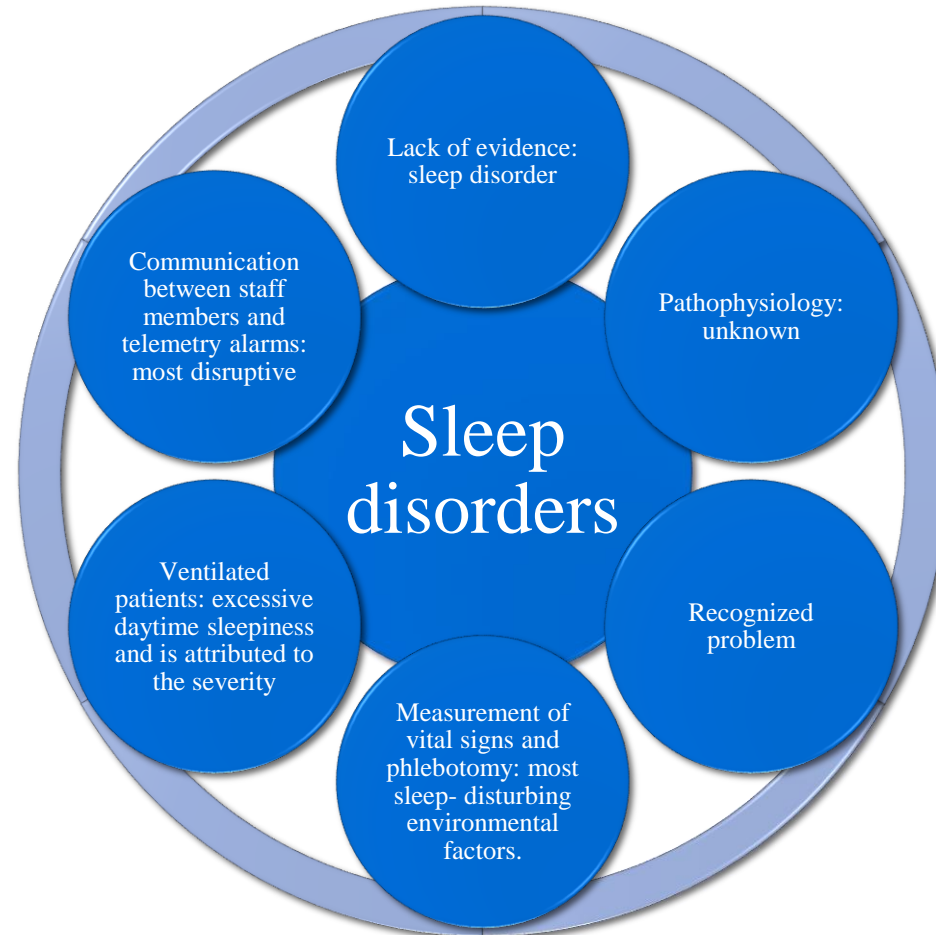


Rate the Quality of sleep in these pictures



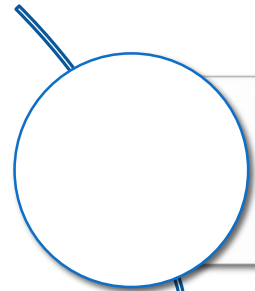


Sleep disorders in intensive care unit: Knowns & Unknown

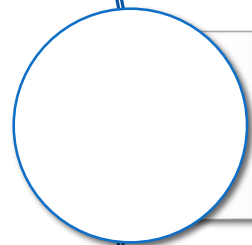




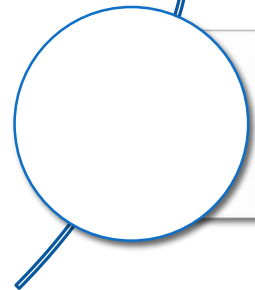
Sleep in Intensive Care Unit:



Polysomnographic data: sleep fragmentation and sleep loss.



Decrease in sleep time increase in stage 1 NREM and concomitant decrease in the SWS, uncoupling of day-night circadian pattern are reported.



Only 50-60% of sleep occurred during the night



Sleep in ventilated patient: polysomnographic findings

Disruptive
sleep,

- Abnormal temporal distribution of sleep, reduced amounts of slow wave and REM sleep, also, an increased frequency in arousal and awakenings.

Atypical
sleep

- intermediate between sleep and coma. Absence of stage 2 NREM and REM sleep along with features of pathologic wakefulness (saccadic eye movements and sustained chin muscle activity) which coincides with slow wave sleep.

Coma

- EEG features according to the classification by Young et al.



Whom polysomnography can be used

1. Acute physiology score <13 ,
2. Glasgow coma scale >10 ,
3. Sedative dose of lorazepam equivalents and morphine equivalents less than 10mcg/kg per hour.

Bedside assessment by nurse and actigraphy are considered to be unreliable



Causes of disturbed sleep in the ICU

- Preexisting diseases: asthma, sleep apnea
- The most important cause of sleep disruption is the severity of illness that lead to the admission to ICU.
- REM rebound: post-operative period, narcotics, sedatives, analgesics, decrease in the illness-related sleep disruptors such as pain
- Environment and its interaction with the circadian rhythm



Intensive Care Unit Environment

Light: 100-500 lux can affect melatonin secretion; 300-500 lux may disrupt the circadian pacemaker

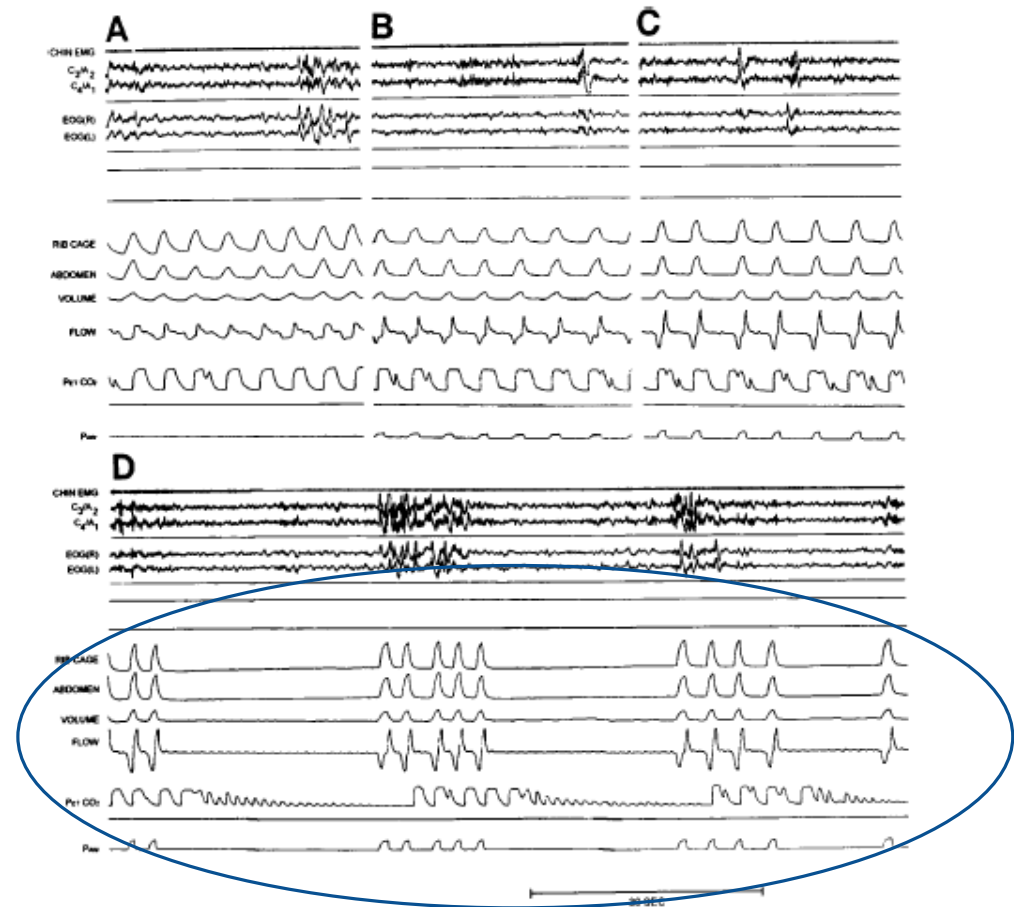
Noise: 80 A-weighted decibels

Health care provider: Nursing intervention etc



Mechanical Ventilation

- Sleep disruption
- Periodic breathing
 - Central apnea
 - Patient ventilator asynchrony
 - Excessive ventilator assist



J appl physiol (1985) 1998;85:1929-40

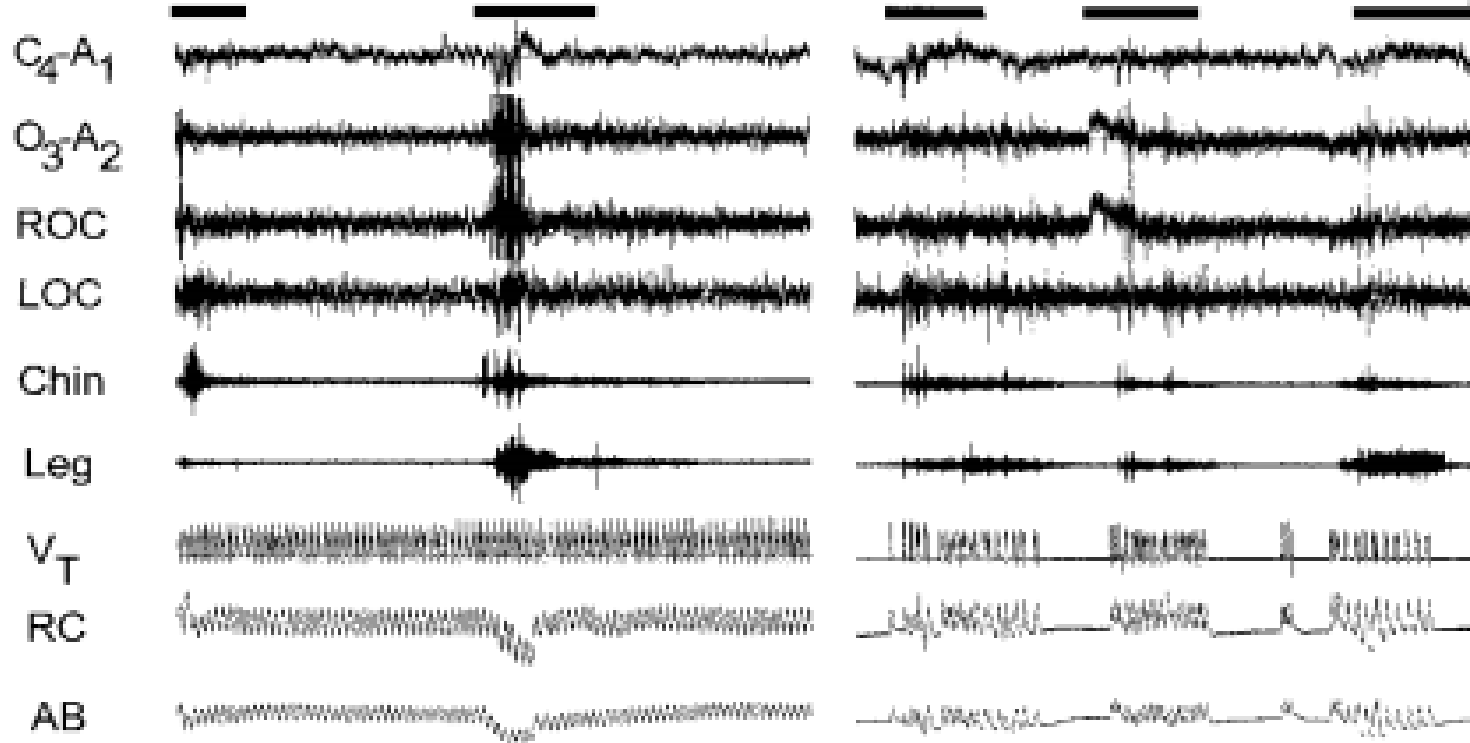


| Investigators | Type of Study | Comparisons | Conclusions |
|---------------------|-----------------------------|-------------|---|
| Parthasarathy, 2002 | Randomised cross-over study | ACV vs PSV | Increase in SEI in ACV; Decrease SFI in ACV |
| Bosma, 2007 | Randomised cross-over study | PAV vs PSV | No difference in SEI |
| Toublanc 2007 | Randomised cross-over study | ACV vs PSV | No Significant reduction in awakening index |
| Alexopoulou 2007 | Randomised cross-over study | PAV vs PSV | SEI higher in PAV. No reduction in SFI. |
| Cabello, 2008 | Randomised cross-over study | ACV vs PSV | No Significant reduction in fragmentation index |
| Andréjak 2013 | Randomised cross-over study | PCV vs PSV | SEI higher in PCV. Increase in REM sleep |



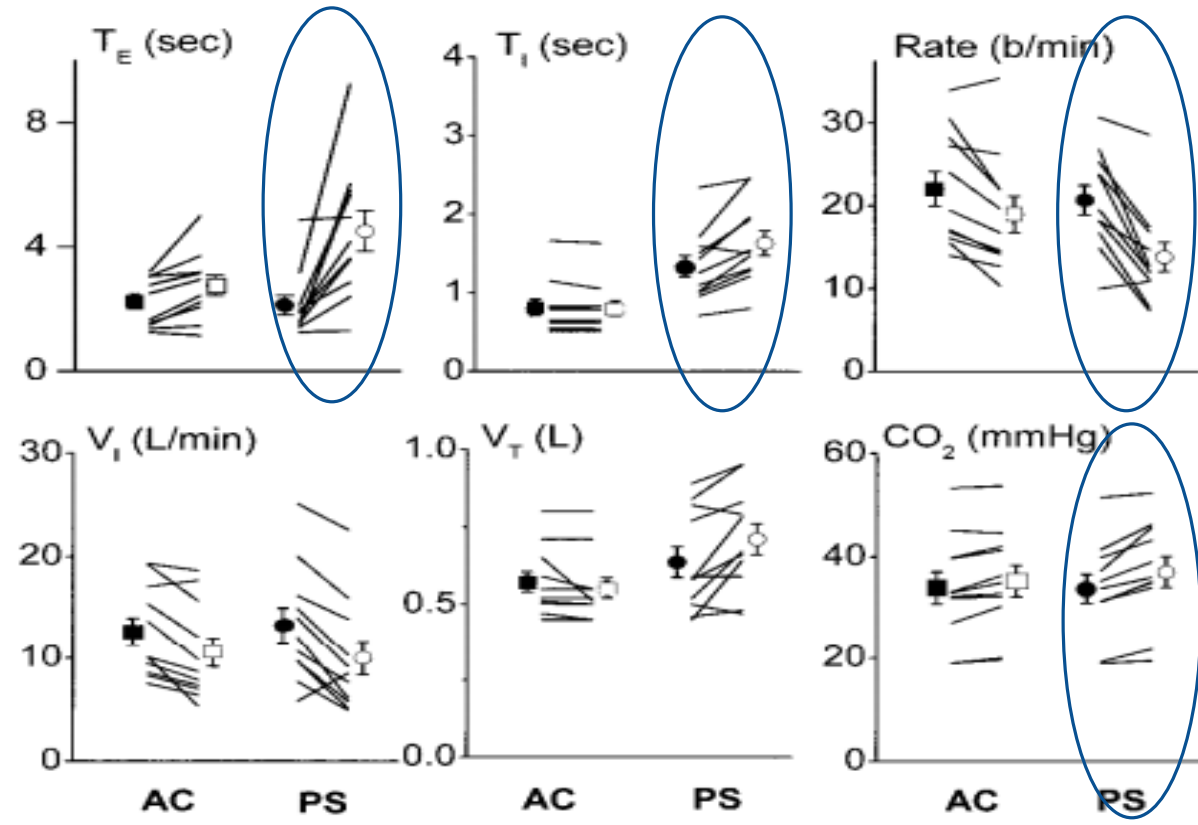
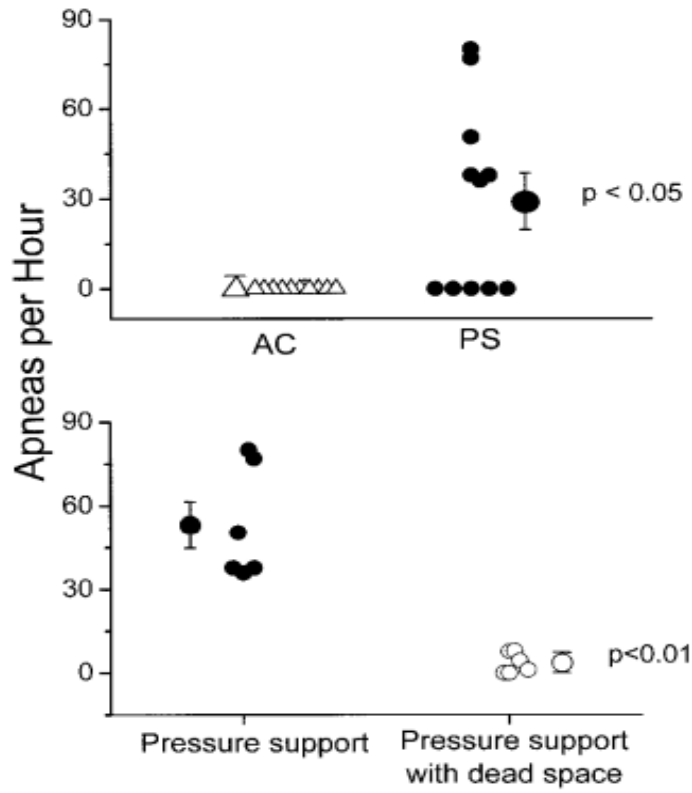
Assist Control

Pressure support



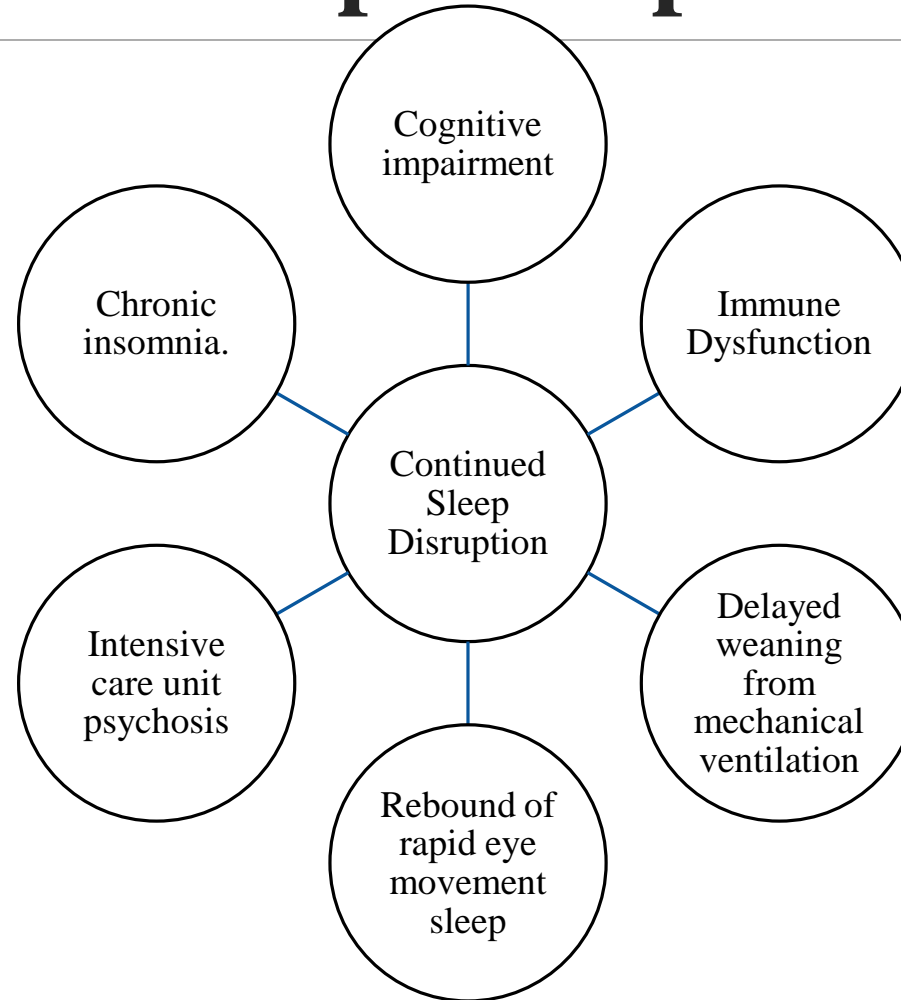
1 min

Am J Respir Crit Care Med. 2002:
Parthasarathy S, Tobin MJ.





Consequences of sleep disruption





Improving sleep in intensive care unit

Controlling the severity of the disease

maintaining the treatment of chronic disease

Reduction of pain

Optimization of the intensive care unit environment

Minimizing light, noise and nursing interventions

sleep scheduling

Mode of Ventilation

Patient Ventilator Asynchrony

Optimization of support (PAV, PCV, ACV)



Conclusion:

- ✓ Sleep disturbances are common in mechanically ventilated patients and patients admitted in ICU.
- ✓ They have potential to increase the morbidity and mortality thorough disturbing the neurocognitive, cardiorespiratory and immune functions.
- ✓ Only 30 % of the total sleep disruption is attributed to ICU environment and the patient-care activities