Sleep related movement disorders?

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Nocturnal Frontal Lobe Epilepsy (NFLE)

• Seizures in NFLE may have bizarre clinical features, with vocalization, complex automatisms, and ambulation (only in the bedroom)
• Typically of the hyper-motor type,
  – Repetitive, high-amplitude, and high-velocity movements of the trunk and proximal extremities and
  – Asymmetric tonic seizures having dystonic, dyskinetic, and repetitive proximal movements.
• Complex motor seizures in NFLE have hypermotor manifestations,
  – Marked agitation with body rocking, kicking, boxing, thrashing, pedaling, bending, hitting, running, spitting, and various types of vocalization that include shouting and swearing
### Classification of movement disorders during sleep

<table>
<thead>
<tr>
<th>Physiologic Motor Activity during sleep or at sleep onset</th>
<th>Pathologic Motor Activity during Sleep</th>
</tr>
</thead>
<tbody>
<tr>
<td>Postural shifts, body &amp; limb movements during sleep</td>
<td>Motor parasomnias</td>
</tr>
<tr>
<td>Physiologic fragmentary myoclonus</td>
<td>Sleep-Related Movement Disorders</td>
</tr>
<tr>
<td>Hypnic jerks</td>
<td>Isolated Sleep-Related Motor Symptoms</td>
</tr>
<tr>
<td></td>
<td>(Apparently Normal Variants)</td>
</tr>
<tr>
<td>Hypnagogic foot tremor</td>
<td>Nocturnal seizures</td>
</tr>
<tr>
<td>Rhythmic leg movements</td>
<td>Miscellaneous Nocturnal Motor Hyperactivity</td>
</tr>
<tr>
<td></td>
<td>Voluntary Movement Disorders (Sleep-related Dissociative disorders)</td>
</tr>
</tbody>
</table>
Abnormal paroxysmal events in sleep

• Polysomnography test → gold standard to distinguish
• How to perform clinical approach of this abnormal paroxysmal events in sleep

  – Sleep related movement disorders
  – Parasomnias
    • Non REM parasomnias
    • REM parasomnias
  – Frontal Lobe Epilepsy and Parasomnias Scale (FLEP)
  – Other sleep related epilepsy
  – Other persistent daytime abnormal movements
  – Sleep-related Dissociative Disorders
Clinical approach

Abnormal paroxysmal events in sleep

Complex
- Parasomnia
  - NREM
  - REM
- NFLE
- Functional movement

Simple
- Persistent daytime abnormal movement
- Functional movement

Sleep related movement disorders

Derry CP, Arch Neurol 2006.
International classification of Sleep disorders 3rd edition (ICSD-3)

<table>
<thead>
<tr>
<th>Insomnia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sleep related breathing disorders</td>
</tr>
<tr>
<td>Central disorders of hyper somnolence</td>
</tr>
<tr>
<td>Circadian rhythm sleep wake disorders</td>
</tr>
<tr>
<td>Parasomnias</td>
</tr>
<tr>
<td>Sleep- related movement disorders</td>
</tr>
<tr>
<td>Other sleep disorders</td>
</tr>
</tbody>
</table>
### Sleep related movement disorders

- Characterized by relatively simple, usually stereotyped movements that disturb sleep

### Parasomnias

- Undesirable physical or experiential events that accompany sleep without disrupting sleep architecture.

- Complex behaviors during sleep that appear *purposeful and goal-directed*, but are outside the conscious awareness of the individual and are therefore inappropriate

- Consist of abnormal sleep-related movements, behaviors, emotions, perceptions, dreaming, and autonomic nervous system functioning

- Disorders of arousal, partial arousal, and sleep-stage transition
### Sleep-related movement disorders

- Restless legs syndrome
- Periodic limb movement disorder
- Sleep-related leg cramps
- Sleep-related bruxism
- Sleep-related rhythmic movement disorder
- Benign sleep myoclonus of infancy
- Propriospinal myoclonus at sleep onset
- Sleep-related movement disorder due to a medical disorder
- Sleep-related movement disorder due to a medication or substance
- Sleep-related movement disorder, unspecified

### Parasomnias

#### NREM-related parasomnias
- Confusional arousals
- Sleepwalking
- Sleep terrors
- Sleep-related eating disorder

#### REM-related parasomnias
- REM sleep behavior disorder
- Recurrent isolated sleep paralysis
- Nightmare disorder

#### Other parasomnias
- Exploding head syndrome
- Sleep-related hallucinations
- Sleep enuresis
- Parasomnia due to a medical disorder
- Parasomnia due to a medication or substance
- Parasomnia, unspecified

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### Isolated Symptoms and Normal Variants

- Excessive fragmentary myoclonus
- Hypnagogic foot tremor and alternating leg muscle activation
- Sleep starts (Hypnic jerks)

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Michael J, Chest. 2014
# Restless leg syndrome (RLS)

- **Willis-Ekbom disease (WED):** A circadian disorder of sensory-motor integration manifested.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Characteristics</th>
</tr>
</thead>
</table>
| The *urge* to move the legs | • Usually but not always accompanied by or felt to be caused by uncomfortable and unpleasant sensations in the legs  
• “need to move,” “crawling,” “tingling,” “rest-less,” “cramping,” “creeping,” “pulling,” “painful,” “electric,” “tension,” “itching,” “burning,” “prickly”  
• Typical RLS sensations are felt deep inside the muscles and bones of the legs  
• Bilateral legs (usually) |
| Begin or worsen during periods of *rest or inactivity* such as lying down or sitting | |
| Partially or totally *relieved by movement*, such as walking or stretching, at least as long as the activity continues | |
| Only occur or are *worse in the evening or night* than during the day | |
| The above features are not solely accounted for by other medical or behavioral conditions | **Exclude:** myalgia, venous stasis, leg edema, arthritis, leg cramps, positional discomfort, habitual foot tapping, and other nocturnal sensory-motor symptoms. |
Restless leg syndrome (RLS)

Clinical features supporting the diagnosis of restless legs syndrome/Willis–Ekbom disease (RLS/WED).

The following features, although not essential for diagnosis, are closely associated with RLS/WED and should be noted when present:

1. Periodic limb movements (PLM): presence of periodic leg movements in sleep (PLMS) or resting wake (PLMW) at rates or intensity greater than expected for age or medical/medication status.


3. Family history of RLS/WED among first-degree relatives.

4. Lack of profound daytime sleepiness.\(^\text{a}\)

\(^{a}\) RLS/WED shares this characteristic with other hyperarousal conditions including insomnia disorder.

Pathogenesis

• Not fully understood
• Genetic factors
  – $BTBD9$, $MEIS1$, and $MAP2K5/SKOR1$ genes
• Dopaminergic, adenosinergic, and glutamatergic pathways involved
  – ‘hyperdopaminergic state’
• Low central nervous system (CNS) iron stores may lead to down-regulation of the adenosine 1 receptor (A1R)
  – Contributes to both a hyperdopaminergic and hyper-glutamatergic state
• Deficiency in CNS opioid receptors in patients with RLS compared with controls
Restless legs syndrome associated with major diseases
A systematic review and new concept

Primary/Idiopathic
Familial & genetic risk factors

Secondary/symptomatic
• Iron deficiency anemia (IDA),
• Multiple sclerosis (MS),
• Polyneuropathy, and
• Parkinson disease (PD)
• Common chronic diseases such as
  • Arterial hypertension or
  • Headache or
  • Conditions such as inflammation and pregnancy.

Other associated conditions
• Arthritis,
• Sensory neuropathy,
• Radiculopathy
• Diabetes,
• Renal disease
• Psychiatric disorders such as depression and anxiety is increased 1.5- to 2-fold in patients with RLS
<table>
<thead>
<tr>
<th>RLS mimic</th>
<th>Characteristics</th>
</tr>
</thead>
</table>
| Neuropathy         | • Often worse at night and causes discomfort  
                      • Not associated with an urge to move the legs  
                      • Not relieved by movement                     |
| Akathisia          | • Positive for an urge/ need to move body or restlessness  
                      • Does not have a circadian evening propensity  
                      • The sensation of restlessness is typically diffuse without predilection for the legs |
| Muscle cramps      | • Predominantly or solely occur during sleep  
                      • Result in painful muscle contractions  
                      • Not associated with an urge to move         |
| Habitual foot taping | • A behavioral phenomenon that is not associated with an urge to move, and  
                         • It can be suppressed.                |
| Positional discomfort | • From pressure that compresses nerves, limits blood flow, or stretches body tissue.  
                          • Resolved by changing body position without requiring any repetitive movement  
                          • No urge to move                       |
| Sleep starts (or hypnic jerks) | • Short, massive body movements during the sleep/wake transition  
                                        • Involve the extremities of both sides synchronously but without periodicity  |
## RLS mimic

<table>
<thead>
<tr>
<th>RLS mimic</th>
<th>Characteristics</th>
</tr>
</thead>
</table>
| **Sleep-related leg cramps**       | • Worse at night and are relieved by movement  
• Involve a specific muscle and usually require stretching of the muscle more than moving of the leg to relieve symptoms  
• Residual pain or sensitivity after the event |
| **Painful legs and moving toes syndrome** | • Severe pain in one or both feet  
• A sensation of burning and associated with frequent, repetitive movements of the toes  
• Pain is not necessarily increased at night or relieved by movement. |
| **Vascular intermittent claudication** | • Leg pain or discomfort  
• Relieved by rest and worsens during a prolonged upright position or walking.  
• Absence of the typical circadian feature of RLS. |
| **Pain related to the narrow spinal canal** | • When lying in bed, pain is more pronounced in the supine position compared to a lateral position with bended knees.  
• Combination with back pain, as well as with clinical signs of a myelopathy |

E. H. During, J. W. Winkelman, Drug & Aging 2019  
Ferini-Strambi L, Sleep Med 2007
Reported:
RLS & major diseases
• Renal failure
• HT
• DM
• Obesity
• Thyroid dysfunction
• Depression
• Anxiety

USG Carotid intima-media thickness

RLS had significant carotid intima-media thickness more than non RLS patients

RLS is associated with a higher degree of atherosclerosis

Excluded PLMS

Sympathetic hyperactivity, autonomic fluctuations, and hypertension in PLMS

Sleep deprivation & increase appetite/ sugar craving

Microcirculation impairment in the legs and/or global hypoxia might cause leg discomfort

Key Words: restless leg syndrome; carotid intima-media thickness; atherosclerosis; CLSA

Zolfaghari S, Mov Disord 2020
(Non-pharmacological) Treatment

- Serum Iron: keep > 50-75 mcg/ml
- Transferrin saturation: keep > 20%
- Check exacerbating factors:
  - Lifestyle: Alcohol, smoking, sleep deprivation
  - Drugs:
    - Dopamine antagonist
    - Antidepressants - SSRI, TCA
    - Anti-histamine
    - Recent opioid discontinuation
  - Blood loss
  - Pregnancy (iron)
Pharmacological Treatment

<table>
<thead>
<tr>
<th>Drugs</th>
<th>Effective</th>
<th>Probably effective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pramipexole</td>
<td>6 mo</td>
<td>1 year</td>
</tr>
<tr>
<td>Ropinirol</td>
<td>6 mo</td>
<td>1 year</td>
</tr>
<tr>
<td>Rotigotine</td>
<td>6 mo</td>
<td>5 years</td>
</tr>
<tr>
<td>Levodopa</td>
<td>-</td>
<td>2 years</td>
</tr>
<tr>
<td>Pregabalin</td>
<td>1 year</td>
<td>-</td>
</tr>
<tr>
<td>Gabapentin</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>D3 agents</th>
<th>Efficacy</th>
<th>Safety</th>
<th>Side effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pramipexole</td>
<td>Efficacious at doses of 0.25, 0.50, and 0.75 mg</td>
<td>Acceptable risk with special monitoring for augmentation</td>
<td>Nausea, lightheadedness, fatigue, augmentation</td>
</tr>
<tr>
<td>Rotigotine</td>
<td>Efficacious at a dose of 2–3 mg</td>
<td>Acceptable risk with special monitoring for local site reactions and augmentation</td>
<td>Skin reaction, augmentation</td>
</tr>
<tr>
<td>Ropinirole</td>
<td>Efficacious at a dose of 0.78–4.6 mg</td>
<td>Acceptable risk with special monitoring for augmentation</td>
<td>Nausea, lightheadedness, fatigue, augmentation</td>
</tr>
</tbody>
</table>

Dopamine agonists recommendation in RLS

Winkelmann J, et al. Mov Disord 2018
Casoni F, Adv in Phar Vol 48. 2019
### Treatment

**Table 5**

Clinical consensus of the benefits and risks for each pharmacologic treatment of RLS/WED.

<table>
<thead>
<tr>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Levodopa</td>
</tr>
<tr>
<td>Nonergot DA</td>
</tr>
<tr>
<td>Ergot-based DA</td>
</tr>
<tr>
<td>(\alpha_2\delta) Ligand</td>
</tr>
<tr>
<td>Opioid</td>
</tr>
<tr>
<td>Clonazepam</td>
</tr>
</tbody>
</table>

#### The potential of the drug to cause the following adverse events

<table>
<thead>
<tr>
<th>Augmentation</th>
<th>LoE</th>
<th>ICD</th>
<th>EDS</th>
<th>Negative mood</th>
<th>Weight gain</th>
<th>General toxicity</th>
</tr>
</thead>
<tbody>
<tr>
<td>+++</td>
<td>++</td>
<td>+</td>
<td>+</td>
<td>++</td>
<td>0</td>
<td>NK</td>
</tr>
<tr>
<td>+++</td>
<td>++</td>
<td>NK</td>
<td>+</td>
<td>++</td>
<td>0</td>
<td>NK</td>
</tr>
<tr>
<td>0</td>
<td>+</td>
<td>0/+</td>
<td>NK</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>NK</td>
<td>0</td>
<td>0</td>
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<td>++</td>
<td>+</td>
<td>++</td>
<td>++</td>
<td>++</td>
</tr>
</tbody>
</table>

#### The potential of the drug to have positive effect on these parameters

<table>
<thead>
<tr>
<th>Subjective nighttime sleep</th>
<th>Classic nighttime RLS symptoms</th>
<th>QoL</th>
<th>Pain reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>++</td>
<td>+++</td>
<td>++</td>
</tr>
<tr>
<td>+</td>
<td>++</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>NK</td>
<td>++</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>+</td>
<td>+</td>
<td>++</td>
<td>+</td>
</tr>
</tbody>
</table>

**Abbreviations:** RLS/WED, restless legs syndrome/Willis–Ekbom disease; DA, dopamine-receptor agonist; LoE, loss of efficacy; ICD, impulse control disorders; EDS, excessive daytime sleepiness; QoL, quality of life; NK, not known.

+++, is very likely to affect this parameter; ++, is somewhat likely to affect this parameter; +, is slightly likely to affect this parameter; 0, has no effect on this parameter.

### Initial Treatment: Factors that impact the choice of agent

#### Table 6
Clinical recommendations regarding factors that affect the selection of an agent for initial treatment in patients with restless legs syndrome/Willis–Ekbom disease.

<table>
<thead>
<tr>
<th>Factor that impacts the choice of agent</th>
<th>Treatment choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time of day (daytime disturbance)</td>
<td>Preferably a long-acting agent</td>
</tr>
<tr>
<td>Sleep disturbance disproportionate to other symptoms of RLS/WED</td>
<td>Twice a day dosing of a short-acting agent</td>
</tr>
<tr>
<td>Comorbid insomnia</td>
<td>( \alpha_2 \delta ) Ligand</td>
</tr>
<tr>
<td>Pregnancy risk</td>
<td>( \alpha_2 \delta ) Ligand</td>
</tr>
<tr>
<td>Impaired renal function</td>
<td>Avoid both dopaminergic agents and ( \alpha_2 \delta ) ligands</td>
</tr>
<tr>
<td>Increased risk for falls</td>
<td>Consider the use of iron</td>
</tr>
<tr>
<td>Painful restless legs</td>
<td>Select a drug that is not renally excreted</td>
</tr>
<tr>
<td>Comorbid pain syndrome</td>
<td>Dopamine-receptor agonist</td>
</tr>
<tr>
<td>History of or current ICD</td>
<td>( \alpha_2 \delta ) Ligand</td>
</tr>
<tr>
<td>History of or current alcohol or substance abuse</td>
<td>( \alpha_2 \delta ) Ligand</td>
</tr>
<tr>
<td>Severe symptoms of RLS/WED</td>
<td>( \alpha_2 \delta ) Ligand</td>
</tr>
<tr>
<td>Excess weight, metabolic syndrome, or obstructive sleep apnea</td>
<td>Dopamine-receptor agonist or ( \alpha_2 \delta ) ligand</td>
</tr>
<tr>
<td>Availability(^a)</td>
<td>Dopamine-receptor agonist</td>
</tr>
<tr>
<td>Cost(^b)</td>
<td>Dopamine agonist or ( \alpha_2 \delta ) ligand</td>
</tr>
<tr>
<td>Comorbid depression</td>
<td>Dopamine-receptor agonist</td>
</tr>
<tr>
<td>Comorbid generalized anxiety disorder</td>
<td>Dopamine agonist or ( \alpha_2 \delta ) ligand</td>
</tr>
<tr>
<td>Daytime sleepiness</td>
<td>Dopamine-receptor agonist</td>
</tr>
<tr>
<td>Higher potential for drug interactions</td>
<td>( \alpha_2 \delta ) Ligand</td>
</tr>
<tr>
<td></td>
<td>Investigate the cause</td>
</tr>
<tr>
<td></td>
<td>Select drug that is not hepatically excreted</td>
</tr>
</tbody>
</table>

Restless legs syndrome (RLS) / Willis—Ekbom disease with augmentation

- RLS = a sensorimotor disorder with leg discomfort and the irresistible urge to move affected body parts with relieve by movement & usually occur in the evening.

**Augmentation** is the condition that
An earlier onset of the symptom or
An expansion to other body parts or
Paradoxical response to pharmacological treatment or have shorter duration of the treatment effect than during early treatment days.

**Risk factors for augmentation**
High dosage of dopaminergic Rx and short acting dopamine agonist drugs.

Down regulation of DA receptor

Takahashi M. et al. PLOS one 2017
Winkleman JW. Et al. Neurology 2016
Other Risks of Augmentation

• Increased risk of augmentation in:
  – low iron stores
  – Greater severity of RLS/WED symptoms prior to initiation of treatment
  – Possibly a family history of RLS or lack of neuropathy (Primary RLS)

Ref: D. Garcia-Borreguero et al. 2015, www.irlssg.org
• Combination of the extension of big toe and partial flexion of ankle, knee and sometimes hip
• Lower extremities > upper extremities
• Typically, patient is unaware of movement
• Arousal may precede, coincide with or follow the movement.

PLMS is associated with hypertensive autonomic arousals
Periodic limb movement disorder

• Accompany in
  – RLS, RBD, OSA, narcolepsy, MSA, DRD
  – General medical conditions such as
    • Renal failure, anemia, CHF, peripheral neuropathy
  – In patients treated with some medications such as
    • Tricyclic antidepressants, neuroleptics and serotonin reuptake inhibitors

• Associated features
  – Higher rates of mood disorders,
    • Anxiety, attention deficits, oppositional behaviors and
  – parasomnias
Periodic limb movement disorder: treatments

- Treatment:
  - Dopaminergic drugs:
    - Dopamine agonists esp. pramipexole and ropinirole
    - Levodopa
  - Gabapentin
  - Clonazepam
Sleep related leg cramps

• Differential diagnosis:

**RLS:**
- Leg discomfort during the sleep and sometimes complain of cramping sensation in RLS
- Actual spasm and hardening of muscle: critical differentiating factor
- Much briefer in leg cramp (a few second to sometimes several minutes) than RLS (persist for hours)

**Dystonia:**
- Electrophysiologic study: on-going co-contraction of agonist and antagonist muscles.
- Leg cramp can be relieved by stretching, while dystonia can not.

• Treatment:
  - Local massage, stretching and movement of the limbs
Sleep related bruxism

Drugs that may induce bruxism (awake or sleep)

- Anti dopaminergic drugs
- Selective serotonin reuptake inhibitors
- Calcium antagonists
- Alcohol, caffeine or cigarettes
- Cocaine
- Amphetamine

- 3% in elderly

Clinical subtypes

Primary, idiopathic: no medical/ dental causes

Secondary: associated with other disorders
- Children with cerebral palsy, mental retardation, ADHD
- Adults with abnormal movements such as facio-mandibular myoclonus, Parkinson’s disease, RBD, tardive dyskinesia, dementia, and sleep related breathing disorders esp. OSA

Iatrogenic: Treatment-induced
Sleep related bruxism

• Pathophysiology: Multifactorial
  – Physiologic central nervous system (oromotor, sleep-wake regulation, catecholaminergic)
  – Autonomic nervous system
  – Psychosocial factors
  – Genetic factors

• Non-REM stage 1,2 (80%) but can occur in all stage
## Sleep related bruxism

- **Management:** no specific cure exists

### Behavioral strategies
- Psychological or physiological relaxation: sleep hygiene
- Biofeedback techniques

### Dental strategies
- Occlusal appliances

### Pharmacological strategies
- Benzodiazepine
- Muscle relaxants
- Dopaminergic drugs
- Botulinum toxin injection
- Avoid Selective Serotonin Reuptake Inhibitor (SSRI): increase sleep related bruxism

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Ohayon M, Chest. 2001
Others

- Benign sleep myoclonus of infancy
- Propriospinal myoclonus at sleep onset
- Sleep related movement disorder due to a medical disorder
- Sleep related movement disorder due to a medication or substance
- Sleep related movement disorder, unspecified
REM PARASOMNIA

RBD
- Recurrent isolated sleep paralysis
- Overlap parasomnia
- Status dissociatus

Nightmare disorders
"REM-ON" glutamatergic neurons in the sublaterodorsal tegmental neurons

Gamma-aminobutyric acid and glycine-releasing neurons in the ventral gigantocellular reticular nucleus

Inhibit spinal motor neurons

Preventing pyramidal neurons in the motor cortex

Exciting intralaminar thalamo-cortical neurons

REM sleep atonia
Movements in RBD

- Short and abrupt,
- Sometimes jerky, and
- Mostly related to the extremities.
- Complex behaviors with violent actions (punching or kicking) or bed falls may occur.
- Dream content is usually unpleasant and may involve the individual being attacked, chased, or threatened (by a person or animal)
Behaviors during RBD are complex and varied.
- Gesturing, reaching, grabbing, arm flailing, slapping,
- Punching, kicking, sitting up, and leaping from bed
- The forceful and violent aspect of these motor behaviors,
- Often distal than proximal
- Usually associated with vivid, unpleasant, and active dreams
- Fighting or fleeing in response to danger (91%),
- Nonviolent elaborate behaviors during RBD, which were found in 18% of patients with PD

In contrast to sleepwalking, only a minority of patients with RBD (3%)
- Occasionally stand up and walk and run, and most patients have the eyes closed

***"Acting out” of dream content***
Vocalization in RBD

- Mumbling,
- Talking,
- Shouting,
- Swearing profanities,
- Laughing, and
- Crying
- Modulate their voices according to the dream context
Dreams and sleep behaviours

- **Eye usually closed**
- **No major differences in dream content** were found between patients with PD who did or did not have RBD.
- **Dream recall is quite variable**, individuals are usually easily awakened and **often remember** their dreams, especially if questioned immediately after the behaviour.
- The dreams reported tend to have **negative emotional content**, or are often action-packed and aggressive but they can also be pleasant.
- **Falling out of bed is frequent**, but **deliberately leaving the bed is rare**.

Yes- No Question

“Have you ever been told, or suspected yourself, that you seem to ‘act out your dreams’ while asleep (for example, punching, flailing your arms in the air, making running movements, etc.)?”

A sensitivity of 93.8% and a specificity of 87.2%
Other RBD questionnaires

- **REM behavior disorder screening questionnaire (RBDSQ):**
  - 10-item questionnaire with scores ranging from 0 to 13.
  - Sensitivity of English version in PD for $\geq 6$ cutoff 68-90%, specificity 63-82.8%

- **REM sleep behavior disorder questionnaire Hong Kong (RBDQ-HK):**
  - 13 item questionnaire.
  - Sensitivity 82.2%, specificity 86.9% mixed (idiopathic and secondary) RBD population

- **Mayo sleep questionnaire (MSQ) item 1:**
  - Single question.
  - Sensitivity in PD 90.3%, specificity 87.9% among PD patients meeting ICSDII criteria

- **Innsbruck REM sleep behavior disorder inventory:**
  - Five item questionnaire.
  - In mixed (idiopathic and secondary) RBD population, sensitivity 91.4%, specificity 85.7%. For single RBD summary question, sensitivity 74.3%, specificity 92.9%.
Normal control
REM sleep

RBD
EMG activity at
chin
TA
FDS
EMG activity during REM sleep

**Phasic activity:** a short burst of electromyography (EMG) activity lasting 0.1–5.0 s that is more than twice as high as the background EMG amplitude. Can be measured in 3 s mini-epochs or 30 s epochs.

**Tonic activity:** EMG activity increased by at least a factor of two or four compared with baseline in more than half of the epoch. Can be measured in 3 s mini-epochs or 30 s epochs.

**Any activity:** either phasic or tonic EMG activity. In addition, tonic and phasic muscle activity lasting between 5 and 15 s can be scored and can be measured in 3 s mini-epochs or 30 s epochs.
Differential diagnosis RBD-like feature

• History of dream enactment behavior and daytime sleepiness with no evidence of REM sleep without atonia on PSG → OSA
  – Treatment with CPAP → eliminate the behavior (possible increased pressure for REM atonia prior REM sleep fragmentation)

• NFLE

• PLMS

• NREM parasomnias (such as sleepwalking, sleep terrors and confusional arousals, nightmares and sleep-related seizures (mainly sleep-related hypermotor epilepsy)

Breen D. Mov Disord 2018
NREM PARASOMNIA

Disorders of arousal (DOAs)
- Confusional arousals
- Sleep walking
- Sleep terrors

sleep-related eating disorder (SRED)
Confusional arousal

- Onset: peak onset before 5 years
- Abrupt onset out of slow wave sleep in the first third of the night, but may also occur out of stage N2
- Appears confused with vacant look and may have automatic and inappropriate behavior (few seconds to minutes), behavior may be inappropriate & violent but no autonomic hyperactivity or signs of fear like STs
- Multiple confusional episodes in the same night: uncommon
- Part of spectrum of sleep walking and sleep terror: all may occur in the same individual
Sleep walking (Somnambulism)

- Most common in children between 5-12 years of age.
  - Sometimes it persists in adulthood, rarely begins in adult (1/3).

- *Simply sitting up in bed, picking at the covers to walking, eye open but clumsy, more complex & violent & longer in adult.*

- Episodes last less than 10 minutes, or terminated by returning to bed or simply lying down and continuing sleep.

- Injury, violent actions but they can negotiate their way/ may have sleep-related sexual behavior or violence.

- Family history: positive

- Precipitating factors:
  - sleep deprivation, fatigue, sedatives, concurrent illness

Berry R. sleep medicine pearl 3rd ed.
ICSD 3rd edition, 2014
Sleep terror (Pavor Nocturnus)

• Peak onset is between 5 and 7 years of age
  – Sometimes it persists into adulthood

• Non-REM stage (slow wave sleep)

• The spell begins with abrupt set of intense autonomic and motor symptoms
  – A loud piercing scream
  – Confuse and fearful/ diaphoretic/ tachycardia
  – Usually sits up in the bed but can not communicate

• Many pts have history of sleep walking

• Precipitating factors: same as sleep walking

Berry R. sleep medicine pearl 3rd ed.
ICSD 3rd edition, 2014
Disorders of Arousal From Non-REM Sleep
## NREM PARASOMNIA

<table>
<thead>
<tr>
<th></th>
<th>Confusional arousal</th>
<th>Sleep walking</th>
<th>Sleep terrors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sleep stage at onset</td>
<td>N3</td>
<td>N3</td>
<td>N3</td>
</tr>
<tr>
<td>Autonomic hyperactivity</td>
<td>No</td>
<td>No</td>
<td>Prominent</td>
</tr>
<tr>
<td>Loud scream</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Ambulation out of bed</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Confusion during episode</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Amnesia (partial/complete)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

PSG is not required in NREM parasomnia

Berry R. sleep medicine pearl 3rd ed.
# Sleep-related movement disorders VS Nocturnal epilepsy

<table>
<thead>
<tr>
<th>Feature</th>
<th>NFLE</th>
<th>Arousal disorders</th>
<th>RBD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age at onset</strong></td>
<td>Variable, typically 1st-2nd decade</td>
<td>Usually 1st decade</td>
<td>Over 50 years</td>
</tr>
<tr>
<td><strong>Sleep stage of origin</strong></td>
<td>NREM (N1,2, sleep wake transition)</td>
<td>NREM (N3)</td>
<td>REM</td>
</tr>
<tr>
<td><strong>Timing of episode</strong></td>
<td>Anytime</td>
<td>First third of sleep period</td>
<td>Last third of sleep period</td>
</tr>
<tr>
<td><strong>Duration of episode</strong></td>
<td>5-60 seconds</td>
<td>2-30 minutes</td>
<td>Seconds to 2 minutes</td>
</tr>
<tr>
<td><strong>Frequency of episode</strong></td>
<td>Nightly clusters</td>
<td>Sporadic, rare cluster</td>
<td>Sporadic, rare cluster</td>
</tr>
<tr>
<td><strong>Onset and offset</strong></td>
<td>Sudden</td>
<td>Gradual</td>
<td>Sudden</td>
</tr>
<tr>
<td><strong>Seminology</strong></td>
<td>Highly stereotyped, hypermotor, asymmetric tonic/dystonic</td>
<td>Not stereotyped, variable complexity</td>
<td>Not highly stereotyped, vocalizations, self-protective behaviors, dream recall</td>
</tr>
<tr>
<td><strong>Level of consciousness during episode</strong></td>
<td>Usually preserved</td>
<td>Variable</td>
<td>Poorly responsive</td>
</tr>
<tr>
<td><strong>Postictal confusion</strong></td>
<td>Typically absent</td>
<td>Present</td>
<td>Absent</td>
</tr>
<tr>
<td><strong>Risk of injury</strong></td>
<td>Low</td>
<td>High</td>
<td>Moderate</td>
</tr>
<tr>
<td><strong>PSG with EEG</strong></td>
<td>Epileptic activity &lt; 50%</td>
<td>Slow-wave sleep arousals, rhythmic delta pattern</td>
<td>REM sleep without atonia</td>
</tr>
</tbody>
</table>

*Source: Tinuper P, et al. Sleep medicine, 2007*
Sleep-related Dissociative Disorders

- Emerge at the transition from wake to sleep or shortly following awakening with EEG evidence of wakefulness
- Psychiatric comorbidities
  - Mood disorders, post-traumatic stress disorder, and a history of sexual abuse
- Episodes are non-stereotyped and feature screaming, running, and self-mutilating, violent behaviors that may represent a reenactment of prior traumatic events.
- Can last from minutes to an hour or longer, waxing & waning
- 70% developed between 2nd and 4th decades
- Injury & female → common
- Psychogenic non-epileptic seizures (PNES)
  - Arise from awake
  - Seizure overlap (pseudosleep)
Sleep-related Dissociative Disorders

Motor manifestations
• Jactitation (restless tossing in bed),
• Asynchronous movements,
• Side- to-side head movements,
• Pelvic thrusting,
• Opisthotonic posturing,
• Prolonged body flaccidity,
• Preserved awareness during bilateral motor activity.
• Ictal eye closure and jaw clenching

Affective manifestations
• Vocalizations,
• Ictal moaning and crying,
• Emotive speech,
• Ictal stuttering,
• Heart rate elevations
• Postictal crying

lateral tongue bites, urinary incontinence, event-related injury, and myalgia --> Seizure
Movement disorders during sleep

- Palatal myoclonus
- Spinal myoclonus
- Tics in Tourette’s Syndrome
- Hemifacial spasm
- Drug-induced dyskinesia
- Hyperekplexia

- Jaw, face - Bruxism
- Leg - RLS/ PLMD
- Leg cramp

- Childhood - Benign sleep myoclonus in infancy - RMD

- Others - Propriospinal myoclonus
- Mm disorders due to medical, substance, unspecified.

- Simple

- In or around sleep

- Complex: parasomnia
  - NREM: Confusional arousal, sleep walking, sleep terror
  - REM: RBD, Recurrent isolated sleep paralysis, nightmares
  - Other parasomnias

- Nocturnal Epilepsy

Thank you for your attention