Sleep Science:
Sleep, Sleepiness, and Sleeplessness

Kenneth Lichstein, Ph.D.
Professor Emeritus
Department of Psychology
The University of Alabama

sleeplessness II

a lot can go wrong

topics (among 70 sleep disorders)

- sleep apnea
- narcolepsy
- restless legs
- periodic limb movements

disorders we won't talk about

- exploding head syndrome
- sexsomnia
- sleep-related epilepsy
- catathrenia

sleep apnea

if left untreated, sleep apnea is a slow moving terminal illness

Pickwickian syndrome (now called obesity-hypoventilation syndrome)

- obesity, daytime labored breathing, daytime sleepiness

  – Burwell et al., 1956

10 Years Later

sleep apnea

- "Nocturnal polygraphic registrations disclosed respiratory pauses…"

  – Gastaut et al., 1966

invisible sleep apnea

science advances by two processes

- steady, incremental, systematic research
- abrupt, accidental discovery

- Between 1956 and 1966, 10s of thousands of PSGs had been performed world wide and no one noticed some people had quit breathing.
- Bed partners were not complaining that their partner had quit breathing.

when you don't know what you are looking for, you don't see the obvious

benign snoring and sleep apnea

moderate and severe snoring

sleep apnea

benign snoring I

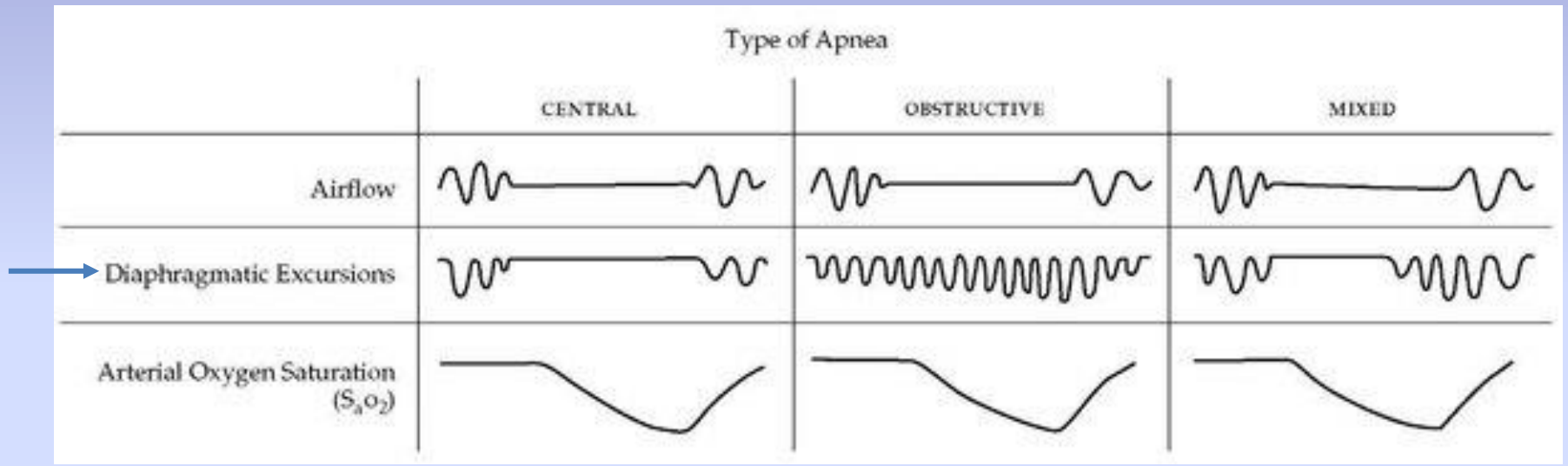
- snoring without breath cessation
  - occurs in 10-15% of population
  - sleeping on back increases likelihood of snoring
  - snorer usually has no knowledge of condition
  - more troublesome to bed partner
  - at 5-year follow-up, benign snoring (without weight gain) is <u>not</u> a risk factor for sleep apnea
- physiology
  - partial airway obstruction
  - on continuum of obstruction with sleep apnea
  - usually occurs on the inhale
  - occurs with natural breathing, $\cong$ every 4 sec

benign snoring II

- risk factors
  - obesity, male, older adults
- aggravating factors
  - alcohol, sleeping pills
- treatment
  - weight loss
  - OTC nasal dilator, usually ineffective
  - wedge pillow, may be effective but uncomfortable
  - sleep on side
  - any treatment effective for sleep apnea (e.g., CPAP) will be effective for snoring

2 types of sleep apnea
(ICSD III lists 17 distinct diagnoses)

- central sleep apnea (CSA)
  - failure of brain signal to breathe, absence of respiratory effort
  - does not occur during waking
  - does not occur during REM
  - much less common than OSA: accounts for 5-10% of sleep apnea events
  - caused by brain insult or chemical imbalance (e.g., stroke, multiple sclerosis)
  - risk factors: older age and male
  - treatment: CPAP or PAP (adaptive servo ventilation, ASV; lower pressure during CSA)
- obstructive sleep apnea (OSA)
  - collapsed upper airway (oropharynx)
  - there is respiratory effort
  - does not occur during waking
- complex sleep apnea
  - mix of obstructive and central events
  - a few CSA events are present in 1/3 of OSA patients


Type of Apnea
CENTRAL
OBSTRUCTIVE
MIXED
Airflow
Diaphragmatic Excursions
Arterial Oxygen Saturation
(S_aO_2)

sleep apnea characteristics I

- apnea/hypopnea events
  - apnea: ≥ 10 seconds of not breathing
  - hypopnea: ≥ 10 seconds of partial breathing (airflow decreased 50% + oxygen desaturation 3%)
  - most frequent in REM
- apnea/hypopnea index, AHI
  respiratory disturbance index, RDI (includes arousals)
  - events/hour
  - arousal: abrupt shift to lighter sleep
    - may be instigated by an apneic event
    - may abbreviate REM & N3
    - may cause a brief awakening
  - normal: AHI < 5
  - mild: AHI 5-14
  - moderate: AHI 15-30
  - severe: AHI > 30
- prevalence
  - 3:1 ratio of men to women in middle-aged people
  - all ages, AHI > 15: 13% of men; 6% of women
  - after menopause, AHI in women ↑

sleep apnea characteristics II

- apneic usually has no knowledge of condition
  - 85% of cases are undiagnosed
  - AHI can reach 100
  - apnea event can reach 60 sec
  - arousals (abrupt shift to N2 or lighter) attenuate N3 and REM
- risk factors
  - obesity (neck circumference), male, older adults
  - small anatomical oropharynx opening
  - 30% genetic factor
- clinical features
  - primary: insomnia, heavy snoring and snorting/gasping, excessive daytime sleepiness (EDS)
  - morning headaches, nocturia, nocturnal sweating, GERD

aggravating factors

- weight gain
- alcohol
- sleeping pills
- opioid pain medications

strong health risk

- EDS
- depression
- hypertension
- congestive heart failure
- coronary artery disease
- arrhythmia
- stroke
- all-cause mortality ↑ 46%

There is no clear evidence that sleep apnea causes SIDS.

behavioral morbidity of EDS

- decreased attention
- undesired sleep episodes
- loss of energy
- decreased sexual drive
- lack of motivation
- irritability

EDS risk factors

- car wrecks ↑
- accidents at home & work ↑
- productivity ↓
- socializing ↓

treatment options

- weight loss
  - potential for great effect
- positional treatment
  - sleep on side
  - helpful with 50% of mild-moderate OSA
- dental appliance
  - mandibular advancement device (lower jaw)
  - mild-moderate OSA
  - downside: altered bite, temporal mandibular joint (TMJ) pain, excessive salivation
- surgical interventions
  - 50% success rate
- Inspire
  - hypoglossal nerve stimulation moves the tongue forward
  - 50-70% success rate
- continuous positive airway pressure (CPAP)

CPAP is usually the best option

- some patients experience immediate, dramatic symptomatic relief
- bed partner enjoys a quiet night's sleep

RQPMSLS02


DreamStation
Info
Machine Hours
Blower Hours
0.0
0.0
Device Hours

CPAP masks

nasal

nasal pillow

full face

total face

CPAP

- introduced in 1981
  - air splint; not a cure
  - originally, CPAP was bulky, noisy, and uncomfortable
  - currently, CPAP is small, quiet, and more comfortable
- pressure titration
  - pressure setting (centimeters of water pressure, cm H20) is usually in the 6-14 range
  - determined during the night to completely or mostly (AHI < 5) resolve apnea
  - home study, formulaic determination of pressure (based on BMI, AHI) may not work as well
- modern technology
  - devices are sensitive to air flow resistance
    - mask on or off
    - mask leak
    - presence of apneic events
  - devices can record/transmit time of use and AHI

CPAP resistance

- uncomfortable breathing against pressurized air
- allergic reaction, congestion
- claustrophobia
- tight mask to prevent mask leak
- skin irritation
- not romantic

PAP variations

- BiPAP
  - expiratory pressure relief
  - expiratory pressure lower than inspiratory pressure
- APAP
  - Automatic Positive Airway Pressure
  - real time pressure adjustment
- other adjustments
  - humidified, warmed air
  - treated insomnia: CBTi or hypnotics

CPAP adherence

- adherence defined as ≥ 4 hours of use
- subjective adherence rates vary between 65% and 90%
- objective adherence rates 40%-85%
- patient education and follow-up increase the adherence rate
- partial use of CPAP is still beneficial

after successful treatment:

- long-term follow-up shows inconsistent health benefits
  - EDS, quality of life, & cardiovascular deficits sometimes persist
- example of hypertension
  - caused by multiple factors- e.g., obesity
  - sleep apnea was likely present for years, even decades, before discovery and treatment
  - brain cells are lost during oxygen deprivation and may result in permanent cognitive/physiology changes

sleep apnea assessment, impact, and treatment: summary findings from thousands of studies over 50 years of research

breathing is good for your health

narcolepsy

excessive daytime sleepiness (EDS)- variations in severity

low:	sluggishness
medium:	tendency to fall asleep in quiet situations
high:	irresistible naps
severe:	sleep attacks

EDS types

- symptom of another sleep disorder (e.g., sleep apnea)
- idiopathic hypersomnia
- narcolepsy

EDS assessment

- interview
- questionnaires
- MSLT
- MWT

narcolepsy: diagnosis

- disabling daytime sleepiness: classic tetrad
  1. sleep attacks or chronic sleepiness
  2. cataplexy
     - present: Type 1 (most common)
     - absent: Type 2
  3. hypnagogic hallucinations
  4. sleep paralysis
- all characteristics of sleep onset REM

person with severe narcolepsy

video

https://www.youtube.com/watch?v=C0GyhVN-HwU

narcolepsy: characteristics

- uncommon neurologic disorder
  - prevalence: 1 in 2,000, equal gender
  - typical onset, teens & 20s
  - does not remit
  - usually accompanied by insomnia
- cause
  - hypocretin (orexin) deficiency in hypothalamus
  - multiple contributory genes
  - triggered by emotion, often laughter
  - secondary narcolepsy
    - may be caused by concussion or TBI

narcolepsy: treatment

- planned naps
  - ½ hour nap at same time each day
  - more refreshing than sleep attack
  - helps entrain circadian rhythm
- medications
  - amphetamines (Adderall, Ritalin)
    - severe side effects- loss of appetite, nervousness, depression, psychosis
  - modafinil (Provigil)
    - side effects- headache, anxiety, depression
  - armodafinil (Nuvigil) *
    - longer half-life, milder side effects
  - sodium oxybate (Xyrem, also called GHB)
    - specific for cataplexy
    - intensified when mixed with alcohol- amnesia, unconsciousness
  - antidepressants
    - specific for cataplexy

restless legs
(Willis-Ekbom Disease)

Jon Stewart "Jimmy Legs"

video

http://www.cc.com/video-clips/fco71l/the-daily-show-with-jon-stewart-the-jimmy-legs

Key RLS Diagnostic Criteria

Essential Criteria*

- ✓ Urge to move the legs — caused by uncomfortable leg sensations
- ✓ Temporary relief with movement — partial or total relief from discomfort by walking or stretching
- ✓ Onset or worsening of symptoms at rest or inactivity, such as when lying or sitting
- ✓ Worsening or onset of symptoms in the evening or at night

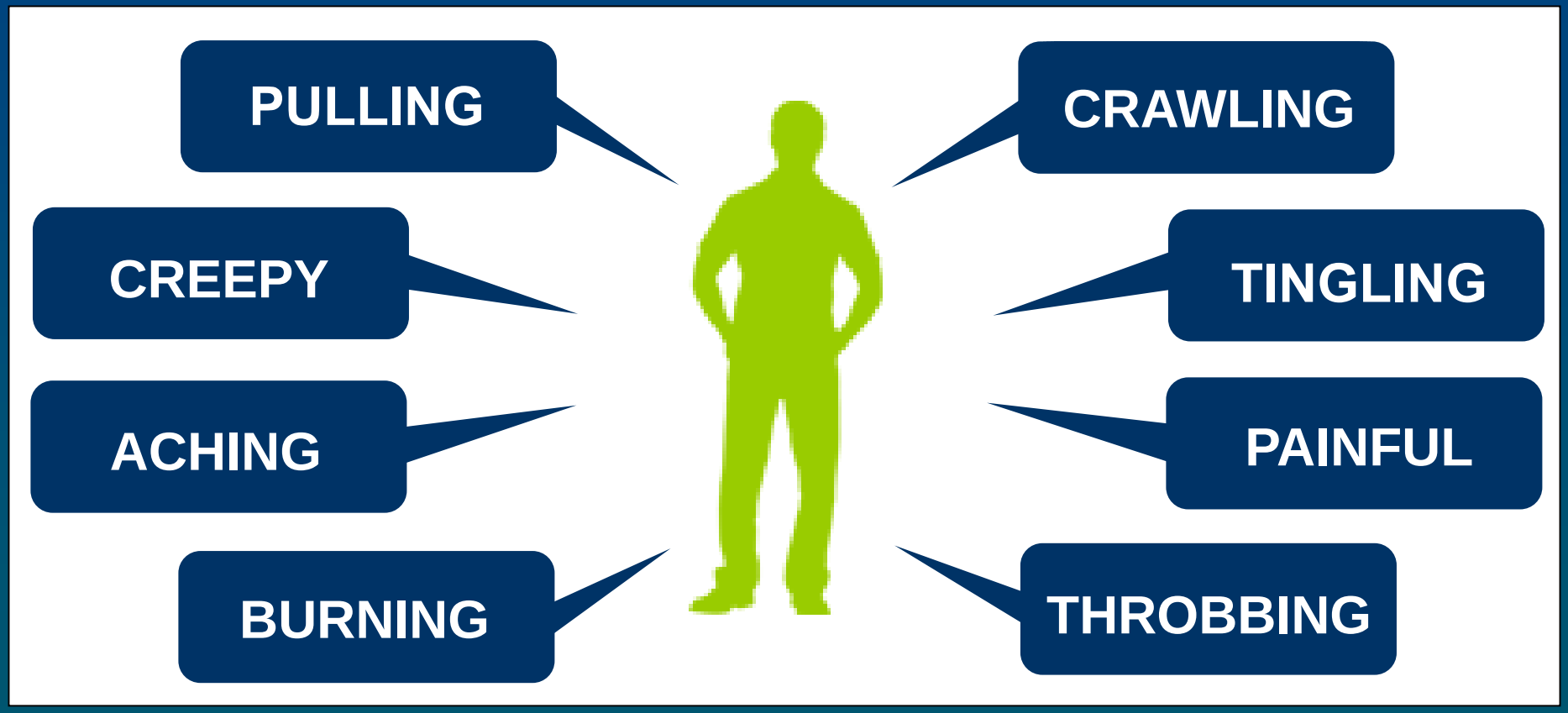
Supportive Features*

- Sleep disturbances
- Periodic leg movements
- Positive family history for RLS

*** Diagnostic criteria developed by the International RLS (IRLS) Study Group in collaboration with the National Institutes of Health (NIH).**

Allen et al. *Sleep Med.* 2003;4:101-119.

How Patients Describe Their Symptoms



Allen et al. *Sleep Med*. 2003;4:101-119.
Ondo and Jankovic. *Neurology*. 1996;47:1435-1441.

restless legs syndrome

- uncomfortable sensation provoking movement
  - most common in legs
  - most common at night
  - most common when sitting or reclined
  - movement produces temporary relief
- prevalence
  - 5-10% of population
  - twice as common in women
  - any age onset, increases with age
- cause
  - possible dopamine disturbance
  - genetic influence
  - low iron (blood)
  - low ferritin (brain)

restless legs syndrome: associated features

- aggravating factors
  - alcohol
  - caffeine
  - antihistamines
  - inactivity
  - pregnancy (20% of women)
- consequences
  - 50% of RLS patients have sleep onset or sleep maintenance insomnia
  - 20% of RLS patients complain of pain
  - 90% have periodic limb movements
  - quality of life is impacted
  - 3× risk of depression

restless legs syndrome: FDA approved drugs

dopaminergic agonists

- Requip (ropinirole), available 1997
  - side effects:
    - dizziness/fainting
    - sedation
    - augmentation
- Mirapex (pramipexole)
- Neupro patch (rotigotine)

antiepileptic

- Horizant (gabapentin enacarbil)

restless legs syndrome: treatment

- medications
  - dopaminergic agonists
    - fewer side effects than carbidopa/levodopa (Sinemet, augmentation)
  - oral iron
  - opioids, benzodiazepines, antiepileptics
- behavioral management
  - good sleep practices, minimize sleepiness
  - active lifestyle, exercise
  - avoid alcohol, caffeine
  - avoid long sitting- plane/car trips

periodic limb movements
(formerly nocturnal myoclonus)

periodic limb movements

video

https://www.youtube.com/watch?v=hTTcMcx5O6k

periodic limb movement disorder: characteristics

- leg jerks during sleep
  - movements may be:
    - twitches of toe
    - ankle flexion
    - knee flexion
    - hip flexion
  - more common in N2
- prevalence
  - greatly increases with age
  - 45% prevalence in people over 65

periodic limb movement disorder: sleep effect and treatment

- PLMs usually don't disturb sleep
  - PLM index, movements/hour > 5
  - clinically significant?
    - arousal index
    - nonrestorative sleep
    - insomnia
    - EDS
- sedative/hypnotic agents

The End
sleep well