Cardiac Arrhythmia & Sleep Apnea

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1. I do not have any relationships with any entities producing, marketing, reselling, or distributing health care goods or services consumed by, or used on, patients, OR

2. I have the following relationships with entities producing, marketing, reselling, or distributing health care goods or services consumed by, or used on, patients.

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<thead>
<tr>
<th>Type of Potential Conflict</th>
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<tr>
<td>Grant/Research Support</td>
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3. The material presented in this lecture has no relationship with any of these potential conflicts, OR

4. This talk presents material that is related to one or more of these potential conflicts, and the following objective references are provided as support for this lecture:
Objectives

- What happens during sleep
- Who are the high risk patients
- Arrhythmias in sleep apnea
- What are we monitoring for
What happens during sleep

2 easily measured parameters of the cardiovascular system

• Heart rate
• Blood pressure

Both controlled by the Autonomic Nervous System

1. Parasympathetic
2. Sympathetic
What happens during sleep

• Parasympathetic Nervous System
  – Mediated by the Vagus nerve → Cardiac muscarinic receptors
    • Causes bradycardia
    • Decreases cardiac muscle contraction
What happens during sleep

• Sympathetic Nervous System
  – Impulse carried by the thoracic and lumbar nerves
    • Constriction of blood vessels
    • Increased heart rate → SA node
    • Increased cardiac muscle contraction → direct effect on the cardiac muscle
What happens during sleep

<table>
<thead>
<tr>
<th>At night</th>
<th>On awakening</th>
</tr>
</thead>
<tbody>
<tr>
<td>➢ Blood pressure dips by 10%</td>
<td>➢ Blood pressure raises</td>
</tr>
<tr>
<td>➢ Heart rate slows down</td>
<td>➢ Increased heart rate</td>
</tr>
</tbody>
</table>

(effect of posture, activity level, circadian influence and effect of sleep)

Gradual steady increases noted
(effect of increasing activity, postural change)
What happens during sleep

• Non-REM stages
  – **Parasympathetic** influence is dominant
    • Heart rate is reduced \( \rightarrow \) bradycardia
    • Sinus pauses (over 2 seconds), AV blocks \( \rightarrow \) due to parasympathetic effect on AV node
    • Respiratory sinus arrhythmia \( \rightarrow \) indicates good cardiac health
      – HR accelerates with inspiration; decreases with expiration
    • No direct effect on Blood pressure
    • Effect most profound in slow wave sleep
  – **Sympathetic activity** reduced and stable
    • Reduced Blood Pressure
What happens during sleep

• REM stage
  – Predominant **sympathetic** state
  – Excitable and unstable state
  – Significant fluctuations in heart rate, BP and respiration
  – Swings from tachycardia to bradycardia
  – Parasympathetic activity present but decreased
What happens during sleep

<table>
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<tr>
<th>Sleep stage</th>
<th>Parasympathetic tone</th>
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<tr>
<td>Non-REM</td>
<td>↑</td>
<td>↓</td>
</tr>
<tr>
<td>REM</td>
<td>↓</td>
<td>(due to surges) ↑↓</td>
</tr>
</tbody>
</table>

REM, rapid eye movement.
What happens during sleep

• During an arousal
  – spontaneous, secondary to PLMS or respiratory event
    • Has a sympathetic effect (HR and BP)
    • Heart rate increases for 4-5 seconds; noted right before the arousal
    • Bradycardia with and following the arousal
What happens during sleep

“Normal” healthy individual

- Slower HR in Non-REM
- Variable HR and BP in REM
- Arousals increase HR and BP
What happens during sleep

Young individuals
Physically fit/athletes
Heavy laborers

Table 1: Normal rhythm changes during sleep in healthy subjects

<table>
<thead>
<tr>
<th>ECG finding</th>
<th>Prevalence</th>
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<tbody>
<tr>
<td>Sinus pause (&gt;2 s)</td>
<td>4-10%</td>
</tr>
<tr>
<td>Sinus bradycardia (&lt;40 bpm)</td>
<td>24%</td>
</tr>
<tr>
<td>First degree AV block</td>
<td>8-12%</td>
</tr>
<tr>
<td>Wenckebach second degree AV block</td>
<td>6-11%</td>
</tr>
</tbody>
</table>

AV, atrioventricular; bpm, beats per minute
What will happen when things are “Abnormal”
Who are the high risk patients

• MI
• Angina
• Heart failure
• Atrial fibrillation
• Long QT syndrome
• Brugada syndrome
• Medications
• Sleep Apnea
Who are the high risk patients

- MI, Angina
  - Increased risk between midnight to 6 am
  - In Non-REM sleep: reduced BP results in decreased coronary circulation $\rightarrow$ “non-demand” ischemia
  - In REM sleep: due to increased sympathetic activity $\rightarrow$ increased heart rate and higher demand from the cardiac muscle $\rightarrow$ ischemia
  - Post MI: heart function is impaired $\rightarrow$ arrhythmias
    - (tachycardia, ventricular premature beats);
    - arrhythmia risk decreases after initial 6 months following MI.
Who are the high risk patients

- Heart Failure
  - Oxygen desaturations can trigger tachycardia and result in arrhythmias
  - Cardiac chambers are remodeled (dilated or hypertrophied)
    - Promote areas for ectopic beats
Who are the high risk patients

• Atrial Fibrillation
  – Increased risk between midnight to 2 am
  – Risk doubled for A. fib when there is underlying sleep disordered breathing
    • Likely from sympathetic activity during REM
    • Hypoxemia

• Long QT syndrome, Brugada syndrome
  – Lethal ventricular arrhythmias/Torsades de pointes mainly occur at rest and during sleep
Who are the high risk patients

• Medications:
  – Beta blockers (Metoprolol, Carvedilol..)
  – Calcium Channel blockers (Verapamil, Amlodipine..)

• They can cross the blood brain barrier and cause violent dreams/nightmares; sleep disruption
• Induce profound hypotension in Non-REM sleep resulting in coronary ischemia
• Due to reduced heart rate in Non-REM, other areas conduct a beat → ectopic beats
Who are the high risk patients

• Medications:
  – Drugs that cause QT interval prolongation
  ❖ The longer pause can lead to ventricular arrhythmias and fatal events like Torsades de pointes
    • Antibiotics
      – Erythromycin, Clarithromycin, Ketoconazole, Quinine,
    • Antihistamines
      – Diphenhydramine, Hydroxyzine, Loratadine
    • Psychiatric drugs
      – Amitriptyline, Nortriptyline, Despiramine, Clomipramine, Doxepin..
      – Haldol, Ziprasidone, Lithium, Thioridazine
    • Type 3 anti-arrhythmic drugs
      – Amiodarone, Sotalol
    • Type 1 anti arrhythmic drugs
      – Quinidine, Flecainine
Sleep Apnea
Arrhythmias in Sleep Apnea

• During an apnea increased vagal tone
  • Slowed heart rate
  • Potential for Bradyarrhythmias
Arrhythmias in Sleep Apnea

- At the end of an apnea there is hypoxemia, hypercapnia
- Increases sympathetic activity
- Causes elevations in BP and HR
Arrhythmias in Sleep Apnea

- Apnea ends with an arousal
- Increased sympathetic activity
- Decreased parasympathetic activity
- Increased BP and HR
Arrhythmias in Sleep Apnea
Arrhythmias in Sleep Apnea

- Due to sleep disruption from respiratory events
  - Instability in normal sleep stage mediated sympathetic and parasympathetic activity
  - Increased sympathetic response
  - Hemodynamic instability (BP and HR)

Table 2: Autonomic changes during sleep

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REM, rapid eye movement.
Arrhythmias in Sleep Apnea

- Risk associated with frequency of apnea (moderate OSA) and degree of hypoxemia
- 50% of OSA patients have nocturnal arrhythmias
- OSA patients have 2-4 fold risk of having complex arrhythmia compared to non-OSA patients.
What should be look for
What should we look for

• AASM Scoring Manual 2012
  – “Recommends” reporting the following adult conditions
    • Sinus tachycardia → sustained HR greater than 90 bpm
    • Sinus bradycardia → sustained HR less than 40 bpm
      – “sustained” means greater than 30 seconds of a stable rhythm
    • Asystole → scored for a pause greater than 3 seconds
Sinus Bradycardia
Asystole

• Less than 3 seconds: normal
• 3-5 seconds pauses: no intervention required.
  – But if patient is symptomatic ➔ Assess patients use of beta blockers or calcium channel blockers
  – Contact on call physician
• 5 -10 second pauses: assess for symptoms; check BP.
  – Assess patients use of beta blockers or calcium channel blockers
  – If patient qualifies for CPAP therapy initiate it.
  – Notify on-call physician.
Sinus pause??
Asystole
Asystole
What should we look for

• AASM Scoring Manual 2012
  – “Recommends” reporting the following adult conditions
    • **Wide complex tachycardia**: consecutive 3 beat minimum; rate greater than 100 bpm; QRS greater than 120 milliseconds.
      – Sustained vs. Non-sustained
    • **Narrow complex tachycardia**: consecutive 3 beat minimum; rate greater than 100 bpm; QRS duration less than 120 milliseconds
Wide Complex Tachycardia
Narrow Complex Tachycardia
What should we look for

• AASM Scoring Manual 2012
  – “Recommends” reporting the following adult conditions
    • Atrial fibrillation: irregularly irregular ventricular rhythm; absence of P-waves
      – Does patient have history of it? Is it new onset?
      – Is patient symptomatic from it?
      – Check BP and HR
      – If patient is symptomatic or if unstable send to ER; notify on call physician
Atrial Fibrillation
What should we look for

AV Block:

• AASM expects reporting of AV blocks if quality is sufficient for accurate scoring.
• Atrial beats are not conducting through to the ventricles at the AV node.
AV Block

- **1st degree AV block**
  - Prolonged PR interval (greater than 0.2 seconds)

- **2nd degree AV block**
  - Mobitz Type 1 (Wenkebach)
    - Slowly increasing PR interval from beat to beat until a dropped beat (QRS) occurs
  - Mobitz Type 2
    - Randomly dropped beats (QRS)

- **3rd degree AV block / Complete heart block:**
  - Complete dissociation between atria and ventricles;
    - atrial rate faster than ventricular rate
1st degree AV block

First-Degree AV Block
2\textsuperscript{nd} degree AV block/Type 1
Mobitz/Wenkebach
2nd degree AV block Type 2 Mobitz
3rd degree AV block
What should we look for

• Ectopic beats: (reported if felt to be clinically significant)
  – Premature atrial contractions
    • P-wave present; narrow QRS
  – Premature ventricular contractions
    • P wave absent; wide QRS complex
  – Premature junctional complexes
    • Originate from the AV junction; will not have a “p-wave” but will have a narrow QRS complex
What should we look for

• Ectopic beats
  – Couplets, Triplets
  – Bigeminy $\rightarrow$ N, E, N, E..
  – Trigeminy $\rightarrow$ N, N, E, N, N, E...
  – Quadrigeminy $\rightarrow$ N, N, N, E, N,N, N, E...
Ectopic Beats
Ectopic Beats
Ectopic Beats
Ectopic beats
Ectopic Beats
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