Tremor

- A rhythmic, oscillation about a joint that occurs at a regular frequency.
- Neurological Tremor is produced by involuntary repetitive contractions of agonist and antagonist muscles.
- Central and peripheral mechanisms
  - Central generators-BG, thalamus, cerebellum, etc
  - Peripheral mechanism of elasticity and stiffness, length, mass of tissues
Classification

Several approaches:

- Anatomic Distribution (hand, foot, etc)
- Frequency (3-5 Hz, 8-10 Hz, etc)
- Phenomenological (modality / activity in which tremor occurs)
TREMOR

REST
- PARKINSONIAN
  - PD / PS
  - DIT
  - PSYCHOGENIC
  - METABOLIC
  - HEREDITARY-DEGENERATIVE
- OTHER (MIXED FEATURES)
- POSTURAL
  - BENIGN: PHYSIOLOGICAL
  - ET
  - ORTHOSTATIC
  - DIT
  - METABOLIC
  - PSYCHOGENIC
- PATHOLOGICAL: CEREBELLAR
  - MIDBRAIN / RUBRAL
  - PERIPHERAL

ACTION

KINETIC
- BENIGN: ET
  - TASK-SPECIFIC
  - METABOLIC
  - PSYCHOGENIC
- PATHOLOGICAL: CEREBELLAR
  - MIDBRAIN / RUBRAL
  - PERIPHERAL
**REST TREMOR**
Occurs when the body part is fully supported against gravity and the musculature is not actively contracting.

### Parkinsonian
- PD
- Parkinsonian syndromes
- DIP

### Other
- Psychogenic
- DIT – may have mixed quality
- Heredito-degenerative
  - Wilson’s Ds
  - HD
  - Fahr’s Ds
  - Alzheimer’s disease (LB pathology in 60%)
ACTION TREMOR:
Occurs during voluntary contraction of muscles

- Postural
  - Physiological
  - Essential tremor
  - DIT
  - Dystonic tremor
  - Neuropathic tremor
  - Orthostatic tremor
  - Psychogenic

- Kinetic
  - Midbrain tremor
  - Cerebellar tremor
  - Thalamic
  - Task-specific
    - Primary writing tremor
  - Psychogenic
Movement Disorders Resembling Tremor

- Myoclonus:
  - CBGD, MSA, dementia, metabolic syndromes, some cortical myoclonic syndromes

- Motor tics

- Hemiballism

- Chorea and Athetosis

Typically the key to these is they are *not* rhythmic, tend to be more random, variable in frequency or amplitude or location
Key Patient Historical Information

- Onset – sudden vs gradual
- Location – one area, several, “all over”
- Length of Time
- Episodic
- Modifiers
- Concomitant Disease (thyroid, pulmonary, etc)
- Family History
- Medication History – DON’T FORGET OTC’S and REC DRUGS
Key Examination Features

- **Location / Laterality**: Extremities, Head, Chin/Jaw
- **Activity of tremor predominance**: Rest, Posture, Action
- **Frequency (should not vary)**: 1-4Hz, 4-7Hz, 8-12Hz, 13-18Hz
- **Amplitude**: Low, Moderate, High
- **Rhythmicity**: Regularity?
- **Associated Features**: Bradykinesia, Rigidity, Gait problems, Neuropathy
Simplifying Approach to Patient with Tremor

- Consider 3 main categories based on “what is common is common”:
  - Essential tremor
  - Parkinsonian tremor
  - Other
Parkinsonism: Rest Tremor

- Most common cause.
  - Idiopathic Parkinson’s Disease (PD)
  - Parkinsonian Syndromes
    - MSA (up to 80% with tremor*), PSP / CBGD (42% with tremor**)
      (*Kaindlstorfer et al, 2013, ** Fujioka et al 2016)

- Secondary causes:
  - Drug, Vascular, Metabolic, Trauma, Toxic insults to BG,

- Heredo-degenerative Diseases
  - Huntington’s Ds, Wilson’s Ds, Neuroacanthocytosis
Parkinsonian Tremor

- Phenomenology is similar regardless of etiology
- Historically, tremor is noted **at rest or with restful, maintained postures** (reading the newspaper, walking, spouse awareness).
- Attenuates or stops with movement or attention.
- Common initial sites: **hand, fingers, foot, jaw**.
  - If complaint of head tremor, parkinsonian type is not likely.

On exam:
- Tremor at rest, may be intermittent. **Can be enhanced with distraction maneuvers.** (Ambulation, activation of other extremities.)
- 4-7 Hz, rhythmic activity.
- In upper extremity, flexion/extension of wrist and pronation/supination of forearm is typical. Other locations common too though.
- In PD may have **Re-emergent tremor. Has a several second latency in held posture**
- If PD – will start **unilaterally**.
Key is *associated* Parkinsonian features

- For PD Dx (bradykinesia and at least 1 other is needed)
  - **Bradykinesia** +
    - **Resting tremor** (30% do not have tremor)
    - **Rigidity**
  - **Supported by:**
    - Asymmetric onset
    - Anosmia / Hyposmia
    - Response to levodopa or other dopaminergic tx
- Suggests Alternative Parkinsonism diagnosis:
  - early **Postural instability** (though this is a cardinal feature of PD, is seen later in the disease typically)
  - early freezing
  - hallucinations
  - early dementia
  - gaze palsy
  - early, severe dysautonomia
  - previous condition known to cause parkinsonism
PD Diagnostic Workup

- Indicated if tremor or other features are atypical
- No biomarker for PD
- Work up may include:
  - Thyroid profile
  - Ceruloplasmin/Urine 24-hr copper
  - Brain imaging – DATScan for dopaminergic dysfunction in striatum
DATScan (Ioflupane)
Drug-Induced Parkinsonism/Tremor

- Tremor usually accompanied by other parkinsonian features
- Usually bilaterally symmetrical
- Seen most often with dopamine-blocking agents (metoclopramide (Reglan) most common cause in this country)
- May take 6 months for symptoms to resolve after withdrawal of offending agent
Rest Tremor Treatment

- PD/parkinsonism – TREATMENT OF PD IS COMPLEX AND SHOULD BE INDIVIDUALIZED STARTING AT TIME OF DIAGNOSIS WITH A COMPREHENSIVE APPROACH.

- Medications are only a small part of treatment and include dopamine stimulation / replacement, anticholinergics, MAO-B inhibitors, surgical therapies

- DIP - removal of offending agent

- Treatment of underlying cause if possible
Severe PD Tremor that Occurs both at Rest and With Posture

*note reduction with action though
ESSENTIAL TREMOR

POSTURAL / ACTION TREMOR

OTHER ACTION TREMORS:

- Postural tremor – held posture
  - Physiological – exists in all of us, may be enhanced
  - Metabolic
  - Dystonic
  - Neuropathic
  - Drug-induced
- Kinetic tremor – during action
  - Task - Specific
  - Midbrain - pathological
  - Cerebellar - pathological
- Isometric tremor – muscle contraction
  - Orthostatic – fine / fast tremor during standing
Essential Tremor
(Benign ET, Familial Tremor)

- More common than PD tremor with prevalence ~4+% of the population
- Incidence increases with age, but bimodal distribution of onset
- Insidious onset
- May appear with minor symptoms early, then level off with a phase of worsening many years later
- Variety of studies show different results on familial tendency with past suspected gene mutations but none confirmed
  - Ch 3q13 Icelandic kindred
  - Ch 2p22-25 American kindred
  - Mutations in LINGO1 gene
Clinical Aspects of ET

- Patient complains of tremor during activities (usually during use of fine motor skills).
- Disappears or attenuates with rest.
- Distal Upper extremities most often affected > whole head > voice
- Less often Face / jaw, Lower extremities, Trunk
Clinical Aspects of ET (cont)

- Frequency range 4-12 Hz
- “Cogwheeling” may be present (“pseudocogwheeling” due to incomplete relaxation typically)
- NO parkinsonian signs
- Can enhance on exam with handwriting, Archimedes spiral, water pouring
- Related disorders: postural imbalance, dystonia, blepharospasm, neuropathy,
- Should NOT see bradykinesia or increased tone
- Is an increased risk of developing PD in ET pts (~4 x gen pop) (Carles Vilarino-Guell, et al. Parkinsonism and Related Disorders, 10(2): 109-111)
ET vs PD

**PD**

2. Copy this sentence in cursive:
   
   This is an example of my handwriting.
   
   

3. Draw a line between the lines:
   
   Start Here
   
   

4. Copy this circle:
   
   

**ET**

2. Copy this sentence in cursive:
   
   This is an example of my handwriting.
   
   

3. Draw a line between the lines:
   
   Start Here
   
   

4. Copy this circle:
Treatment of ET

- **Oral medications:**
  - Propranolol
  - Primidone
  - Others:
    - Topiramate
    - Neurontin
    - Mirtazapine
    - Clozaril
    - Benzodiazepines

- **Local therapy**
  - Botulinum toxin

- **Surgical therapy**
  - Ablative procedures

- **Deep Brain Stimulation**
PRU1 DON£ X 2

BASELINE

2 HOURS

6 HOURS

9 HOURS
OTHER TREMORS

- TREMORS THAT ARE NOT PD OR ET
- THIS CATEGORY CONTAINS MUCH LESS COMMON TREMORS
- CAUSES CAN BE NUMEROUS
DIT
Drugs Causing Tremor

- Valproic Acid
- Lithium
- Corticosteroids
- Neuroleptics
- Metoclopramide
- Amiodarone
- Cyclosporin
- Beta-agonist
- SSRI’s
- Tetrabenazine / Valbenzaine / Duetetetetetetetetbrabenzazine
- Procaine
- Promethazine
- Reserpine
- Prochlorperazine
- Calcium channel blockers
Neuropathic Tremor

- May be due to disruption of normal feedback for posture and tone
- Causes a dysynchrony between antagonistic muscles
- Fast, fine tremor
- Uncommon

However, is MAG Ab - related tremor condition in >age 50 with neuropathy and tremor that looks more like ET – may respond to IVIG
Dystonic Tremor

- Occurs when a dystonic posture is opposed
- Common in cervical dystonia
- Varies in severity depending on position
- Responds less to oral medications
- Treated with botulinum toxin
Task-specific Tremor

- Action-specific.
- Involves advanced learned motor skills.
- May be an “incomplete” task-specific dystonia.
- Not responsive to oral meds.
- Botulinum toxin treatment of choice.
Lesional Kinetic Tremor
(Midbrain Tremor and Cerebellar Tremor)

- **Midbrain Tremor**
  - aka: Holmes tremor, rubral tremor
  - midbrain lesion: stroke, MS, trauma
  - Involves red nucleus and surrounding striatonigral or cerebellothalamic fibers
  - during limb movement with amplification as target is approached
  - chaotic appearance
  - treat with beta blockers, benzo’s, dopamine, anticholinergics, or surgery.

- **Cerebellar Tremor**
  - aka: Intention tremor
  - lesion affecting cerebellum or tracts stroke, MS, trauma
  - may be toxic in nature
  - vermian involvement produces titubation of head / trunk
  - amplified when approaching target
  - treat by reversing cause if possible
  - drug therapy usually unsuccessful
  - surgical treatment in some pts
Psychogenic Tremor

- Sudden onset – especially after an event such as MVA
- Paroxysmal – lasting for a distinct episode typically for several minutes at least, with no tremor in between episodes
- Mixed components
- Little or no involvement of fingers
- Variability in amplitude, frequency and direction
- *Decreases with distraction*
- Inability to maintain tremor activity when activating another body part, such as the opposite extremity
- Very difficult to treat, requiring team approach
Thank you!

Questions?