Attention Deficit Hyperactivity Disorder

Goals and Objectives

- Identify the symptoms of ADHD by an increased awareness of the diagnostic criteria and general clinical picture of ADHD
- Review of research and its input into the Neurobiology of ADHD and its conception
- Increased awareness of pharmacologic and behavioral interventions for ADHD

Diagnostic Criteria

- DSM 5 Criteria
  - Classifies ADHD as a Neurodevelopmental Disorder
  - **Age Inappropriate Hyperactivity – Impulsivity**
    - Impaired motor and verbal inhibition
    - Impulsive decision making
    - Greater disregard of the future
    - Fidgeting, squirming, running, climbing, touching
    - Restlessness decreases with age, becoming more internal, subjective by adulthood
    - Poor emotional self-regulation – impatient, low frustration tolerance, quick to anger, easily excitable
    - **6 or more present over 6 months; impairing in more than one setting**
Diagnostic Criteria

- DSM 5 criteria
  - Age-Inappropriate Inattention
    - Increased distractibility
    - Poor focus and concentration
    - Less able to re-engage incomplete tasks following distractions
    - Poor organizational skills
    - Poor working memory
    - Forgetful; loses needed objects
    - Poor follow through
    - Avoids/dislikes sustained mental effort
  - 6 or more present over 6 months; impairing in more than one setting; age of onset broadened to 12 or older

Old Assumptions

- ADHD and other disruptive behavior disorders arise from faulty social contingencies at home and school
- Changing parent and teacher management methods should improve or eliminate ADHD behavior

Executive Functioning Deficit

- ADHD is a disorder or executive functioning made of:
  - Inhibition
  - Working Memory (Verbal and Non-Verbal)
  - Emotional self-regulation
  - Planning/problem-solving
- The purpose of Executive Functioning is the cross-temporal organization of behavior to anticipate and prepare for future events – goal directed action
- These deficits have a neuro-genetic basis
- Treatment involves medical management of that neuro-genetic basis and adapting the environment to the executive function disabilities to compensate for the deficits
Brain Differences in ADHD

- Total brain volume is 3-4% smaller on average
- Not just the frontal lobes – equivalent everywhere
- Caudate and cerebellum even more affected
  - But Caudate “normalizes” by adolescence
- Brain is smaller but follows normal growth curves

Prevalence

- Recent CDC survey: 11% of school aged children and adolescents
- Varies by sex, age, social class and urban-rural settings
- Children and Adolescents
  - 3:1 M:F in community sample; 9:1 M:F in clinic sample
- Adults
  - < 2:1 M:F in adults
- Chronic Disorder
  - Follow up studies suggest 60-80% persistence in adolescence
  - 50% persistence into adulthood

The Causes of ADHD

- Disorder arises from multiple causes
- All currently recognizable causes fall in the realm of biology (neurology and genetics)
- Final common pathway appears to be the fronto-striato-cerebellar circuits in the brain
- Social causes lack credibility
**Executive Networks**

**Normal Controls**  **ADHD**

**Molecular Genetics**

- Several genes have repeater genes – final result of all pathways is decreased amounts of dopamine in needed areas for optimal performance

- Dopamine B Hydroxylase – converts DA to NE, excess amounts ► Decreased DA
- DRD 4 – excess copies ► Decreased DA
- DAT 1 – excess copies causes overactive transport ► Decreased DA
ADHD Causes: Acquired and Traumatic

- ADHD following Traumatic Brain Injury
  - Pre/Perinatal Factors
    - Fetal Alcohol
    - Maternal Smoking
    - Neonatal Hypoxia (4X risk ADHD offspring)
    - Hyperbilirubinemia
    - Stroke
    - Low Birth Weight
    - Perinatal Stress
  - Environmental Factors
    - Early Deprivation
    - Lead Exposure

Premature Birth Study

- Infants born prematurely at risk for brain injuries that affect cortical development and neural connectivity
- Can be detected by Brain Ultrasound at birth
- At risk for development of:
  - ADHD, OCD, Tic Disorder, Major Depression
    - Archives of General Psychiatry July 2011, NIH and March of Dimes

Evaluation of ADHD (Multi-Disciplinary Approach)

- Interview with parents (history)
  - Gathers behavior symptoms or chief complaint
  - Gather medical history
    - Any disorders with an organic basis (seizures, learning disabilities, etc, etc)
    - Developmental history (delays in development?)
  - Review of systems – Mood, Sleep, Anxiety, Tics
  - Family history (Custody, Divorce)
    - Reactive Attachment Disorder
Evaluation of ADHD

- Interview with the child
  - Gather child’s understanding of why they are here
  - Observe behavior (often not hyperactive in brief visit to novel location)

- Behavior Rating Scales

- Physical Exam

- Neurological Exam

Evaluation of ADHD

- Consultation with Classroom Teacher
- School Observation
- Psychological Testing
  - Continuous Performance Tasks
- Adults – collect elementary school history, substance abuse history, call the parents

Treatment of ADHD

- Effective research supported treatment approaches include:
  - Application of behavior modification principles and techniques
  - Parent Training
    - Parental supervision
    - Consistency
  - Psychopharmacology
  - Problem-solving skill training
Legal Rights of Students

- IDEA, Part B (1990)
  Required public schools to evaluate children and, if one or more impairments found, severe enough to warrant special education, to provide special education or education that is “free and appropriate”
  - Basic Tenets:
    1. FAPE - Free and appropriate public education for all children
    2. LRE = Least restrictive environment
    3. IEP = Individual Education Plan

Legal Rights of Students

- Section 504 of the Rehabilitation Act of 1973
- Civil rights law that prohibits discrimination in federally-funded programs based on disabilities
- No specific categories; can get modifications more easily through 504, but they are most susceptible to being violated

Stimulant Medications: Efficacy

- One of the most robust treatments in psychiatry
- 70% of children with ADHD will respond to any one of the stimulants, all generally equal efficacy
- An additional 20% will respond to the next one attempted
- If the 1st and 2nd choices fail, check for wrong diagnosis and/or comorbidity
Stimulant Medications

- Most well studied drugs in psychiatry
  - Used since 1930's; more than 350 studies

- Response rate to treatment is 75-80% for MPH or AMP

- Response rate if both are tried 90%

Mechanism of Action

- MPH prolongs the effect of some neurotransmitters (the chemicals that the brain makes for the nerve cells to communicate with each other)

- Dopamine and Norepinephrine are neurotransmitters that provide a stimulating effect that can foster renewed focus

- Since the brain is still evolving during childhood, many parents fear that stimulants may disrupt normal neurologic development and create dependency


Stimulant Associated Improvements

- ↑ ATTENTION
- ↓ HYPERACTIVITY ▼ Primary ▲ IMPULSIVITY

- CLASSROOM BEHAVIOR ▼ Secondary ▲ ACADEMIC WORK PERFORMANCE

- SOCIAL INTERACTIONS NONCOMPLIANCE IMPULSIVE AGGRESSION
ADHD FDA Approved Medications

- **Stimulants**
  - Methylphenidate
    - Ritalin
    - Metadate
    - Concerta
    - Quillivant
  - Dextroamphetamine: Dexedrine; Vyvanse; Procentra
  - Mixed amphetamine salts: Adderal

- **Not a stimulant and works in a different way than the stimulant medications; has no abuse potential**
  - Sometimes called a selective norepinephrine reuptake inhibitor
  - FDA approved in US in January of 2003
  - Can increase attention and the ability to follow instructions; decrease distractibility and hyperactivity
  - Can decrease depression and anxiety in children with ADHD
  - Can be given once daily or dosed twice a day
  - If effective may provide 24 hour coverage of ADHD symptoms

How does it work?

- Helps certain parts of the brain that control impulsive actions (“the Brakes”) work better by increasing the activity of the neurotransmitter norepinephrine
Second Line Therapies

- Alpha-agonists
  - Clonidine
    - Clonidine ER (Kapvay)
  - Guanfacine (Tenex)
    - Guanfacine ER (Intuniv)
- Bupropion (Wellbutrin, SR, XL)
- Tricyclic Antidepressants
- Strattera

Medical Issues

- Growth: Faraone meta-analysis:
  - after 2-3 years on stimulants, kids were 1-2.5 cm shorter
  - Growth rate increases when stimulants stopped
- Cardiac Risk
  - AHA: May 2008 – EKG’s are not routinely recommended but in some cases may be recommended by MD
  - AHA: 2008 guidelines – “...it is reasonable for a physician to consider obtaining an ECG as part of the evaluation of children being considered for stimulant drug therapy, but this should be at the physician’s judgment, and it is not mandatory to obtain one”
ADHD and Co-Morbid Conditions
- Language Problems found in 40% of youth with ADHD
- Learning Disorders in 50% of youth with ADHD
- Anxiety Disorders in 60% of youth with ADHD (Australian Study April 2014)
  - At least 30% in US
- Mood Disorders such as Depression and Bipolar Disorder
  - (comorbid teens may have higher rates of suicide)

ADHD Co-Morbid Conditions
- NEJM April 2014
  - Effect of ADHD Treatment on Criminality
    - 26K ADHD patients, 63% M, C/T controls
    - Looked at association B/W ADHD medication use and crime rates
    - Treatment for ADHD with medication associated with reduction in criminality 32% m and 41% F

ADHD in Adolescents/Adults
- ADHD doesn’t always go away
  - 6—70% retain symptoms into adulthood
- May get first presentation of ADHD at adolescence due to increased demands and independence
- Hyperactivity replaced by fidgeting or sense of inner restlessness
- Always losing cell phones and retainers
- Higher rates of MVA’s, ER visits, bankruptcy, relationship problems
Treatment in Adolescents and Adults

- Less support from schools, need to be patient advocate in high school and college
- First line Treatment
  - Stimulants, day long treatment and not just for school
- Second Line (or high risk of substance abuse/diversion) Atomoxetine and others

Recent Studies

- Magnetic Resonance Spectroscopy (MRS)
- Frontal and Striatal glutamate elevated in children and adults with ADHD
- Partially normalized by stimulant
- Open label trial of a medication called Memantine helped ADHD symptoms in children

- Courney et al, J Child Adoles Psychopharmacology, Feb 2007

Recommendations

- History – esp, Cardiac – ask about Family History, sudden death, fainting (esp during exercise)
- Physical Exam – listen for heart murmurs
- ECG – only when clinically indicated
- Pediatric Cardiology referral when indicated (ECG, ECHO)
- BP with every visit
Treatment in Adolescents/Adults

- Less support from schools, need to be patient advocate in high school and college
- First Line Treatment
  - Stimulants, treat for all day long, not just school
- Second Line Treatment
  - If risk of high substance abuse/diversion exists – Strattera (Atomoxetine, others)

Sluggish Cognitive Tempo

- 3.5 million treated with meds for ADHD
- 11% school aged children dx with ADHD
- 2 million children have symptoms of:
  - Lethargy
  - Daydreaming
  - Slow Mental Processing
- Researched since 1980 – never recognized by DSM as a diagnosis
Pop Quiz: ADHD

According to the largest study of ADHD to date (the MTA trial), which was the most effective treatment for ADHD in kids after 1 year?

A. Stimulant medication
B. Behavioral therapy
C. School intervention
D. Stimulant + Behavioral therapy
E. Low sugar diet

ADHD and MTA Study

- NIMH sponsored systematic comparison of treatment with medication to other forms of treatment.
  - Medication alone
  - Intensive behavioral therapy
  - Combined therapy
  - Standard community treatment

- Results: Medication more effective at treating the symptoms of ADHD than treatments which did not include medication