Objectives

- Establish framework for understanding behavior in DMD (causative factors)
- Overview of current research examining behavior patterns in DMD
Behavior in DMD

“Behavior”

- Easily observable external actions and responses (what he is doing)
- Less easily observed internal emotional states (how he is feeling)
Behavior in DMD

- Starting points
  - All behavior is on a continuum
    - From normal to severe
    - May fluctuate
    - Subjective
  - Abnormal behavior usually mimics normal behavior
    - But problematic in timing, intensity, or duration
Behavior in DMD

- Starting Points
  - Behavioral “diagnoses” are based on observable behavior
    - Not based on cause
  - Behaviors must result in some kind of impairment
  - Talking about risk factors
Problems with psychosocial adjustment

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean (SD)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMD Group (N=351)</td>
<td>85.1 (12.1)</td>
<td>17.1 %</td>
</tr>
<tr>
<td>NHIS group (N=5089)</td>
<td>90.3 (17.2)</td>
<td>11.4 %</td>
</tr>
<tr>
<td>Control group (N=93)</td>
<td>95.7 (7.1)</td>
<td>2.2 %</td>
</tr>
</tbody>
</table>

NHIS = National Health Interview Surveys: 5089 children with a chronic physical, cognitive, behavioral condition or impairment, lasting for more than 3 months and having an impact on daily functioning.

Stein RM. Psychosocial Adjustment and Role Skills Scale (PARS III)
Hendriksen JG, Poysky J, Schrans DG, Vles JS (unpublished data)
Behavior in DMD

- DMD is a complex condition
  - Multiple factors need to be considered when determining why a child is having behavioral problems:
    - Cognitive/Brain Functioning
    - Developmental/Neurobehavioral Disorders
    - Coping/Adjustment
    - Other Factors
      - Family
      - Medical
Brain Functioning and Cognitive Factors
Brain Functioning in DMD

- Absence of dystrophin can have an impact on the brain
  - Disruption in ion channel localization
    - Disrupts normal electrophysiology of neurons
    - Downstream consequences for calcium homeostasis and synaptic plasticity

Knuesel I, et al. 1999
Anderson JL, Head SI, Morley JW. 2004
Possible Causes

- **Physiological**
  - Dp427-M: cerebral cortex, hippocampus, glia
  - Dp427-C: cortical grey matter, hippocampus, caudate, putamen
  - Dp427-P: cerebellar Purkinje cells
  - DJP260: low levels
  - Dp140: ubiquitous, astroglial processes
  - Dp116: fetal brain
  - Dp71: cerebral cortex, glia and astrocytes, embryonic stem cells
Brain Functioning in DMD

“What does this mean?”

Sets the stage for disruptions in cognition, behavior, sleep, and medication response
Cognitive Factors in DMD

- **Increased risk for lower IQ**
  - Cotton, Voudouris, Greenwood 2001

- **Language skills often weaker**

- **Immediate memory can be problematic**

- **Possible weaknesses in attention and executive functions**

- **Increased risk for dyslexia and other learning problems, independent of IQ**
  - Hendriksen, Vles 2006
Cognitive Functioning in DMD

- “Visual” learners
- May have trouble following directions
- May have difficulty expressing themselves
- Need information in smaller “chunks”
- Need more repetition for new info to sink in
- May have problems with problem solving and planning
- May be “concrete” or literal in their thinking
- May have difficulty making transitions or being flexible in their thinking
Developmental and Neurobehavioral Disorders in DMD
Neurobehavioral Disorders in DMD

- Attention-Deficit/Hyperactivity Disorder (AD/HD) and Attention Deficit Disorder (ADD) in DMD
  - Hendriksen & Vles (2007) 12 % (ADHD)
Neurobehavioral Disorders in DMD

26 boys with DMD (5 others refused)
  1 with ADD
  8 with ADHD (4 mod., 4 sign.)

ADD = 3-4%
ADHD = 26-31%

Poysky, Lotze in progress
Neurobehavioral Disorders in DMD

What is ADHD/ADD?

- **Impulsivity:**
  - Difficulty waiting turn
  - Often interrupts or intrudes
  - Fidgets
  - Difficulty remaining seated
  - Excessive running or climbing
  - Always “on the go”
  - Talks excessively
  - Blurts things out
Neurobehavioral Disorders in DMD

- **What is ADHD/ADD?**
  - **Inattentive:**
    - Makes careless mistakes
    - Difficulty sustaining attention
    - Doesn’t listen
    - Difficulty following instructions
    - Difficulty organizing tasks
    - Dislikes/avoids tasks requiring mental effort
    - Loses things
    - Easily distracted
    - Forgetful
    - Slow or inefficient thought process
Neurobehavioral Disorders in DMD

- What else is ADHD/ADD?
  - Problems with emotional regulation/frustration tolerance
  - Poor planning, problem-solving, time management
  - Inflexible thinking
  - Concrete thinking
  - Reduced self-monitoring
  - Problems learning from mistakes
  - Bossiness
  - Lowered sensory tolerance
  - Apathy, problems with initiation
  - Problems with working/prospective memory
Neurobehavioral Disorders in DMD

- In DMD, kids with Dx of AD/HD have poorer psychosocial adjustment than those without AD/HD:
  - Peer relations
  - Dependency
  - Hostility
  - Productivity
  - Anxiety/depression
  - Social withdrawal

(Hendriksen & Poysky 2006 – unpublished data)

*This does not necessarily mean that AD/HD is the cause of poor psychosocial adjustment in DMD
Neurobehavioral Disorders in DMD

- Oppositional-Defiant Disorder
  - Argumentative
  - Purposefully defiant/oppositional
  - Excessive temper tantrums
  - Deliberately annoys others
  - Rigid thinking: low adaptability to changes in circumstances/expectations

- About 50-60% in ADHD

- Has not been examined in DMD
# Neurobehavioral Disorders in DMD

## Autism in DMD

<table>
<thead>
<tr>
<th>Study</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wu et al. (2005)</td>
<td>3.7%</td>
</tr>
<tr>
<td>Hendriksen &amp; Vles (2006)</td>
<td>5%</td>
</tr>
<tr>
<td>Hinton, et al. (2006)</td>
<td>15-19%</td>
</tr>
<tr>
<td>Darke, Bushby, Le Couteur, McConachie (2006)</td>
<td>11%</td>
</tr>
</tbody>
</table>
Neurobehavioral Disorders in DMD

- What is Autism?
  - At least 2 of the following:
    - Severe impairment in use of nonverbal communication
    - Failure to develop peer relationships
    - Lack of seeking to share enjoyment, interests, or achievements
    - Lack of social/emotional reciprocity
  - At least 1 of the following:
    - Language delay (without using nonverbals to compensate)
    - Stereotyped/repetitive use of language
    - Lack of varied, spontaneous make believe play or imitative play
Neurobehavioral Disorders in DMD

What is Autism? (Cont.)

- At least 1 of the following:
  - Overly preoccupied with stereotyped/restricted patterns of interests that is abnormal in intensity or focus
  - Inflexible adherence to specific, nonfunctional routines
  - Stereotyped and repetitive motor mannerisms
  - Persistent preoccupation with parts of objects

- May also have:
  - Unusual response to sensory stimulation
  - Deficits in shared attention (looking where someone else is looking)
  - Mental retardation, impulsivity, aggression, self-injurious behavior
  - Developmental regression
Neurobehavioral Disorders in DMD

- Autism in DMD
  (Hinton, Batchelder, Cyrulnik, Fee, Kiefel 2006)
  - Less likely to have
    - Developmental regression
    - Unusual sensory interests
    - Repetitive motor mannerisms
    - Intellectual impairment
  - Some things may improve with age
    - Nonverbal and verbal communication
    - Interest in relationships
    - Sharing interests/enjoyment
    - Make believe play
    - Reciprocal conversation
Neurobehavioral Disorders in DMD

- Obsessive-Compulsive Disorder (OCD) in DMD
  - Hendriksen & Vles (2007) 5 %
Neurobehavioral Disorders in DMD

26 boys with DMD (5 others refused)

17 reported obsessive-compulsive behaviors on a symptom checklist

- 54-65%
- Does not mean they are diagnosed with OCD
- Most in the mild range

Poysky, Lotze in progress
Neurobehavioral Disorders in DMD

What is OCD?

- Obsessions: intrusive thoughts, fears, words, or pictures

  - Common examples:
    - Superstitious/irrational fears
    - Magic numbers
    - Contamination (germ phobia)
    - Excessive religiosity, right/wrong
    - Terrifying/grotesque images
    - Need for symmetry or exactness
    - Social embarrassment
    - Excessive concern with how things feel
What is OCD? (Cont.)

- Compulsions: Urges to perform ritualistic behavior
  - Common examples:
    - Checking
    - Counting
    - Touching/tapping
    - Rearranging/lining up
    - Cleaning/washing
    - Smelling/sniffing
    - Re-doing or repeating things
Neurobehavioral Disorders in DMD

- **Sensory Processing Disorder**
  - **Hypersensitive to stimuli**
    - Tactile: cannot handle how clothes/tags feel
    - Auditory: sounds too loud
    - Oral: picky eaters, food consistency/texture
  - **Hyposensitive to stimuli**
    - Oral: put things in mouth, chew on pencils, etc.
    - Auditory: don’t respond when spoken to
    - Vestibular: excessive activity

Ayres 1972
Sensory Integration

- Common in many non-DMD children
  - Most outgrow by 3-5 years of age
- Some continue to have excessive reactions
- Usually occurs in the context of another cognitive, behavioral, or developmental disorders
Neurobehavioral Disorders in DMD

Social Problems

40 % PPMD Online Survey (2006)

34 % Hinton, Nereo, Fee, Cyrulnik (2006)
Social Functioning

- Peer relationships decline with age
  - Due to increased physical limitations and health problems?
  - Boys on steroids had better peer relationships than those off steroids.

Hendriksen, Poysky, Schrans, Vles (unpublished data)
Coping/Adjustment
Coping/Adjustment

**Depression and Anxiety**

- Fitzpatrick et al (1986) 50 % Depression
- Leibowitz et al (1981) 33 % Emotional Probs
- Kiefel et al (2006) 8 % Depression
  0 % Anxiety
Coping/Adjustment

Anxiety

- Worries, fearful
- Tense or uptight
- Jittery or trembling
- Chest pains
- Problems catching breath
- Stomach aches, headaches, dizziness
- Problems leaving parents or other family members
Coping/Adjustment

- Depression
  - Irritability, moodiness
  - Loss of interest in fun
  - Sad mood, flat emotions
  - Guilty feelings
  - Low self-esteem
  - Crying spells
  - Social withdrawal
  - Change in appetite
  - Lethargy, agitation
  - Problems sleeping
Study on Psychosocial Adjustment in Duchenne

Overall correlation +0.20 *** Lowest adjustment scores between 8-10 years

n=322
Other Factors
Family Factors

- **Parental depression** Abi Daoud, Dooley, Gordon 2004
- **Parental stress** Nereo, Fee, Hinton, 2003
- **Behavior problems can potentially interfere with treatment** Gauld, Boynton, Betts, Johnston, 2005
- **Issues related to independence**
- **“Mommy’s little monster”**
Medical Factors

- Fatigue
- Steroid treatment
  - Acute effects
  - Delays in puberty/growth
Most boys with DMD do just fine!

Increased risk for behavior problems in DMD:
- ADHD
- Autism spectrum disorders
- Obsessive-compulsive disorder
- Depression/anxiety
- Social difficulties
- Sensory integration dysfunction
Behavior and emotional problems are likely caused by multiple factors including:

- Physiological/Cognitive
- Development/Neurobehavioral
- Adjusting to DMD/Coping
- Family factors
- Medical

Need to keep these factors in mind when assessing and treating problems.
Want More?

Connecting to Your Son
Breakout Panel

James Poysky, PhD
Jos Hendriksen, PhD
Veronica Hinton, PhD
David Schonfeld, MD
Kathy Kinnet, RN

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