Pediatric Vestibular Assessment for Children Who Are Deaf or Hard of Hearing

Kristen Janky, Au.D., Ph.D., CCC-A
Vestibular Audiologist
Vestibular Services, Clinical Coordinator

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Kristen Janky Au.D., Ph.D., CCC-A
Coordinator, Vestibular Services
Director, Clinical Vestibular Laboratory
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Questions?
For any questions during this broadcast, please send an email to: teresa.mcevoy@boystown.org
Questions will be answered at the end of the presentation.

Learner Objectives

• At the conclusion of this presentation, the participant will be able to:
  – Describe the signs and symptoms associated with vestibular dysfunction
  – List the etiologies of hearing loss that are commonly associated with vestibular dysfunction
  – List commonly used vestibular assessments

What Is The Vestibular System?

• How do we maintain balance?
  – Somatosensation
  – Visual
  – Vestibular System
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What Is The Vestibular System?

- Vestibulo-spinal Reflex (VSR): helps to maintain head and postural stability
- Vestibulo-colic Reflex (VCR): Righting reflex, stabilize the head
- Vestibulo-ocular Reflex (VOR): stabilize vision during head movement
- All reflexes originate in the vestibular system and are modulate by the brain
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Vestibulo-Ocular Reflex (VOR)

- The vestibular “balance” system is primarily responsible for maintaining steady and clear vision during head movement
- Implications: overall balance as well as reading, writing, and development

**What Is Oscillopsia?**

- Visual phenomenon in which the visual environment appears to oscillate
- Oscillopsia only occurs in response to head movement
- Subsequently, oscillopsia is associated with poor visual acuity
- Associated with vestibular loss in both ears

**What Is Oscillopsia?**
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**Vestibular Loss - Adults**

- **Adults**
  - Imbalance
  - Gait abnormalities (wide-based, slow)
  - Greater disability when visual and somatosensory cues are not present
  - Greater risk of falling
  - Blurred vision with movement (i.e., walking, head turns, avoidance of driving, etc.)
  - Limit social interactions

**Vestibular Loss - Adults**

- **Treatment:**
  - Physical therapy
  - Compensatory eye movements to help improve gaze stability
  - Improve overall balance ability

**Vestibular Loss - Children**

- Functional effects are not well understood
- When vestibular loss occurs congenitally or during early development, it can effect motor development
- When looked at over time, this delay was found to be progressive (Rine et al., 2000)
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**Vestibular Loss - Children**

- **Specific problematic activities:**
  - Sitting unsupported
  - Standing
  - Walking
  - Navigating in the dark
  - Clumsiness
  - Riding a bike
  - Hopping

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**Vestibular Loss - Children**

- **Children with sensorineural hearing loss and bilateral vestibular loss found to have significantly worse visual acuity during head movement**
  
  (Rine & Braswell, 2003)

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**Vestibular Loss - Children**

- **Visual acuity found to have a relationship with reading acuity**
  - Children need larger print size for comfortable reading
  
  (Braswell & Rine, 2006a & 2006b)
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## Vestibular Loss - Children

### Specific problematic activities:
- Reading (skipping words or letters)
- Schoolwork
- Develop fine and gross motor control

## Vestibular Loss - Children

### Age of onset:
- Congenital demonstrate more deficits

### Degree of impairment:
- Valente et al. 2012 report on two children: one with mild and the other with profound vestibular loss, both exhibiting functional deficits

### Other variables

## Vestibular Loss - Children

### In spite functional consequences, not all facilities perform vestibular testing

### Awareness of risk factors and symptoms
Vestibular Loss - Children

• The incidence of vestibular dysfunction estimated between 30 – 91%
  (Shinjo et al., 2007; Tribukait et al., 2004; Zhou et al., 2009)
• Incidence higher as severity of hearing loss increases (Angeli et al., 2003)

Vestibular Loss - Children

• Post-natally acquired cases
  – Meningitis
  – Cytomegloivirus (CMV)
  – Ototoxicity
  – Rubella
  – Anoxia

Vestibular Loss - Children

• Some syndromic deafness
  – Usher’s
  – Waardenburg
  – Pendred
  – Alport’s
  – Labyrinthine dysplasia
  – Auditory Neuropathy (some cases)
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Vestibular Loss - Children

• Secondary to Cochlear Implantation
  – General anesthesia and/or temporary disturbance of inner ear fluids
    (Licameli et al., 2009)

Vestibular Loss - Children

• Secondary to cochlear implantation
  – Range incidence of vestibular dysfunction following implantation
  – Estimate vestibular dysfunction in 40 - 86% following CI
    (Licameli et al., 2009; Vibert et al., 2001, Krause et al., 2012, Melvin et al., 2009, Jin et al., 2006)
  – Demonstrate developmental delay
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**Signs And Symptoms**

- Signs and symptoms associated with vestibular dysfunction (Cronin & Rine, 2010)
  - Dizziness
  - Nystagmus

**Signs And Symptoms**

- Signs and symptoms associated with vestibular dysfunction (Cronin & Rine, 2010)
  - Difficult with visual acuity
  - Difficulty with spatial relationships
  - Presence of Hearing loss
  - Motion sickness or sensitivity (avoids or craves)
  - Headaches (family history of migraine headaches)
  - Developmental and reflex delays (slow to learn to ride a bike, swim, hop, stair climb, etc)
  - Difficulty with dancing or certain sports

**Diagnosing Vestibular Loss**

- Caloric Testing
- Rotary Chair Testing
- Vestibular Evoked Myogenic Potential (VEMP) Testing
- Dynamic Visual Acuity (DVA) testing
Caloric Testing

- Right ear calorics

- Left ear calorics

Caloric Testing

Rotary Chair

- Children < 5 years
- When bilateral vestibular loss suspected
- Chair oscillates back & forth
- Electrodes (infrared camera) or goggles
- Sing Songs
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• Vestibular Evoked Myogenic Potential (VEMP)
  • Electromyogram: measuring modulation of muscle activity
    – A good alternative to caloric testing which is not generally tolerated in the pediatric population
      • Ear specific information, as opposed to rotary chair
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Cervical VEMP

Saccule and inferior branch of the vestibular nerve

Dynamic Visual Acuity

• How clear is vision during head movement?
• Rine & Braswell (2003) developed DVA for ages 3-12
  – 100% sensitivity and specificity for identifying bilateral weakness
    (Rine & Braswell, 2003)
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Referring For Vestibular Testing

• When to refer:
  – Hearing Loss
    • High risk population
  – Signs and Symptoms
    • Developmental Delay
  – Pre and Post cochlear implantation
  – Suspect vestibular loss
  – Parent Concern

Treatment

• When vestibular loss is diagnosed, then what?
  – Visual System Assessment
  – Somatosensory System Assessment
  – Vestibular Rehabilitation

Vestibular Rehabilitation

• Preliminary studies demonstrate that children with vestibular loss improve:
  – Developmental Milestones (Rine et al., 2004)
  – Progressive delay was halted and performance moved into the normal range with therapy (Rine et al., 2004)
  – Critical print size and reading acuity (Braswell & Rine, 2006)
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Vestibular Rehabilitation

• Vestibular loss is treated with gaze stabilization exercises - ability to stabilize the visual environment during movement
  – Repeated head and body movements both with and without visual targets
  – Full range of head movement
  – Varying speed, repetitions and sets to build endurance

Vestibular Rehabilitation

• In children, incorporate imagination in play
  – Activities with a ball
  – Finger painting
  – TV and video games
  – Again increasing speed, repetitions, and complexity of environment

Vestibular Rehabilitation

• Balance Systems Integration
  – Integrating Visual, Vestibular, and Somatosensory
  – Challenging the systems to optimize benefit
  – Setting up home and school environment
  – Compensation
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Other Recommendations

- Night lights
- Scuba Diving
- Swimming
- Sports
- Child play: learning to ride a bike, roller/ice skate

Summary

- Primary purpose of the vestibular “balance” center is to maintain steady vision during head movement
- If vestibular loss is suspected, vestibular testing can be completed

Summary

- If vestibular loss is diagnosed, appropriate therapy should be initiated
- Vestibular rehabilitation can improve both developmental milestone delay and visual acuity
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## References

- Cronin, GW, Rine, RM (2010). Pediatric vestibular disorders: Recognition, evaluation, and treatment. VEDA.

## References


## References

References


References


Kristen Janky
Boys Town National Research Hospital
555 North 30th Street
Omaha, Nebraska 68131
kristen.janky@boystown.org