Introduction

- Vision rehabilitation is a growing field in Acquired Brain Injury (ABI) rehabilitation
  - ABI is defined as any type of brain injury that occurs after birth
    - Ex: CVA, TBI, Neoplasms, aneurysms
    - Excludes neurodegenerative conditions
  - Visual disorders related to ABI are unique
  - Integration of optometrists in rehabilitation is important to assess and manage visual sequelae of ABI to improve outcomes

Optometric Care of the Patient with ABI, (AAO 2002, AOA, 2003)

- Treatment of visual dysfunction with lenses, prism, occlusion, low vision devices, and or VT
- Treatment of ocular disease or injury directly or by co-management with other health care professionals
- Counseling and education of patient, family or caregiver about visual problems, functional implications, goals, prognosis and management options
- Consultation with other professionals involved in the rehabilitation and health care of patient

Aren’t all acquired brain injury patients the same?

- Patients with CVA typically have poorer outcomes
  - Increased memory and visual memory deficits
  - Severe cognitive deficits
  - Typically referred later for rehabilitation
  - Slower progress
  - More likely to remain in residential care

Stroke

- 4th leading cause of mortality in US
- Leading cause of disability in US
  - Moderate to Severe disability for older adults
  - $18.8 Billion in medical and rehabilitative care
  - $15.5 Billion in lost productivity
    - Morbidity and Mortality Weekly, May 2012
- 20% reduction in years of potential life lost
  - Marin et al, 2011

CVA and Prevalence

- CVA most common >65 years of age (8.3%)
  - 0.7% 18-45 years old
  - 2.9% 45-64 years old
- 2.6% prevalence in the United States (2010)
  - Increased prevalence
    - Geographic location
    - Race/Ethnicity
    - Age
    - Gender

Morbidity and Mortality Weekly, May 2012
CVA and Children

- 6:100,000 children
  - 60% Male
- Hemorrhagic stroke >Ischemic Stroke
  - Increase in binocular vision issues
- Risk factors differ from adults
  - Increase in children with cardiovascular disorder
- Side effect of stroke similar to adults
  - Increase in Seizures and Cerebral Palsy
  - National Stroke Institute, cited 7/1/2013

Ischemic Stroke

- 80% of all stroke
- Atherosclerotic changes
  - Emboli
  - Thrombus
- Increase in cellular edema
  - Failure of ATP pumps leads to depolarization
- Symptoms
  - Location of affected vessel
  - Collateral Blood Flow
  - Middle Cerebral Artery
    - Hemianopsia
    - Contralateral Sensory/weakness
    - Neglect
  - Posterior Cerebral Artery
    - Memory Loss
    - Hallucinations
    - Ataxia
    - Altered Consciousness
    - Dyslexia
    - Sensory Loss
  - Frizzell 2005

Hemorrhagic Stroke

- 20% of all CVA
  - 50% mortality rate
- Ruptured Blood Vessels
  - Hypertension
  - Trauma
  - Vascular Malformation
  - Change in blood brain barrier: vasogenic edema
  - Leads to increased cranial pressure
- Symptoms
  - Related to site of injury
  - Severity of damage
  - Anterior Cerebral Artery
    - Contralateral weakness/sensory loss
  - Middle Cerebral Artery
  - Vertebral Artery
    - Lid Lag
    - Swallowing
    - Basilar
      - Double Vision
      - Paresis
      - Dizziness
      - Ataxia
  - Frizzell 2005

Pathophysiology

- Disruption of circulation to brain tissue
  - Acute
  - Chronic
- Cerebral Perfusion Pressure
  - MAP-ICP=CPP
  - <50 mmHg cell death occurs
- Two main mechanisms
  - Ischemic
  - Hemorrhagic

Frizzell
2005
Warren’s Hierarchal Model of Visual Processing

- Integration of different levels of visual skills within the matrix of visual processing
- Complex visual tasks require integration of basic visual skills to build a foundation
- Deficits of basic function impact complicated visual tasks – Zoltan, 2007

Approach to patient assessment

- Start with basic components of vision and increase complexity
  - Look for areas of deficiency
  - Build areas of visual complexity
    - Single word vs. Continuous text
    - Ordered vs. Disordered patterns
    - Listen for fluency
      - Note optotype size of most fluent reading for Rehab prof
    - Screen cognition and memory

Patient-centered success

- Cognition
- Learning capacity
- Awareness of potential
- Self-awareness of vision deficit
- Complexity of task

Case History

<table>
<thead>
<tr>
<th>Required Questioning</th>
<th>Expanded Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chief complaint</td>
<td>Functional Complaints</td>
</tr>
<tr>
<td>HPI</td>
<td>– Blur, diplopia, fatigue</td>
</tr>
<tr>
<td>Ocular History</td>
<td>– Performance of ADL’s</td>
</tr>
<tr>
<td>Family Ocular History</td>
<td>– Vocation/Previous Vocation</td>
</tr>
<tr>
<td>Medical History</td>
<td>– Previous hobbies and interests</td>
</tr>
<tr>
<td>Medications and Allergies</td>
<td>– Educational level</td>
</tr>
<tr>
<td>Family Medical History</td>
<td>– Support system</td>
</tr>
<tr>
<td>Patient Orientation</td>
<td>– Ongoing/previous Rehabilitation</td>
</tr>
</tbody>
</table>

Case History

<table>
<thead>
<tr>
<th>ABI related questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nature of injury</td>
</tr>
<tr>
<td>– Type</td>
</tr>
<tr>
<td>– Date</td>
</tr>
<tr>
<td>– Number of injuries/CVA</td>
</tr>
<tr>
<td>– Length of hospitalization</td>
</tr>
<tr>
<td>Rehabilitation History</td>
</tr>
<tr>
<td>– Inpatient and outpatient services</td>
</tr>
<tr>
<td>– Current and previous</td>
</tr>
<tr>
<td>– Current visual complaints</td>
</tr>
</tbody>
</table>

ABI, An Integrative Neuro-Rehabilitation Approach Elbaum and Benson
Observation

- Physical appearance
  - Clothing
  - Facial appearance
  - Visual attention
- Head turn or head tilt
- Mobility
- Motor weakness
- Support System

Communication Disorders

- Following brain injury, patients may experience several issues
  - Difficulty participating in conversation
  - Difficulty following changes in conversations
  - Inappropriate responses to questions or comments
  - Lack of self-awareness of inappropriate comments
  - Inability to detect sarcasm or humor
  - Elbaum & Benson, 2007
  - Zoltan, 2007

Communication Disorders

- Expressive Aphasia- Broca’s area (Area 22)
  - Inability to produce speech
- Receptive Aphasia- Wernicke’s Area (Area 44)
  - Inability to understand spoken word
  - Difficulty with speaking correct meaning
- Global Aphasia- Broca’s, Wernicke’s and Arcuate fasciculus
  - Combination of Expressive and Receptive
  - Limited vocabulary, if any

Cognitive Testing

- Cognitive Tests
  - MMSE
  - MOCA
- Test selection is important
  - Screening tests
  - Validity
  - What are you actually measuring?

Montreal Cognitive Assessment (MOCA)

<table>
<thead>
<tr>
<th>Item</th>
<th>Maximum Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orientation</td>
<td>5</td>
</tr>
<tr>
<td>What is the day, month, season, date, year? Where are we? i.e. State, place, country, office, floor</td>
<td>5</td>
</tr>
<tr>
<td>Registration</td>
<td>3</td>
</tr>
<tr>
<td>Name three objects and ask patient to repeat</td>
<td></td>
</tr>
<tr>
<td>Calculation and Attention</td>
<td>5</td>
</tr>
<tr>
<td>Serial Subtraction of 7 or spell a five letter word backwards (i.e. world)</td>
<td></td>
</tr>
<tr>
<td>Recall</td>
<td>3</td>
</tr>
<tr>
<td>Ask patient to repeat words from Registration</td>
<td></td>
</tr>
<tr>
<td>Language</td>
<td>2</td>
</tr>
<tr>
<td>Name a pencil and watch Repeat “no ifs, ands or buts”</td>
<td></td>
</tr>
<tr>
<td>Follow a three stage command Read and obey “close your eyes”</td>
<td>3</td>
</tr>
<tr>
<td>Write a Sentence</td>
<td>1</td>
</tr>
<tr>
<td>Copy a design of two intersecting pentagons</td>
<td>3</td>
</tr>
</tbody>
</table>
### MOCA for VI or Blind

[MOCA test image]

- [www.moca.org](http://www.moca.org)

### Visual Acuity

- Assess current visual potential
- Use measures to improve detail detection
  - Refraction
  - Magnification
- Method of acuity measurement should be determined by patient
- Communicate size of letter to rehabilitation professionals

### Visual Acuity Testing

- Letter or Number recognition
  - Line vs. isolated
- Shapes or figures
- Directed gaze
- Preferential Looking
- Fixate and follow
- Light perception
- No Light Perception

### Refraction

- Adjust lighting to comfortable level
- Trial Frame vs phoropter
  - Allows for head turn/tilt
  - Large lens jumps
  - Trial accessory lenses (yoked prism)
- Determine refractive error
  - Subjective measurements may fluctuate
  - Rely on objective measurements
  - Go slow

### Prescribing

- 88% of patients ABI patients correct to 20/20 (Sabates 1991)
- Consider mobility/field when prescribing
  - Bifocal vs. Single vision
- Increased sensitivity to small changes in prescription
  - Exacerbates visual stimulation, figure ground
  - Trial frame full prescription, add plus to comfort
  - Prescription may fluctuate
- Translate findings to patient, family and caregivers

### Entrance Testing

- Subjective or Objective
  - Pupils
    - Pupillary reaction time, APD
  - Pursuits and Saccades
  - Binocular Assessment
  - Color Vision
  - Contrast Sensitivity
  - Field Assessment
Binocular Vision

- Large area of discovery of CVA patients
- Rowe et al, 2011 Evaluated 323 patients
  - 68.4% had mobility or alignment deficit
  - 22% has strabismus
  - 32.7% convergence insufficiency
- Treatment options
  - Vision Therapy
  - Prism
  - Occlusion

Saccadic Dysfunction

- Hick’s Law: Time for decision to act or respond increases with number of choices presented
- Normal Saccadic function violates Hick’s law
  - Saccadic speed and accuracy does not increase with increasing levels of uncertainty (Keverga et al, 2002)
  - Saccades are initiated by interactions between cortex and subcortex

Saccadic Dysfunction

- Significance factor in field loss rehabilitation
- Hypometric saccades more common with Hemianopic loss
- Subjective visual difficulties highly correlated to saccadic dysfunction (Zihl)
  - Poor fixation
  - Scene scanning
  - Poor reading efficiency

Potential Rehabilitation Plan

- Home Therapy
- Large Saccades
  - Saccade between two known objects
  - Descriptive walking
  - Use post it notes in home environment
- Fine Saccades
  - Puzzles
  - Card games (Consider large print)
  - Word searches/cancellation
# Visual Field Assessment

- Requires visual and cognitive skills
  - Repeat testing throughout rehabilitation
- Confrontation Fields
  - Static and dynamic
  - Check for inattention, extinction
- Static Visual Field
  - Requires decent reaction time
  - Requires 5-10 minutes of attention
- Kinetic Visual Field
  - Alter speed and stimulus size based on patient
  - Movement of stimulus can cause dizziness

# Visual Field Loss

- Hemianopic field loss common amongst CVA
  - Visual Field loss, 49.5%
  - Complete Hemianopsia, 29.4%
  - Rowe et al, 2008
- Major impact on ADL’s
  - Mobility
  - Reading
  - Driving

# Visual fields

- Hemianopic Field loss
  - Quality of life reduced compared to controls
    - Chen et al, 2009
  - Strong correlation between entire remaining field and Score on NEI-VFQ (r=.67)
    - Lower correlation when measuring UFOV, (r= .36)
  - Quality of life reduced compared to ON conditions
  - Near Vision affected more than distance
  - Driving most affected
    - Gall et al, 2009, Investigative Ophthalmology and Vision Science

# Visual Field Rehabilitation

- Several options are available for field rehabilitation
  - Scanning
  - Prism
  - VRT
- Dynamic tasks may not respond to one type of therapy

# Scanning therapy

- Retrain head and eye movements
  - Can improve Field by 35 degrees (Koons et al, 2010) (ABI)
  - 30 degrees, Bouwmeester, Heutink and Lucas, 2006 (BD)
- Goal to develop organized, efficient scan patterns
- Improvements in reading speed, mobility
  - Bouwmeester et al 2006

# Scanning Therapy

- Rehabilitation Techniques
- Use near targets and progress to distance
  - Hart Chart, Quillman Exercises, word searches
  - Improves saccadic function, develops organized scanning
- Use distance targets and progress to near
  - Mobility
  - Descriptive Walking
Sloan Hemianopic Field Chart

Field Enhancement

- Mobility
  - Prism
  - Mirror system
  - Combination
- Near point tasks
  - High contrast borders
  - Tactile

Field Enhancement with Prism

- Refract light into preserved field
- 0.57 degrees of enhancement for every prism diopter
- Placement and fit of prism depends on patient
  - Binocular vision status
  - Presence of Neglect or Inattention
  - Scanning ability

Prism Assessment

- Prism
  - Aids in fusion
  - Field enhancement
  - Field relocation
- Patients are often referred to see if prism is of benefit
- Need to assess patient’s deficiencies before considering prism
  - Ie., saccades, cognition, binocular vision

Prism Placement

- Peli Prism Placement
  - Peripheral Diplopia
  - No image jump
  - Maintain Central Acuity
  - ~20 degrees of expansion
Prism Placement

- Sectoral Prism
  - Variable expansion
  - Image jump
  - Central Vision affected
    - Diplopia
    - Blur
    - Contrast loss

To Fresnel or not Fresnel...

To Fresnel
- >12 diopters
- Temporary treatment
- Cost
- Sectoral Placement
- Clarity and cosmesis are not important
- Weight is a factor
- Sutter

To not Fresnel
- Permanent prescription
- Low amount of prism
- Clarity and cosmesis is necessary
- Cost
- Prism is prescribed throughout the full field

Mirror system

- Reflection of light from hemianopic field to functional field
  - Can be angled, typically ~45 degrees
  - Opaque or semi opaque
- Opposite movement in mirror disorienting

Training with Field Enhancement Devices

- Field enhancement changes spatial awareness
  - Requires training
    - OT
    - O&M specialist
  - Handle device before application
  - Begin with static environment and objects
  - Progress to moving objects
  - Progress to dynamic environment

Field Enhancement Reading

- Enhance beginning and end of line
  - Use high contrast borders
    - Ruler
    - Post-it notes
    - Brightline Guides
    - Use hand/tactile to keep beginning of line
  - To follow printed material
    - Use straight edge to keep place
    - Use finger to keep place while reading
Cognitive Vision

• Utilize tests for 2nd and 3rd order visual processing
  – Know what you are looking for
  – Make sure test is valid**
  – Most pen and paper tests are screening tests
    • Demonstrates defects
    • One finding does not confirm diagnosis
    • Various scoring methods
    • Does not correlate to real space

Visual Spatial Defects

• Poor localization of objects
• Decreased depth perception
• Difficulty with orientation and travel
• Visual Neglect
  – One Hemifield
  – Both Hemifields (Balint’s Syndrome)

Cognitive Vision Testing

• Star Cancellation
  – Simple
  – Crowded
• Line Bisession
• Clock drawing
• Phone number
• Copy shape/drawing

Neglect rehabilitation

• Yoked Prism
  – Bilateral prism shifts image to match new visual midline
• Reminders
  – Post it notes
  – Leave list of directions
  – Separate paired items between normal field and field of neglect, ie toothbrush and tooth paste
• Auditory cues
  – Place small bells or shaker on bracelet on side of neglected field

Compensatory Techniques

• Magnification
  – Reduce effects of saccadic dysfunction
  – Fixation loss
• Contrast enhancement
  – Glare
  – Lighting
• Sight substitution
  – Auditory
  – Tactile

Magnification

• Magnification enlarges retinal image
  – Relative size magnification (RSM): Object is enlarged
    • Examples: Large print books, Large button phone
  – Relative distance magnification (RDM): Object is moved closer to eye
    • Sitting closer to television, moving book from 40 cm to 20 cm
  – Total Retinal Image Magnification: Product of all forms of Magnification presented
Benefit of Magnification

- Larger retinal image leads to larger ganglion receptive field
  - May absorb visual error from inaccurate saccades and fixation errors
    - Larger optotypes have been shown to increase fluency in patients with hyper- and hypo-metric saccades
    - Important to assess threshold with patient

Contrast Enhancement

- Glare
  - Discomfort Glare
  - Disability Glare
  - Filters
  - Fitover style vs. Spectacle treatments
    - Photochromatic
    - Wide Brim hat/visor
    - Typoscopes/acetate filters

Contrast Sensitivity

- Goal for rehabilitation improve contrast thresholds
- Interventions and modifications are designed to improve function
  - Improve detection and recognition by visual system
- Severe, profound contrast loss
  - Need multidisciplinary approach
  - OT, O&M, Rehabilitation Teachers
  - Brilliant, 1998

Organization

- Develop organization system with patient
  - Counsel family members
  - May need to train aspects of routine
- Reduce clutter in area of interest
  - Improve figure ground to allow visual attention for item of interest
  - Focus visual attention

Sight Substitution Strategies

- Utilize most efficient pathway for information
- Consider ways to reduce visual stress
  - Auditory
    - Talking watch/clock
    - Talking Caller ID
    - Talking books/news programs
  - Tactile
    - Bump dots
    - Velcro
Rehabilitation Team

- Referral source useful in relaying information
  - Response to rehabilitation
  - Prognostic indicators

- Communication is key
  - Visual rehabilitation
  - Activities and therapies by other specialists
  - Develop relationships

Rehabilitation Team

- Team approach is key
- Rehabilitation team
  - Occupational Therapist
  - Physical Therapist
  - Speech Therapist
  - Neuropsychologist
  - Neurologist/Neurosurgeon
  - Ancillary Therapy

Referrals and Communications

- Department of Human Services
  - Vocational and educational goals
  - Mobility training

- Department of Veteran Affairs
  - http://www.va.gov/BLINDREHAB/

- Scholastic Referrals
  - Vision teachers and O&M
  - College disability services

Conclusion

- Rehabilitation of stroke patients requires careful attention to visual symptoms
- Vision rehabilitation enhances ancillary rehabilitation treatments for stroke patients
- Early intervention with vision rehabilitation strategies improves outcomes

Questions?

- Thank you!
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