Neurocognitive Function: Are CPC Scores Enough?

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Presenter Disclosure Information

• Sue Sendelbach
• FINANCIAL DISCLOSURE:
  – None
• UNLABELED/UNAPPROVED USES DISCLOSURE:
  – None
Overview & Objectives

- Overview
  - Assessing neurocognitive function
  - History of CPC scores
  - Studies of cognitive function post cardiac arrest
  - Our approach to assessing and managing neurocognitive dysfunction

- Objectives
  1. Identify two limitations of the CPC scores;
  2. Describe a post hospital program focusing on neurocognitive rehabilitation.

Assessing Neurocognitive Function

- **Glasgow Outcome Scale**: A five-point scale –
  1. death
  2. persistent vegetative state
  3. severe disability
  4. moderate disability
  5. good recovery

Outcome after Resuscitation

- Quality of life


CPC and OPC Scores

<table>
<thead>
<tr>
<th>Cerebral Performance Categories</th>
<th>Overall Performance Categories</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPC 1. Good cerebral performance:</td>
<td>OPC 1. Good overall performance:</td>
</tr>
<tr>
<td>Conscious, alert, able to work, might have mild neurologic or psychologic deficit.</td>
<td>- Healthy, alert, capable of normal life, CPC 1.</td>
</tr>
<tr>
<td>CPC 2. Moderate cerebral disability:</td>
<td>OPC 2. Moderate overall disability:</td>
</tr>
<tr>
<td>Conscious, sufficient cerebral function for independent activities of daily life. Able to work in sheltered environment.</td>
<td>- Conscious (CPC 2), or moderate disability from non-cerebral systems dysfunction alone (CPC 1), or both.</td>
</tr>
<tr>
<td>- Performs independent activities of daily life, but is disabled for competitive work.</td>
<td></td>
</tr>
<tr>
<td>CPC 3. Severe cerebral disability:</td>
<td>OPC 3. Severe overall disability:</td>
</tr>
<tr>
<td>Conscious, dependent on others for daily support because of impaired brain function. Ranges from ambulatory state to severe dementia or paralysis.</td>
<td>- Conscious (CPC 3), or severe disability from non-cerebral systems dysfunction alone (CPC 1 or 2), or both.</td>
</tr>
<tr>
<td>- Dependent on others for daily support.</td>
<td></td>
</tr>
<tr>
<td>CPC 4. Coma or vegetative state:</td>
<td>OPC 4. Coma or vegetative state:</td>
</tr>
<tr>
<td>Any degree of coma without the presence of all brain death criteria. Unresponsive, even if appears awake (vegetative state) without interaction with environment, may have spontaneous eye opening and sleep-awake cycles. Cerebral unresponsiveness.</td>
<td>Same as CPC 4.</td>
</tr>
<tr>
<td>Apnea, areflexia, EEG silence, etc.</td>
<td></td>
</tr>
</tbody>
</table>
Are CPC Scores Enough?

• “Intellectual and cognitive deficits may be overlooked in a brief clinical interview, but may be revealed by formal psychometric testing.”¹

• “In addition to CPC And OPC, we should learn to evaluate loss in learning ability, memory, changes in emotional status, and maladjustment to society, using a variety of tests…”²


Limitations of CPC Scores

• Not well validated¹,²
• Assessed by chart review²
• Subjective²
• Not well defined²
• Very little discriminative ability

Studies of Therapeutic Hypothermia post Cardiac Arrest and Outcome Measure(s)

<table>
<thead>
<tr>
<th>Study</th>
<th>Outcome measure</th>
<th>Hypothermia</th>
<th>Normothermia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bernard et al. 1997</td>
<td>Glasgow Coma Scale</td>
<td>5% good outcome</td>
<td>5% good outcome</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5% severe disability</td>
<td>4% severe disability</td>
</tr>
<tr>
<td></td>
<td></td>
<td>45% mortality</td>
<td>77% mortality</td>
</tr>
<tr>
<td>Bernard et al. 2002</td>
<td>Hypothermia after Cardiac Arrest Study Group 2002</td>
<td>4% good outcome</td>
<td>2% good outcome</td>
</tr>
<tr>
<td></td>
<td>Pittsburgh Cerebral Performance Category (within 6 months)</td>
<td>55% good outcome</td>
<td>55% good outcome</td>
</tr>
<tr>
<td></td>
<td>Rehabilitation specialist evaluation for discharge location (good outcome = discharge to home or rehabilitation facility; Poor outcome = whether patient was conscious or unconscious)</td>
<td>5% severe disability</td>
<td>6% severe disability</td>
</tr>
<tr>
<td></td>
<td></td>
<td>45% mortality</td>
<td>68% mortality</td>
</tr>
<tr>
<td>Hypothermia after Cardiac Arrest Study Group 2002</td>
<td>Overall Performance Category</td>
<td>4% good outcome</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>45% mortality</td>
<td>68% mortality</td>
</tr>
<tr>
<td>Hachimi-Idrissi S et al. 2001</td>
<td>CPC at ICU discharge?</td>
<td>13% good outcome</td>
<td>13% good outcome</td>
</tr>
<tr>
<td></td>
<td>CPC at ICU discharge?</td>
<td>6% severe overall disability</td>
<td>6% severe overall disability</td>
</tr>
<tr>
<td></td>
<td>CPC at ICU discharge?</td>
<td>88% mortality</td>
<td>93% mortality</td>
</tr>
<tr>
<td>Yanagawa et al. 1998</td>
<td>CPC at hospital discharge?</td>
<td>25% complete recovery</td>
<td>8% normal/ minimal disability</td>
</tr>
<tr>
<td></td>
<td>CPC at hospital discharge?</td>
<td>6% severe disability</td>
<td>21% vegetative state</td>
</tr>
<tr>
<td></td>
<td>CPC at hospital discharge?</td>
<td>27% vegetative state</td>
<td>67% mortality</td>
</tr>
<tr>
<td>Zeiner et al. 2000</td>
<td>CPC at hospital discharge?</td>
<td>52% good outcome</td>
<td>8% normal/ minimal disability</td>
</tr>
<tr>
<td></td>
<td>CPC at hospital discharge?</td>
<td>7% bad outcome</td>
<td>23% vegetative state</td>
</tr>
<tr>
<td></td>
<td>CPC at hospital discharge?</td>
<td>41% mortality</td>
<td>67% mortality</td>
</tr>
</tbody>
</table>

CPC Scores: Are They Enough?

- **INTCAR (International Cardiac Arrest Registry)**
  - CPC
    - Best CPC during ICU stay?
    - CPC at ICU discharge?
    - CPC at hospital discharge?
Sequelae of Cerebral Anoxia

- Cardiac arrest
  - Global cerebral ischemia and hypoxic-ischemic injury
- Neuropsychological sequelae of hypoxic-ischemic injury
  - Disturbances of memory, including amnestic syndrome, variable executive deficits, changes of personality and behavior, visuospatial deficits, and impairment of expressive language


Executive Function

- Cognitive abilities necessary for complex goal-directed behavior and adaptation to a range of environmental changes and demands. It includes the ability to plan and anticipate outcomes (cognitive flexibility) and to direct attentional resources to meet the demands of nonroutine events.

Cognitive Impairment Post Cardiac Arrest without Therapeutic Hypothermia ($n=57$)

- Domains evaluated (6 months after resuscitation)
  - Immediate and delayed memory
  - Attention
  - Verbal fluency

- Evaluation tools
  - Rey’s Auditory Verbal Learning Test (AVLT)
  - Stroop Color Word Test
  - Trail Making A and B
  - Controlled oral word association

- Results
  - 11% to 28% of survivors were cognitively impaired
  - 58% scored unimpaired for all tests


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Cognitive Impairment Post Cardiac Arrest without Therapeutic Hypothermia ($n=45$)

- Domains evaluated
  - Orientation
  - Attention
  - Memory (Immediate recall)
  - Memory (Early recall)
  - Memory (Delayed recall)
  - Recognition
  - Reasoning

- Evaluation Tools
  - Neurobehavioral Cognitive Status Examination
  - Symbol Digit Modalities Test
  - Rey Auditory Verbal Learning Test
  - Memory Scan Test
  - Oral Word Association Test

- Timing of measurement (post arrest)
  - Time 1: Within 3 weeks of initial arrest
  - Time 2: 6 to 9 weeks
  - Time 3: 12 to 15 weeks
  - Time 4: 22 to 25 weeks

- Results
  - Time 1: Most frequent impairment was in delayed recall and the most severe deficit was in recognition
  - Time 2: Most common deficit was memory
  - Time 4: 50% of subjects had impairments in one or more memory outcome

Cognitive Impairment Post Cardiac Arrest without Therapeutic Hypothermia ($n=68$)

- **Domains evaluated (3 months and one year)**
  - Intellectual ability
  - Memory
  - Verbal
  - Visual perception
- **Evaluation tools**
  - Wechsler Adult Intelligence Scale (WAIS)
  - Wechsler Memory Scale
  - Word fluency, naming, comprehension of short sentence
  - Poppelreuter’s overlapping figures
- **Results**
  - 3 months: 60% of patients were found to have moderate to severe cognitive deficits
  - 12 months: 48% of 54 survivors still had moderate to severe deficits
  - Most common neuropsychological sequela was the impairment of delayed memory


Outcome with TH Post Cardiac Arrest

- **Neuropsychological outcomes 3 months post cardiac arrest**
  - Patients randomized into the Hypothermia After Cardiac Arrest trial and surviving at least 3 months
- **Domains evaluated**
  - Cognition
  - Learning and memory
  - Executive functioning
  - Verbal fluency
  - Speed of performance
- **Most common impaired cognitive domains:**
  - Executive functioning
  - Memory and learning

<table>
<thead>
<tr>
<th></th>
<th>Therapeutic hypothermia</th>
<th>Normothermia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognitively intact or very mild impairment</td>
<td>67%</td>
<td>44%</td>
</tr>
<tr>
<td>Severe deficits</td>
<td>15%</td>
<td>28%</td>
</tr>
</tbody>
</table>

Statement of Consensus on Assessment of Neurobehavioral Outcomes after Cardiac Surgery

• Selection of tests should take the following issues into consideration:
  – The cognitive domain of the test
  – The sensitivity and reliability of the test
  – The time taken to perform the test
  – The degree to which learning may occur in the test
  – The availability of parallel forms of the test
  – The physical effort required to perform the test
  – The overall balance of the cognitive domains assessed in the battery


• Performance on neuropsychologic tests can be influenced by mood state and mood state variations. Mood state assessments should be performed concurrently with the neuropsychologic assessments.

Approach to Identify Cognitive Dysfunction

- **Our challenge:**
  - Select array of tests with validity and reliability in this population
  - Acceptably easy to administer
  - Broad yet focused

- **Our reference model was a screening test**
  - Method that would find survivors with any cognitive dysfunction after Cool-it
  - Know method will over identify dysfunction
  - Recognize that not all dysfunction identified would be due to effects of hypothermia

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Testing Battery

<table>
<thead>
<tr>
<th>Test</th>
<th>Domain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mini-Cog</td>
<td>Mental Status, basic Visuoconstruction and Executive skills</td>
</tr>
<tr>
<td>(includes 3-word repetition, Clock Drawing, and word recall)</td>
<td></td>
</tr>
<tr>
<td>Rey Auditory Verbal Learning Test</td>
<td>Attention and Verbal Memory</td>
</tr>
<tr>
<td>Digit Span</td>
<td>Attention and Working Memory</td>
</tr>
<tr>
<td>Trails A and B</td>
<td>Attention, Processing Speed, Executive Functioning</td>
</tr>
<tr>
<td>Controlled Oral Word Association</td>
<td>Language and Executive Functioning</td>
</tr>
<tr>
<td>Symbol Digit Modalities Test</td>
<td>Attention, Psychomotor Speed</td>
</tr>
<tr>
<td>Grooved Pegboard</td>
<td>Psychomotor Speed and Coordination</td>
</tr>
</tbody>
</table>
### (31271) Hypothermia Post Therapeutic
### Phase III - Transfer

| Consult to hospitalist | Cool It/Hypothermia Patient  
| Staff to call consultant(s), add to treatment team, and update the order with date and time of call placed |
| Consult to Neuropsychology | Cool It/Hypothermia Patient  
| Staff to call consultant(s), add to treatment team, and update the order with date and time of call placed |
| Consult to Physical Medicine and Rehab | Cool It/Hypothermia Patient  
| Staff to call consultant(s), add to treatment team, and update the order with date and time of call placed |

### Phase 3 Transfer out of ICU

- **Phase 3 – Transfer out of the ICU to the progressive care unit**
  - New consults to include:
    - Physical Therapy
    - Occupational Therapy
    - Speech/Language Pathology
    - **Neuropsychology**
    - Physical Medicine and Rehab
    - Cardiac Rehab
Phase 4: Prep for Discharge

- Orders completed after discharge planning meeting
- 30 – 45 day follow up appointments with OT and neuropsychologist

- Family must be present at the time of discharge
- Discharged to acute rehabilitation
  - Cardiologist to follow
  - 2-4 day follow up phone call by home health coordinator
- Discharged to home
- Discharged to nursing home

Neurocognitive Function: Are CPC Scores Enough?

- Research considerations
  - Absence of control subjects – what is an appropriate control group
  - How to estimate the incidence of decline (e.g., 20% decline on 20% of tests?)
  - Unable to measure baseline neurocognition

Neurocognitive Function: Are CPC Scores Enough?

- Need to know the question you want answered
  - Clinical
  - Research
2008 Survivors