Let's Be Objective: Using Objective Measures and Vital Signs in Acute PT

Combined Sections Meeting 2018
New Orleans, LA, February 21-24, 2018
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Disclosures
• No relevant financial relationship exists for the content being presented today.

Learning Objectives
• Describe various rehabilitation objective measures used in acute care settings and their clinical usefulness
• Apply objective measures to clinical cases and synthesize test results
• Demonstrate knowledge of hemodynamic principles when mobilizing patients through interactive, case-based discussions
• Describe normal vs. abnormal hemodynamic responses to mobility and explain implications for rehabilitation

Course Outline
• Part 1
  – The case for objective measures
  – Objective measures useful in acute care
  – Case studies
• Part 2
  – Hemodynamic concepts
  – Relevance of Hemodynamics in acute care PT
  – Case studies
The Case for Objective Tests and Measures

- Objective Measures –
  - Establish a measurable baseline
  - Outcomes measurement to determine response to interventions
  - Meaningful goal setting (e.g., reduction in fall risk, improved endurance, improved gait speed to safely access the community)

Gait Speed

- Psychometric Properties
- Valid and reliable as a measure of walking ability, and is strongly related to balance.\(^1,2\)
- Predictive of health outcomes, SNF placement, mortality, poor QOL, falls\(^1,3\)
- Meaningful change – in general, \(\sim .10\) m/s for older adults\(^4\)

The Case (cont)

- Support discharge recommendations ("AMPAC is indicative of probable discharge to home")
- Provide a repeatable process to measure performance ("slow gait speed" vs. "patient ambulated .30 meters/sec")
- Some help predict rehabilitation prognosis (e.g., ICUAW vs. deconditioning weakness)
- May allow for rehabilitation research
What About Acute Care?

- Peel et al - Meta-analysis older adults mean age ≥ 70 yrs; acute care CGS = .46 m/s, FGS = .75 m/s
- Braden et al - 66 ill elderly (acute care setting) with broad range of dx, majority using a wh walker at discharge, mean gait speed was .31 meters/sec at eval and .38 meters/sec at discharge (either 10 meter walk test or 3 meter walk test used depending on ability)

Implications of Gait Speed

- Gait speed change of .10 m/s considered substantial in patients with abnormal gait speed
- < 0.4 m/s – household ambulation
- 0.4 – 0.8 – “limited” community ambulation
- >0.8 m/s – unlimited community ambulation
- Patients in the Braden et al study that did return home walking < 0.4 m/s were only household ambulators who had caregiver assistance and few or no steps

AMPAC 6 Clicks

- Psychometric Properties
- Valid and reliable as a measure of basic mobility function in the acute care setting
- Predictive of discharge setting after acute care (raw “cut-off” score of 17 or less predicts institutional discharge)

How Its Done

<table>
<thead>
<tr>
<th>Item</th>
<th>Scale</th>
<th>Older</th>
<th>Younger</th>
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<tbody>
<tr>
<td>1.</td>
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<td>6.</td>
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Jette 2014
Predicting Discharge Location

Berg Balance Scale

• Psychometric Properties
• Valid and reliable as a measure of balance (most studied in elderly, stroke and other neurological conditions). Normative values in community elderly have been established (above 50 for all age ranges)\textsuperscript{10}.
• Predictive of falls (“cut-off” score of 45 or less predicts risk of falls [90% specificity, but only 64% sensitivity])\textsuperscript{10,11}

Berg (cont)

• One study of 44 community-dwelling elderly combined Berg score with falls history - found that those who have more than 1 fall in the past 6 months and score ≤ 51 or who do not fall but score ≤ 42, correctly categorized fallers (Sensitivity) 91% of the time, and non-fallers (Specificity) 82% of the time.\textsuperscript{12}
• Meaningful change – MDC\textsubscript{95} = between 3 and 7 points\textsuperscript{11,13}

Dynamic Gait Index (DGI)

• Psychometric Properties\textsuperscript{14}:
  – Populations studied: older adults, CVA, PD, MS and vestibular deficits
  – Test-Retest reliability (ICC between .84 -.96) and inter-rater reliability are high
  – Concurrent validity moderate to high with TUG and 10 meter walk test
  – Sensitivity and specificity have been reported as 59% and 64%
  – Cut-off score for fallers vs. non-fallers varies by population, ranging from 19 to 23
  – MDC\textsubscript{95} = -3 points (community elderly with falls or near falls)
4-item DGI

- Marchetti and Whitney\textsuperscript{15} proposed a 4 item DGI to improve time efficiency
  - 4 items selected – horizontal/vertical head turns, gait on level surfaces, changes in gait speed
  - Cut off to identify fallers was reported at 9 or less (out of 12 total points)\textsuperscript{15,16}
  - Psychometric properties – less studied than original DGI, reliability and validity established in outpatient stroke population with a proposed MDC of 3 points\textsuperscript{17}

**Functional Status Score ICU (FSS ICU)**

- Psychometric properties:
  - Validated against other established measures of strength and function in critical care\textsuperscript{19}
  - Responsiveness – established and correlates to muscle strength improvements\textsuperscript{19}
  - Reliable - .99 ICC\textsuperscript{20}
  - MID estimated to be between 3-5 points\textsuperscript{19}
  - Predictive of discharge location when measured at time of ICU discharge ([median scores] 28 = home, 20 = IP Rehab, 9 = SNF)\textsuperscript{20}

**FSS ICU**

<table>
<thead>
<tr>
<th>Functional Status Score in the Intensive Care Unit (FSS ICU)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Therapeutic Activities</strong></td>
</tr>
<tr>
<td>- Rolling</td>
</tr>
<tr>
<td>- Supine to flat transfer</td>
</tr>
<tr>
<td>- Unassisted sitting</td>
</tr>
<tr>
<td>- Sit to stand transfer</td>
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<tr>
<td>- Ambulation</td>
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<tr>
<td>- Standing</td>
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<tr>
<td>- Gait</td>
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<tr>
<td>- Total assistance</td>
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<tr>
<td>- Minimal assistance</td>
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<tr>
<td>- Supervision</td>
</tr>
<tr>
<td>- Modified independence</td>
</tr>
<tr>
<td>- Complete independence</td>
</tr>
<tr>
<td><strong>Cumulative FSS ICU Score</strong></td>
</tr>
</tbody>
</table>

**MRC**

- Psychometric properties –
  - Valid and reliable [ICC of .96 for inter-tester reliability\textsuperscript{21}] in patients with central/peripheral nerve dysfunction and those with critical\textsuperscript{22}
  - Cut-off score of 48 (persists with serial measurement) identifies ICUAW\textsuperscript{23}
  - Cut-off of greater than or equal to 41.5 required to stand and complete the PFIT\textsuperscript{22}
MRC Scale

**Medical Research Council Scoring System**

<table>
<thead>
<tr>
<th>Strength of Muscle Groups</th>
<th>Strength Grades</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shoulder adduction</td>
<td>4—normal muscle strength/power</td>
</tr>
<tr>
<td>Blank flexor</td>
<td>3—active movement against gravity with resistance</td>
</tr>
<tr>
<td>Wrist extension</td>
<td>2—active movement against gravity</td>
</tr>
<tr>
<td>Hip flexion</td>
<td>2—active movement with gravity eliminated</td>
</tr>
<tr>
<td>Knee extension</td>
<td>1—Rigid/trace muscle contraction</td>
</tr>
<tr>
<td>Ankle dorsiflexion</td>
<td>0—no active muscle contraction</td>
</tr>
</tbody>
</table>

Nordon-Craft 2012

Handheld Dynamometer

- What it can tell you – weak grip accompanies decreased muscle mass and physical function, weak grip predicts mortality and longer hospitalization.
- Correlates to MRC score to detect ICUAW:
  - <11 kg for men, and <7 kg for women identifies ICUAW
  - These cut-off scores yielded 81% sensitivity and 83% specificity
- Valid and reliable (inter-rater and test-retest) as a measure of grip force

Hemodynamic Terms

- **Hemodynamics** is primarily about tissue perfusion (with oxygen)
- **Cardiac Output** – amount of blood pumped/min (Normal Value = 4 to 8 lpm at rest)
- **Heart Rate and Rhythm**
- **Stroke Volume (SV)**
- **Cardiac Output** (CO) - a function of HR and SV
- **Peripheral Vascular Resistance** (PVR)
- **Blood pressure** (BP) – a function of CO and PVR
- **Preload, Contractility and Afterload**

Formula That Changes Lives

\[
BP = CO \times PVR \div (HR \times SV)
\]
Factors Lowering HR

• Key point: the actual HR is less important than its impact on systemic perfusion

Heart Rhythm

• How would this heart rhythm affect hemodynamics?

Stroke Volume

• Amount of blood ejected from each ventricle with each heartbeat (normally 50 – 100 ml/beat)
• Ejection Fraction (normal is usually over 60%) = percentage of blood volume ejected from the ventricles with each heartbeat
• Preload - amount of stretch on the LV reflecting EDV
• Afterload - amount of resistance to ejection of blood from LV
• Contractility and venous return

Determinants of Preload

• Factors that increase preload:

• Factors that decrease preload:
Changing Position Impacts Hemodynamics

- How does a transfer to sitting (from supine) or standing (from sitting) affect preload?
- What should happen to BP when your patient transfers from supine to sitting? Sitting to standing?
- Why?

Physiology of the Reflex

- Baroreceptors are stretch receptors that send electrical impulses to the brain at a certain rate directly related to BP
- Increased or decreased BP results in changes to rate of baroreceptor signal firing
- Brainstem reacts with either a sympathetic (norepinephrine) or parasympathetic (increased vagal tone) effect on HR, contractility (SV), and vascular tone. 28,29

Gait Speed References


AM-PAC 6 Clicks References

Berg References


DGI References

• Marchetti GF, Whitney SL. Construction and validation of the 4-item dynamic gait index. Phys Ther. 2006;86(12):1651-60.

FSS-ICU References


MRC References

Dynamometry References


Hemodynamics References

- Aminoff's general neurology; 5th edition; Postural hypotension and syncope. 2014;Elsevier Ch 8 PP147-168.
- Cardiovascular and Pulmonary Physical Therapy; 4th Edition; Respiratory and Cardiovascular Drug Actions. 2006; Mosby Inc. Ch 45 PP792.