Pre- Cardiac intervention
Frailty assessment

Dr. Victor Sim
26th Sept 2014
Defining frailty

- **Lacks consensus** (Rockwood CMAJ 2005;173(5):489-95 Introduction)
  - Some consider symptoms, signs, diseases and disabilities as frailty deficits
  - Others consider frailty as separate syndrome from co-morbidity and disabilities, accepting some overlaps (Fried Journal of Gerontology 2001, Vol. 56A, No. 3, M146–M156)

Overlap of frailty and ADL disability and co-morbidity- Fried’s model

- Frailty strongly associated with a number of major diseases;
- Greater likelihood of frailty when 2 or more diseases were present.
- Frailty hypothesised to be causing disability

Fried J of Gerontology 2001; 56A: M146- 156
Defining frailty (1)


- An apparently small insult (eg, a new drug, minor infection, or minor surgery) results in a striking and disproportionate change in health state—ie, from independent to dependent, mobile to immobile, postural stability to proneness to falling, or lucid to delirious.
Suggested pathophysiology

Genetic factors → Epigenetic mechanisms ← Environmental factors

Cumulative molecular and cellular damage

Reduced physiological reserve
- Brain
- Endocrine
- Immune
- Skeletal muscle
- Cardiovascular
- Respiratory
- Renal

Physical activity → Nutritional factors

Frailty

Stressor event

Falls
Delirium
Fluctuating disability

Increased care needs
Admission to hospital
Admission to long-term care

Clegg Lancet vol 381, 2013, 752-762
Cardiac surgery and older people

- Increasing number of older people undergoing cardiac interventions for both conventional surgical treatments and noval interventions in the last two decades.

- The proportion of patients who undergo isolated CABG surgery decreases with increasing age, and the proportion of valve surgery or combined CABG and valve surgery increases; more than two-thirds of operations on patients over 85 are valve operations. Sixth National Adult Cardiac Surgical Database Report 2008
Aortic Valve Disease is Common in Elderly Patients

"Valvular heart diseases represent an underappreciated yet serious and growing public health problem that should be addressed."

- V.T. Nkomo, Mayo Clinic, Rochester, USA

As the chart illustrates, aortic valve disease is common and its prevalence increases with age. For people over the age of 75 years, the prevalence of aortic stenosis is 3%. More than one in eight people over the age of 75 have moderate or severe valve disease. As the population ages, this condition becomes an important public health problem.
Why additional risk assessment tools
Limitations of current Pre-Cardiac surgery assessment tools for older patients

- Many established risk scores, such as EuroSCORE or Society of Thoracic Surgeons (STS) score, insufficiently assess the risk of elderly co-morbid patients undergoing surgical cardiovascular procedures.

  Schoenenberger European Heart Journal (2013) 34, 684–69

- The global risk scores (EuroScore and STS) have been deemed suboptimal for the risk assessment of elderly patients with aortic stenosis.

Limitations of current Pre-Cardiac surgery assessment tools for older patients (1)

- **Ageing population, established tools**  
  Stortecky et al JACC Cardiovascular Intervention vol 5 No. 5 2012: 489-96

  - Validated for younger patients
  - Validated for cardiovascular diseases (CABG) rather than cardiovalvular diseases
  - Use medical diagnoses and co-morbidities as the main variables for scoring the perioperative risk. A factor not represented besides these medical features is the ‘biological status’ of the patient (frailty).
Cardiac risk scores: co-morbidity main variables

- Cumulative Illness Rating Scale (comorbidity) is a poorer predictor of mortality and institutionization than frailty score

Rockwood CMAJ 2005; 173(5): 489-495
How to assess frailty?
Validated Frailty assessment tools

- *Fried Frailty Phenotype

- *Rockwood Frailty Index (accumulation of deficits)
Fried’s five phenotype criteria

1. **Shrinking (weight loss):** Shrinking was defined through self-report as an unintentional weight loss of >10 pounds in the last year.

2. **Decreased grip strength (weakness):** Weakness was assessed by grip strength, and was measured directly with a hand-held JAMAR dynamometer (Sammons Preston Rolyan).

3. **Exhaustion:** Exhaustion was measured by responses to the following 2 statements from the modified 10-item Centre for Epidemiological Studies Depression

4. **Low activity:** Physical activities were ascertained for the 2 weeks before this assessment using the short version of the Minnesota Leisure Time Activities Questionnaire, and included frequency and duration.

5. **Slowed walking speed:** Slowness was measured by averaging 3 trials of walking 15 feet at a normal pace.

**Frailty ≥ 3; pre-frail 1-2.**
Appendix

Criteria Used to Define Frailty

- **Weight loss:** “In the last year, have you lost more than 10 pounds unintentionally (i.e., not due to dieting or exercise)?” If yes, then frail for weight loss criterion. At follow-up, weight loss was calculated as: (Weight in previous year – current measured weight)/(weight in previous year) = K. If K ≥ 0.05 and the subject does not report that he/she was trying to lose weight (i.e., unintentional weight loss of at least 5% of previous year’s body weight), then frail for weight loss = Yes.

- **Exhaustion:** Using the CES-D Depression Scale, the following two statements are read. (a) I felt that everything I did was an effort; (b) I could not get going. The question is asked “How often in the last week did you feel this way?” 0 = rarely or none of the time (<1 day), 1 = some or a little of the time (1–2 days), 2 = a moderate amount of the time (3–4 days), or 3 = most of the time. Subjects answering “2” or “3” to either of these questions are categorized as frail by the exhaustion criterion.

- **Physical Activity:** Based on the short version of the Minnesota Leisure Time Activity questionnaire, asking about walking, chores (moderately strenuous), mowing the lawn, raking, gardening, hiking, jogging, biking, exercise cycling, dancing, aerobics, bowling, golf, singles tennis, doubles tennis, racquetball, calisthenics, swimming. Kcals per week expended are calculated using standardized algorithm. This variable is stratified by gender. *Men:* Those with Kcals of physical activity per week <383 are frail. *Women:* Those with Kcals per week <270 are frail.

- **Walk Time,** stratified by gender and height (gender-specific cutoffs for medium height).
  
  **Men**
  - Height ≤ 173 cm
  - Height > 173 cm
  
  **Women**
  - Height ≤ 159 cm
  - Height > 159 cm

- **Grip Strength,** stratified by gender and body mass index (BMI) quartiles:
  
  **Men**
  - BMI ≤ 24
  - BMI 24.1–26
  - BMI 26.1–28
  - BMI > 28
  
  **Women**
  - BMI ≤ 23
  - BMI 23.1–26
  - BMI 26.1–29
  - BMI > 29

  Additional notes:
  - **Cutoff for Time to Walk 15 feet criterion for frailty**
    - ≥7 seconds
    - ≥6 seconds
  - **Cutoff for grip strength (Kg) criterion for frailty**
    - ≤29
    - ≤30
    - ≤30
    - ≤32
    - ≤17
    - ≤17.3
    - ≤18
    - ≤21
Fried’s hypothesis of signs/ symptoms and Frailty
List of variables used to construct Frailty Index
Accumulation of deficits

<table>
<thead>
<tr>
<th>Changes in everyday activities</th>
<th>Mood problems</th>
<th>Seizures, partial complex</th>
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<tbody>
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<td>Head and neck problems</td>
<td>Feeling sad, blue, depressed</td>
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<td>History of depressed mood</td>
<td>Syncope or blackouts</td>
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<td>Problems getting dressed</td>
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<td>Problems with bathing</td>
<td>Sleep changes</td>
<td>History of stroke</td>
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<tr>
<td>Problems carrying out personal grooming</td>
<td>Restlessness</td>
<td>History of diabetes mellitus</td>
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<td>Problems going out alone</td>
<td>History relevant to cognitive impairment or loss</td>
<td>Respiratory problems</td>
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<td>Impaired mobility</td>
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<td>Presence of the palommental reflex</td>
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<td>Falls</td>
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Frailty assessments: phenotype and Index

Fried Frailty Phenotype
- Core clinical presentation
- Quick, non specialist assessment
- No/ limited interventions
- Serve as “alert” to a possible adverse outcomes

Rockwood Frailty Index
- Accumulation of deficits
- Time consuming, CGA multi-discipline specialists required
- Very informative
- Useful tool to develop interventions
## List of variables used to construct Frailty Index
### Accumulation of deficits

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Rockwood Clinical Frailty Scale

- Simpler tool, highly correlated to the Frailty Index (time consuming complex tool)
The CSHA Clinical Frailty Scale (Rockwood) CMAJ 2005; 173(5): 489-493

1. Very fit — robust, active, energetic, well motivated and fit; these people commonly exercise regularly and are in the most fit group for their age

2. Well — without active disease, but less fit than people in category 1

3. Well, with treated comorbid disease — disease symptoms are well controlled compared with those in category 4

4. Apparently vulnerable — although not frankly dependent, these people commonly complain of being “slowed up” or have disease symptoms

5. Mildly frail — with limited dependence on others for instrumental activities of daily living

6. Moderately frail — help is needed with both instrumental and non-instrumental activities of daily living

7. Severely frail — completely dependent on others for the activities of daily living, or terminally ill
Very fit. (category 1)
People who are robust, active, energetic and motivated. These people commonly exercise regularly. They are among the fittest for their age.

Well. (category 2)
People who have no active disease symptoms but are less fit than category 1. Often, they exercise or are very active occasionally, e.g. seasonally.

Managing Well. (category 3)
People whose medical problems are well controlled, but are not regularly active beyond routine walking.

Vulnerable. (category 4)
While not dependent on others for daily help, often symptoms limit activities. A common complaint is being "slowed up," and/or being tired during the day.

Mildly frail. (category 5)
These people often have more evident slowing, and need help in high order IADLs (finances, transportation, heavy housework, medications). Typically, mild frailty progressively impairs shopping and walking outside alone, meal preparation and housework.

Moderately frail. (category 6)
People need help with all outside activities and with keeping house. Inside, they often have problems with stairs and need help with bathing and might need minimal assistance (cuing, standby) with dressing.

Severely frail. (category 7)
Completely dependent for personal care, from whatever cause (physical or cognitive). Even so, they seem stable and not at high risk of dying (within ~ 6 months).

Very Severely frail. (category 7)
Completely dependent, approaching the end of life. Typically, they could not recover even from a minor illness.

Terminally ill. (category 8)
Approaching the end of life. This category applies to people with a life expectancy <6 months, who are not otherwise evidently frail.
Rockwood Clinical Frailty Scale

- CFS highly correlated to the Frailty Index
- Each 1-Category increment associated with increased risk of death and institutional care
- CFS correlates:
  - Measures of cognition
  - Cumulative Illness Rating Scale (co-morbidity)
  - CSHA Function Score (disability)
  - CSHA rule-based frailty definition
  - *CFS stronger predictors than any of above
<table>
<thead>
<tr>
<th>Frailty domain</th>
<th>Item</th>
<th>0 point</th>
<th>1 point</th>
<th>2 points</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cognition</strong></td>
<td>Please imagine that this pre-drawn circle is a clock. I would like you to place the numbers in the correct positions then place the hands to indicate a time of ‘ten after eleven’</td>
<td>No errors</td>
<td>Minor spacing errors</td>
<td>Other errors</td>
</tr>
<tr>
<td><strong>General health status</strong></td>
<td>In the past year, how many times have you been admitted to a hospital?</td>
<td>0</td>
<td>1–2</td>
<td>≥2</td>
</tr>
<tr>
<td></td>
<td>In general, how would you describe your health?</td>
<td>‘Excellent’, ‘Very good’, ‘Good’</td>
<td>‘Fair’</td>
<td>‘Poor’</td>
</tr>
<tr>
<td><strong>Functional independence</strong></td>
<td>With how many of the following activities do you require help? (meal preparation, shopping, transportation, telephone, housekeeping, laundry, managing money, taking medications)</td>
<td>0–1</td>
<td>2–4</td>
<td>5–8</td>
</tr>
<tr>
<td><strong>Social support</strong></td>
<td>When you need help, can you count on someone who is willing and able to meet your needs?</td>
<td>Always</td>
<td>Sometimes</td>
<td>Never</td>
</tr>
<tr>
<td><strong>Medication use</strong></td>
<td>Do you use five or more different prescription medications on a regular basis?</td>
<td>No</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>At times, do you forget to take your prescription medications?</td>
<td>No</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td><strong>Nutrition</strong></td>
<td>Have you recently lost weight such that your clothing has become looser?</td>
<td>No</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td><strong>Mood</strong></td>
<td>Do you often feel sad or depressed?</td>
<td>No</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td><strong>Continence</strong></td>
<td>Do you have a problem with losing control of urine when you don’t want to?</td>
<td>No</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td><strong>Functional performance</strong></td>
<td>I would like you to sit in this chair with your back and arms resting. Then, when I say ‘GO’, please stand up and walk at a safe and comfortable pace to the mark on the floor (approximately 3 m away), return to the chair and sit down</td>
<td>0–10 s</td>
<td>11–20 s</td>
<td>One of &gt;20 s patient unwilling, or requires assistance</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td>Final score is the sum of column totals</td>
<td></td>
<td></td>
<td></td>
</tr>
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</table>
The purposes of frailty assessment

- To aid risk stratification in addition to conventional assessment
- To identify the frailty deficits (by CGA) and modified the deficits before surgery (also post-surgical care could be planned), to improve clinical outcomes.
- To evaluate if the cardiac intervention can improve frailty
Frailty assessment tools for Cardiac surgery

- Fried’s criteria
- Rookwood Frailty Index
- Rookwood Clinical Frailty Scale (deficit scale)
Recent published “best papers”

Sundermann et al 2011- Cardiac surgery

- Comprehensive assessment of frailty (CAF)
  - Tools
    - Gait speed, weakness, handgrip, exhaustion, low activity
    - IADL, tandem balance testing, chair rise ×3, pick up object
    - Serum albumin, creatinine, BNP, FEV1,
    - Clinical frailty scale
  - Results
    - CAF correlated with EuroScore and STS
    - CAF predicts outcome but not no better than EuroScore/STS
    - Complex measurement

- *FORECAST*
  - Tools
    - chair rise ×3, subjective reported weakness, stair climb, clinical frailty scale, serum creatinine
  - Results
    - Simpler
    - FORECAST AUC better than EuroScore and STS (0.76 vs 0.67 and 0.67) for 1-year mortality
Afilalo 2010/2012 - cardiac surgery

*Gait speed
- No correlation between gait speed and STS
- Slow gait conferred 2-3X increase for any levels of STS predicted mortality

*Frailty and Disability Scores
- Frailty
  - (1) CHS scale: gait speed, handgrip, inactivity, exhaustion, weight loss;
  - (2) CHS scale with cognitive impairment and depression;
  - (3) gait speed, handgrip, inactivity, cognitive impairment;
  - (4) gait speed alone
- Disability
  - (1) Katz ADL scale, (2) IADL, (3) Nagi scale:

Results
- Frailty and disability scores increase risk predictions above Cardiac risk score (EuroScore, STS, Parsonnet)
- Most predictive: 5-meter gait speed and >3 impairment on Nagi scale
Lee 2010- cardiac surgery

- Frailty defined as any impairment in
  - ADL
  - Ambulation
  - Diagnosis of dementia

- Results
  - Predicts mortality and institutional discharge
  - Do not compare with conventional cardiac risk scores
De Arenaza AS and AVR 2010

- 6MWT prior AVR

- *6MWT provide further risk stratification above EuroScore
TAVI:

- **Stortecky 2011**
  - Frailty index based on: MMSE, MNA, TUG, BADL, IADL preclinical mobility disability
  - Predict adverse outcomes
  - Frailty vased risk scores with mortality and MACCE were independent of global risk scores, suggesting additional risk prediction

- **Schoenenberger 2013**
  - Frailty index based on: MMSE, mobility (TUG), nutrition (MNA), instrumental and basic ADL, pre-clinical mobility disability
  - Results:
    - EuroSCORE and STS did not predict functional decline.
    - Frailty index strongly predicted functional decline
    - Overall predictive performance was best for frailty index and low for EuroSCORE and STS score

- **Green 2012**
  - Frailty score: low albumin, slow gait speed, weak handgrip strength, IADLs and ADL
  - Frailty assessment does not add significant additional risk stratification
Frailty Index

- 2 points were assigned, if MMSE was $\leq 21$ points; 1 point was assigned for each of the following: MMSE $\geq 21$ and $<27$ points,
- TUG $\geq 20$ s,
- MNA $<12$ points,
- BADL $\geq 1$ limited activity,
- IADL $\geq 1$ limited activity,
- Pre-clinical mobility disability (defined as decreased frequency of walking 200 m and/or of climbing stairs during the preceding 6 months).
- Frailty Index: $\geq 3$ points (frail) vs. $<3$ points (non-frail).
Tools to assess frailty used in these papers

- Fried CHS scales: gait speed, handgrip, inactivity, exhaustion, weight loss
- Rockwood Clinical Frailty Scale (CFS)
- Cognitive assessment/ depression assessment
- Disability assessment: ADL, IADL, Nagi
- *(MMSE, MNA, TUG, BADL, IADL) +/- pre-clinical mobility
- *6MWT/ *gait speed
- Blood- albumin, BNP, creatinine
- Comprehensive assessment of frailty (CAF)= Fried + CFS + disability + balance + blood
- *Frailty (Fried’s) + cognition + disability (gait speed and Nagi disability most predictive)
- *FORECAST- chair rise, weakness, stair climb, CFS and creatinine
- *= increase risk predictions above cardiac risk scores
Recent published “best papers”

- All show pre-operative frailty assessment correlates with adverse outcomes in elderly patients undergoing cardiac surgery.

- Four studies found that the addition of frailty increased the predictive power of conventional risk scores, but this requires further validation.
- Cognitive impairment
- Slow gait
- Poor ambulation
- ADL
Singh et al Clinical Update EHJ 2014: 35; 1726-1731

- Fried criteria
- Rockwood Clinical frailty scale- global clinical assessment
- Gait speed
- Rockwood deficit index
Wales proposed frailty measurements for Cardiology 2014

- Gait speed- 10 meters walk (>6 s) (Fried’s)
- MMSE (<27) (Schoenenberger et al 2013)
- Lawton IADL (1 deficit) 10-15 mins (Schoenenberger et al 2013)
- Time get up and go (TUG) (>20 s/ 6 m) (Schoenenberger et al 2013)
- Mini Nutritional Assessment- simplified version (MNA) (Schoenenberger et al 2013)
- Hand grip strength (Fried’s)
Wales proposed frailty measurements for Cardiology 2014

- Probably work for risk stratification!
- But:
  - New combination- not validated
  - No defined scores/thresholds for frailty (Schoenenberger scores quoted)
  - Gait speed/ TUG- similar assessment?
  - MMSE <27 not sensitive enough to detect cognitive impairment. MMSE not available
  - Possible> 30mins
Wales proposed frailty measurements for Cardiology 2014- Suggestion (1):

- Gait speed- 10 meters walk (>6 s) (Fried’s)
- MMSE (<27) (Schoenenberger et al 2013)- MOCA<25
- Lawton IADL (1 deficit) 10-15 mins (Schoenenberger et al 2013)
- Time get up and go (TUG) (>20 s/ 6 m) (Schoenenberger et al 2013)
- Mini Nutritional Assessment- simplified version (MNA) (Schoenenberger et al 2013)
- Hand grip strength (Fried’s)

**Define cut-off frailty score**
Wales proposed frailty measurements for Cardiology 2014- Suggestion (2):

- Gait speed- 10 meters walk (>6 s) (Fried’s)- use only one
- MMSE (<27) (Schoenenberger et al 2013)- Use MOCA< 25
- Lawton IADL (1 deficit) 10-15 mins (Schoenenberger et al 2013)
- Time get up and go (TUG) (>20 s/ 6 m) (Schoenenberger et al 2013)
- Mini Nutritional Assessment- simplified version (MNA) (Schoenenberger et al 2013)
- Hand grip strength (Fried’s)

**Still have to define frailty cut-off score**
Wales proposed frailty measurements for Cardiology 2014- Suggestion (3):

- Use Schoenenberger et al 2013 criteria:
  - 2 points were assigned, if MMSE was < 21 points; 1 point was assigned for each of the following: MMSE ≥ 21 and < 27 points,
  - TUG ≥ 20 s,
  - MNA < 12 points,
  - BADL ≥ 1 limited activity,
  - IADL ≥ 1 limited activity,
  - Pre-clinical mobility disability (defined as decreased frequency of walking 200 m and/or of climbing stairs during the preceding 6 months).
  - Frailty Index: ≥3 points (frail) vs. <3 points (non-frail).
Other suggestions

- **Combination:**
  - Fried’s criteria ($\geq 3$)
  - Clinical Frailty Scale (Rookwood) (moderately frail category)
  - MOCA$<25$
  - Frailty defined as any of above
Other suggestions (1)

- Combination:
  - Clinical Frailty Scale (Rookwood)
  - MOCA<25
  - Selected Fried criteria: Hand grip and gait speed
Frailty scores- help or hindrance?

- Concerns for inappropriate use of frailty scores:
  - "Excuses" used not to provide appropriate cardiac interventions to frail older people (therefore important to address whether the intervention will improve frailty)
  - Referral to Geriatricians may form another barrier and delay to cardiac intervention (therefore Geriatricians should be part of the multi-disciplinary team to encourage joined up working)
Frailty assessment: The way forward

- An user friendly, quick but sensitive Frailty score to alert about a potential problem
- In selected patients, a detailed complex Frailty Index (Rockwood) via CGA should be carried out to identify deficits and develop interventions before and after surgery
- Then, the frailty assessment process is able to:
  - Aid risk stratification in addition to conventional assessment for decision for intervention
  - Optimise patients before surgery by addressing their frailty deficits and to plan post-surgery care
  - Evaluate if the cardiac intervention can improve frailty
Research collaboration between Cardiology and Clinical Gerontology in Cardiff

- Research questions for patients undergoing TAVI or AVR:
  - Identify the “best” frailty tools- to alert a potential problem
  - Construct comprehensive complex Frailty Index via CGA
  - Identify the high risk patient via Frailty Index assessment (CGA)
    - Identify areas of deficits and develop intervention before surgery
    - Plan post surgery care
    - Improve clinical outcomes
  - Evaluate the role of Geriatrician in the TAVI Heart Team? How to develop a “joined up” service between Cardiologists and Geriatricians?

- Clinical Research Fellow- 2 years project leading to MD- see all patients undergoing TAVI or surgical AVR
Other sub groups which may benefit from CGA

- Parkinson Disease
- Stroke with disability
- Low MOCA < 25
Thank You