Operative Risk Stratification in Older Adults

The cardiac and skeletal muscles tell the story

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Division of Cardiology & Centre for Clinical Epidemiology, Jewish General Hospital

Johns Hopkins Anesthesiology & Critical Care Grand Rounds
March 5, 2020
Disclosure

• No COI
Mr. R

• 90 year old male
• Admitted Nov 17\textsuperscript{th} with syncope
• Medical issues:
  • Severe AS
  • CAD (PCI 2013)
  • Hypertension
  • Dyslipidemia
  • BPH
  • GERD
Mr. H

• 80 year old male
• Admitted Nov 16th with ADHF
• Medical issues:
  • Severe AS
  • CAD
Mr. G

- 94 year old male
- Admitted Nov 16th with NSTEMI
- Medical issues:
  - Severe AS
  - Pacemaker Nov 7th
  - HF-PEF
  - Hypertension
  - Dyslipidemia
  - Diverticular bleed 2014
  - Anxiety
<table>
<thead>
<tr>
<th>AV Disease Etiology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Select a value</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Incidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>First cardiovascular surgery</td>
</tr>
<tr>
<td>First re-op cardiovascular surgery</td>
</tr>
<tr>
<td>Second re-op cardiovascular surgery</td>
</tr>
<tr>
<td>Third re-op cardiovascular surgery</td>
</tr>
<tr>
<td>Fourth or more re-op cardiovascular surgery</td>
</tr>
<tr>
<td>NA - Not a cardiovascular surgery</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elective</td>
</tr>
<tr>
<td>Urgent</td>
</tr>
<tr>
<td>Emergent</td>
</tr>
<tr>
<td>Emergent Salvage</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IABP Insertion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preop</td>
</tr>
<tr>
<td>Intraop</td>
</tr>
<tr>
<td>Postop</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Catheter Based Assist Device Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preop</td>
</tr>
<tr>
<td>Intraop</td>
</tr>
<tr>
<td>Postop</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ECMO</th>
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</thead>
<tbody>
<tr>
<td>Preop</td>
</tr>
<tr>
<td>Intraop</td>
</tr>
<tr>
<td>Postop</td>
</tr>
<tr>
<td>Non-operative</td>
</tr>
</tbody>
</table>
STS Predicted Risks

- Risk of Mortality: 6.3%
- Morbidity or Mortality: 25.3%
- Long Length of Stay: 12.1%
- Short Length of Stay: 18.1%
- Permanent Stroke: 2.6%
- Prolonged Ventilation: 15.5%
- DSW Infection: 0.3%
- Renal Failure: 6.4%
- Reoperation: 11.4%

STS Predicted Risks

- Risk of Mortality: 7.1%
- Morbidity or Mortality: 36.5%
- Long Length of Stay: 16.1%
- Short Length of Stay: 17.7%
- Permanent Stroke: 1.8%
- Prolonged Ventilation: 24.2%
- DSW Infection: 0.3%
- Renal Failure: 13.0%
- Reoperation: 14.4%

STS Predicted Risks

- Risk of Mortality: 6.0%
- Morbidity or Mortality: 29.7%
- Long Length of Stay: 16.4%
- Short Length of Stay: 12.9%
- Permanent Stroke: 2.4%
- Prolonged Ventilation: 17.8%
- DSW Infection: 0.2%
- Renal Failure: 9.8%
- Reoperation: 10.4%
The Weatherman’s AUC

Swets JA. Science 1988
age
sex
cardiac disease
comorbidities
sarcopenia
malnutrition
cognitive impairment
sensory impairment
depression
anxiety
social isolation
cardiac fibrosis
subclinical organ damage
endocrine dysregulation
immunosenescence
inflamm-aging
The *cardiac* muscle tells the story
Echo Report
• LV EF: 33%
• LV diastology: Grade I
• LV size: Dilated
• LV mass: Top-Normal
• RV FAC: 40%
• RV MPI: 0.50
• RV size: Normal
• PASP: 44 mmHg
• Aortic MG: 38 mmHg
• MR: Mild-Moderate

Echo Report
• LV EF: 55%
• LV diastology: Grade III
• LV size: Normal
• LV mass: Increased
• RV FAC: 25%
• RV MPI: 0.90
• RV size: Normal
• PASP: 70 mmHg
• Aortic MG: 50 mmHg
• MR: Moderate

Echo Report
• LV EF: 75%
• LV diastology: Grade II
• LV size: Small
• LV mass: Normal
• RV FAC: 40%
• RV MPI: 0.70
• RV size: Normal
• PASP: 50 mmHg
• Aortic MG: 30 mmHg
• MR: Mild
213 SAVR, 219 SAVR+CABG
73.5 years of age
39% females
5.3% STS-PROM
2 years f/u (IQR 1–3)
88 in-hospital M&M
45 total deaths

---

**Risk Prediction in Aortic Valve Replacement: Value of the Preoperative Echocardiogram**
Tan T, Afilalo J, et al. JAHA 2015
667 CABG (derivation cohort)
187 CABG (validation cohort)
67.2 years of age
23% females
3.2 years f/u (IQR 2.5–3.9)
104 in-hospital M&M
73 total deaths
Lessons Learned: Echo Risk Markers

- LV restrictive filling
- LV hypertrophy
- LV small cavity
- MR ≥moderate
- RV dysfunction (FAC, MPI)
- PASP elevation
- RA dilation
- LVEF
Echo Report

- **LV EF:** 33%
- **LV diastology:** Grade I
- **LV size:** Dilated
- **LV mass:** Top-Normal
- **RV FAC:** 40%
- **RV MPI:** 0.50
- **RV size:** Normal
- **PASP:** 44 mmHg
- **Aortic MG:** 38 mmHg
- **MR:** Mild-Moderate

---

Echo Report

- **LV EF:** 55%
- **LV diastology:** Grade III
- **LV size:** Normal
- **LV mass:** Increased
- **RV FAC:** 25%
- **RV MPI:** 0.90
- **RV size:** Normal
- **PASP:** 70 mmHg
- **Aortic MG:** 50 mmHg
- **MR:** Moderate

---

Echo Report

- **LV EF:** 75%
- **LV diastology:** Grade II
- **LV size:** Small
- **LV mass:** Normal
- **RV FAC:** 40%
- **RV MPI:** 0.70
- **RV size:** Normal
- **PASP:** 50 mmHg
- **Aortic MG:** 30 mmHg
- **MR:** Mild
Diastolic Dysfunction
Grading by echocardiography

• Prospective 5-center study

• 450 (diverse) patients referred for clinically-indicated cath
  • Included AF, PPM, LBBB, MR, REF/PEF
  • Excluded transplants & complex congenitals

• Echo during or immediately after cath

• Cath standard for LAP: PCWP or LVEDP

• New echo algorithm for ↑LAP >12 mmHg → sensitivity 87%, specificity 88%

Andersen OS. JACC 2017
Diastolic Dysfunction

Restrictive = Nonviable

Yong Y. Circulation 2001
Diastolic Dysfunction
Mechanistic insights from CMR

$r = 0.75$, $p < 0.01$

$y = -0.0363 + 0.2121 \times x$
What is ECV?

- ECV = extracellular volume
- Measured noninvasively by CMR with gadolinium “ECV fraction” without gadolinium “T1 map”
- Surrogate marker of interstitial fibrosis, infiltration, or edema
- Potentially reversible

Miller CA. Circulation 2013
ECV and Mortality Post-AVR

B

All-Cause Mortality, %

0 10 20 30 40 50 60 70 80 90 100

Time to Event, Years

Log-rank test
p = 0.009

Tertile 1

Tertile 2

Tertile 3

Number at risk:

- n = 147
- n = 135
- n = 126
- n = 109
- n = 55
- n = 19
- n = 2

- n = 146
- n = 131
- n = 123
- n = 113
- n = 74
- n = 27
- n = 3

- n = 147
- n = 121
- n = 113
- n = 98
- n = 67
- n = 27
- n = 4

C

Decreased Risk of All-Cause Mortality

Increased Risk of All-Cause Mortality

ECV% (per %)

Age (per year)

Male sex

LVEF <50%

LGE

Hazard Ratio (95% Confidence Interval)
### Stages/Criteria

<table>
<thead>
<tr>
<th>Stages/Criteria</th>
<th>Stage 0</th>
<th>Stage 1</th>
<th>Stage 2</th>
<th>Stage 3</th>
<th>Stage 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Cardiac Damage</td>
<td>LV Damage</td>
<td>LA or Mitral Damage</td>
<td>Pulmonary Vasculature or Tricuspid Damage</td>
<td>RV Damage</td>
<td></td>
</tr>
<tr>
<td>Echocardiogram</td>
<td>Increased LV Mass Index &gt;115 g/m² (Male) &gt;95 g/m² (Female)</td>
<td>Indexed left atrial volume &gt;34mL/m²</td>
<td>Systolic Pulmonary hypertension ≥50 mmHg</td>
<td>Moderate-Severe right ventricular dysfunction</td>
<td></td>
</tr>
<tr>
<td></td>
<td>E/e' &gt;14</td>
<td>Moderate-Severe mitral regurgitation</td>
<td>Moderate-Severe tricuspid regurgitation</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LV Ejection Fraction &lt;50%</td>
<td>Atrial Fibrillation</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Genereux P. Eur Heart J 2017
The *skeletal* muscle tells the story
### Table 1. Operationalizing a Phenotype of Frailty

<table>
<thead>
<tr>
<th>A. Characteristics of Frailty</th>
<th>B. Cardiovascular Health Study Measure*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shrinking: Weight loss</td>
<td>Baseline: 10 lbs lost unintentionally in prior year</td>
</tr>
<tr>
<td>(unintentional)</td>
<td></td>
</tr>
<tr>
<td>Sarcopenia (loss of muscle mass)</td>
<td></td>
</tr>
</tbody>
</table>

(a) SARC-F

<table>
<thead>
<tr>
<th>Component</th>
<th>Question</th>
<th>Scoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strength</td>
<td>How much difficulty do you have in lifting and carrying 10 lb?</td>
<td>None=0, Some=1, A lot or unable=2</td>
</tr>
<tr>
<td>Assistance in walking</td>
<td>How much difficulty do you have walking across a room?</td>
<td>None=0, Some=1, A lot or use aids, or unable=2</td>
</tr>
<tr>
<td>Rise from a chair</td>
<td>How much difficulty do you have transferring from a chair or bed?</td>
<td>None=0, Some=1, A lot or unable without help=2</td>
</tr>
<tr>
<td>Climb stairs</td>
<td>How much difficulty do you have climbing a flight of 10 stairs?</td>
<td>None=0, Some=1, A lot or unable=2</td>
</tr>
<tr>
<td>Falls</td>
<td>How many times have you fallen in the past year?</td>
<td>1–3 falls=1, ≥4 falls=2</td>
</tr>
</tbody>
</table>
CoreSlicer: a web toolkit for analytic morphomics

Louis Mullie1,2 and Jonathan Aflalo1,2,3*

Abstract

Background: Analytic morphomics, or more simply, “morphomics,” refers to the measurement of specific biomarkers of body composition from medical imaging, most commonly computed tomography (CT) images. An emerging body of literature supports the use of morphomic markers measured on single-slice CT images for risk prediction in a range of clinical populations. However, uptake by healthcare providers has been limited due to the lack of clinician-friendly software to facilitate measurements. The objectives of this study were to describe the interface and functionality of CoreSlicer—a free and open-source web-based interface—aiming to facilitate measurement of analytic morphomics by clinicians and to validate muscle and fat measurements performed in CoreSlicer against reference software.

Results: Measurements of muscle and fat obtained in CoreSlicer showed high agreement with established reference software. CoreSlicer features a full set of DICOM viewing tools and extensible plugin interface to facilitate rapid prototyping and validation of new morphomic markers by researchers. We present published studies illustrating the use of CoreSlicer by clinicians with no prior knowledge of medical image segmentation techniques and no formal training in radiology, where CoreSlicer was successfully used to predict operative risk in three distinct populations of cardiovascular patients.

Conclusions: CoreSlicer enables extraction of morphomic markers from CT images by non-technically skilled clinicians. Measurements were reproducible and accurate in relation to reference software.

Keywords: Analytic morphomics, Morphometric analysis, Body composition analysis, Planimetric measurements, Medical image segmentation, Computed tomography, Obesity, Sarcopenia

✓ WebApp
✓ Open source
✓ Anonymized
✓ Cornerstone library
✓ WebGL
✓ WebWorkers
✓ WebCanvas
✓ Pseudo-polar projection
Drag & drop DICOM folder or files to get started

or Select manually

Go to old version (v1.0)
Psoas muscle area:

- 27.0 cm²
- 16.1 cm²
- 18.5 cm²
Psoas Muscle Area and All-Cause Mortality After Transcatheter Aortic Valve Replacement: The Montreal-Munich Study

Samuel Mamane, MD,⁎⁎ Louis Mullie, MD,⁎⁎ Nicolo Piazza, MD, PhD,⁎⁎ Giuseppe Martucci, MD,⁎⁎ José Morais, MD,⁎⁎ Antonio Vigano, MD,⁎ Mark Levental, MD,⁎ Kristoff Nelson, MD,⁎ Ruediger Lange, MD,⁎ and Jonathan Afilalo, MD, MSc⁎⁎,⁎⁎,⁎

Psoas Muscle Area and Length of Stay in Older Adults Undergoing Cardiac Operations

Jesse Zuckerman, BS, Matthew Ades, BS, Louis Mullie, MD, Amanda Trnkus, MS, Jean-Francois Morin, MD, Yves Langlois, MD, Felix Ma, MD, Mark Levental, MD, José A. Morais, MD, and Jonathan Afilalo, MD, MS
**Psoas Muscle Area Predicts All-Cause Mortality & Major Morbidity After Cardiac Transplantation**
Lior Bibas, Eli Saleh, Samah Al-Kharji, Jessica Chetrit, Louis Mullie, Marcelo Cantarovich, Renzo Cecere, Nadia Giannetti, Jonathan Afilalo

**Psoas Muscle Area Predicts All-Cause Mortality After Endovascular & Open Aortic Aneurysm Repair**
Laura Drudi, Kim Phung, Matthew Ades, Jesse Zuckerman, Louis Mullie, Oren Steinmetz, Daniel O’Brand, Jonathan Afilalo
CoreSlicer AI

Some other Results:

Dicom

Mask _Original

Predicted mask on Dicom

Mask _Predicted
dice score = 0.9284

Acknowledgement: Zara Vajihi 2019
Frailty Constructs

Sarcopenia Phenotype

Deficit Accumulation
Frailty Constructs

Frailty Phenotype = ≥3 Points
5 Points

Frailty Index = # Deficits Present
# Deficits Counted

Appendix 1: List of variables used by the Canadian Study of Health and Aging to construct the 70-item CSA Frailty Index

- Changes in everyday activities
- Head and neck problems
- Poor muscle tone in neck
- Brudinski, Babinski
- Problems getting dressed
- Problems with bathing
- Problems carrying out personal grooming
- Urinary incontinence
- Toileting problems
- Bulky difficulties
- Rectal problems
- Gastrointestinal problems
- Problems cooking
- Sucking problems
- Problems going out alone
- Impaired mobility
- Musculoskeletal problems
- Bradykinesia of the limbs
- Poor muscle tone in limbs
- Poor limbs coordination
- Poor coordination, trunk
- Poor standing posture
- Irregular gait pattern
- Falls
- Mood problems
- Feeling sad, blue, depressed
- History of depressed mood
- Tiredness all the time
- Depression (clinical impression)
- Sleep changes
- Restlessness
- Memory changes
- Short-term memory impairment
- Long-term memory impairment
- Changes in general mental functioning
- Onset of cognitive symptoms
- Clouding or delirium
- Paranoid features
- History relevant to cognitive impairment or loss
- Family history relevant to cognitive impairment or loss
- Impaired vibration
- Tremor at rest
- Pectoral tremor
- Intention tremor
- History of Parkinson’s disease
- Family history of degenerative disease
- Seizures, partial complex
- Seizures, generalized
- Syncope or blackouts
- Headache
- Cardiovascular problems
- History of stroke
- History of diabetes mellitus
- Arterial hypertension
- Peripheral pulses
- Cardiac problems
- Myocardial infarction
- Anemia
- Congestive heart failure
- Lung problems
- Respiratory problems
- History of thyroid disease
- Thyroid problems
- Skin problems
- Malignant disease
- Breast problems
- Abdominal problems
- Presence of smell reflex
- Presence of the palmar mental reflex
- Other medical history


Rockwood K. CMAJ 2005
Frailty Constructs

<table>
<thead>
<tr>
<th>Study</th>
<th>ES (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Afifalo, 2017</td>
<td>0.49 (0.45, 0.52)</td>
</tr>
<tr>
<td>Arnold, 2016</td>
<td>0.60 (0.58, 0.62)</td>
</tr>
<tr>
<td>Ewe, 2010</td>
<td>0.33 (0.26, 0.41)</td>
</tr>
<tr>
<td>Pinheiro, 2017</td>
<td>0.47 (0.41, 0.53)</td>
</tr>
<tr>
<td>Overall</td>
<td>0.48 (0.37, 0.58)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Study</th>
<th>ES (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Afifalo, 2017</td>
<td>0.35 (0.32, 0.39)</td>
</tr>
<tr>
<td>Kleczynski, 2017</td>
<td>0.17 (0.11, 0.25)</td>
</tr>
<tr>
<td>Martin, 2018</td>
<td>0.40 (0.38, 0.42)</td>
</tr>
<tr>
<td>Shimura, 2017</td>
<td>0.29 (0.27, 0.32)</td>
</tr>
<tr>
<td>Overall</td>
<td>0.31 (0.24, 0.38)</td>
</tr>
</tbody>
</table>
Gait Speed “Geriatric Vital Sign”
Gait Speed in Cardiac Surgery

Gait Speed and Operative Mortality in Older Adults Following Cardiac Surgery (Society of Thoracic Surgeons)

Median: 5.3 sec
Fast: <5 sec
Mid: 5-6 sec
Slow: >6 sec

N=15,171

Afilalo J. JAMA Cardiol 2016
Landmark Analysis

Figure 4. Landmark analysis with survival function by tertiles of gait speed. The association between slow gait speed and mortality was most marked during the time interval from 30 to 365 days after surgery.
Gait Speed in TAVR

Gait Speed and 30-Day Mortality in Older Adults Following Transcatheter AVR (STS/ACC TVT Registry)

Median: 7.9 sec
Fast: <6 sec
Mid: 6-10 sec
Slow: >10 sec

N=8,039

Predicting Early and Late Mortality After Transcatheter Aortic Valve Replacement

James B. Hermiller, Jr, MD, a Steven J. Yakubov, MD, a Michael J. Reardon, MD, a G. Michael Deeb, MD, a
David H. Adams, MD, a Jonathan Ahlalo, MD, MSc, b Jian Huang, MD, c Jeffrey J. Popma, MD, c
for the CoreValve United States Clinical Investigators

| TABLE 2 Univariable and Multivariable Predictors of Mortality Rates From the Derivation Cohort |
|-----------------------------------------------|-----------------|----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
|                             | Univariable Rate | Univariable Analysis | Multivariable Rate | Multivariable Analysis | Risk Score Assigned Weight |
|                             | (95% CI) N  | HR  | 95% CI | p Value | HR  | 95% CI | p Value | Risk Score |
| Predictors of 30-day mortality |                   |     |       |          |     |       |          |             |
| Albumin <3.3 g/dl            | 8.7 (6.4-11.8) 427 | 1.89 | 1.29-2.76 | 0.001 | 1.60 | 1.04-2.47 | 0.03 | 2 |
| Katz ADL ≥2 deficits         | 9.0 (6.1-13.2) 268 | 1.82 | 1.17-2.82 | 0.008 | --   | --      | --   | --   |
| Assisted living              | 8.8 (6.2-12.6) 306 | 1.79 | 1.18-2.74 | 0.007 | 1.68 | 1.05-2.69 | 0.03 | 2 |
| Home oxygen                  | 8.0 (6.0-10.6) 542 | 1.71 | 1.19-2.46 | 0.004 | 1.74 | 1.16-2.61 | 0.007 | 2 |
| Age >85 yrs                  | 6.4 (5.2-8.0) 1,218 | 1.47 | 1.04-2.08 | 0.03 | 1.46 | 0.99-2.15 | 0.05 | 1 |
| FEV >1,000 cc                | 4.9 (3.9-6.1) 1,533 | 0.63 | 0.42-0.94 | 0.02 | --   | --      | --   | --   |
| Predictors of 1-yr mortality |                   |     |       |          |     |       |          |             |
| Katz ADL ≥2 deficits         | 35.3 (27.9-41.8) 268 | 1.94 | 1.54-2.45 | <0.001 | --   | --      | --   | --   |
| Assisted living              | 34.2 (28.9-40.2) 306 | 1.90 | 1.52-2.38 | <0.001 | --   | --      | --   | --   |
| Home oxygen                  | 31.4 (27.4-35.8) 542 | 1.76 | 1.45-2.14 | <0.001 | 1.90 | 1.47-2.44 | <0.001 | 2 |
| Albumin <3.3 g/dl            | 30.9 (26.4-36.0) 427 | 1.65 | 1.34-2.04 | <0.001 | 1.40 | 1.04-1.91 | 0.03 | 1 |
| Wheelchair bound             | 31.0 (24.8-38.4) 203 | 1.58 | 1.19-2.08 | 0.001 | --   | --      | --   | --   |
| Severe Charlson score        | 25.1 (22.7-27.7) 1,427 | 1.51 | 1.24-1.83 | <0.001 | 1.27 | 0.98-1.65 | 0.07 | 1 |
| STS score >7%                | 24.9 (22.6-27.4) 1,473 | 1.48 | 1.22-1.80 | <0.001 | 1.36 | 1.05-1.77 | 0.02 | 1 |
| Grade III/IV LV diastolic dysfunction | 30.5 (25.4-36.4) 320 | 1.56 | 1.23-1.98 | <0.001 | --   | --      | --   | --   |
| STS severe lung disease      | 28.2 (24.1-32.8) 478 | 1.44 | 1.17-1.78 | <0.001 | --   | --      | --   | --   |
| Unplanned weight loss        | 28.7 (23.2-35.1) 273 | 1.43 | 1.10-1.85 | 0.007 | --   | --      | --   | --   |
| Prior BAV                    | 28.7 (23.7-34.4) 315 | 1.42 | 1.12-1.81 | 0.004 | --   | --      | --   | --   |
| Falls in past 6 months       | 27.9 (23.8-32.5) 482 | 1.42 | 1.15-1.74 | 0.001 | 1.36 | 1.03-1.81 | 0.03 | 1 |
| <5 m gait speed <6 s         | 21.9 (19.8-24.2) 1,685 | 1.42 | 1.06-1.91 | 0.02 | --   | --      | --   | --   |
| Atrial fibrillation or flutter | 24.4 (21.8-27.4) 1,082 | 1.30 | 1.08-1.56 | 0.005 | --   | --      | --   | --   |
| Grip strength < threshold    | 23.1 (21.0-25.4) 1,679 | 1.26 | 1.03-1.55 | 0.03 | --   | --      | --   | --   |
| FEV >1,000 cc                | 19.8 (17.7-22.1) 1,533 | 0.65 | 0.52-0.81 | <0.001 | --   | --      | --   | --   |

CENTRAL ILLUSTRATION: Mortality Risk Score for TAVR: Impact of Frailty and Disability on Outcome

A. 1-year Mortality for the Derivation Cohort by Risk Score

B. 1-year Mortality for the Validation Cohort by Risk Score

“Poor outcome” is defined as:
(1) Death from any cause, or
(2) KCCQ <45 at 6 m or <60 at 12 m, or
(3) ∆KCCQ -10 or more from baseline to f/u
Malnutrition

ORIGINAL RESEARCH ARTICLE

Malnutrition and Mortality in Frail and Non-Frail Older Adults Undergoing Aortic Valve Replacement

BACKGROUND: Older adults undergoing aortic valve replacement (AVR) are at risk for malnutrition. The association between preprocedural nutritional status and midterm mortality has yet to be determined.

METHODS: The FRAGILE-AVR (Frailty in Aortic Valve Replacement) prospective multicenter cohort study was conducted between 2012 and 2017 in 14 centers in 3 countries. Patients ≥70 years of age who underwent transcatheter or surgical AVR were eligible. The Mini Nutritional Assessment (Short Form) was assessed by trained observers preoperatively, with scores ≤14 considered malnourished.

RESULTS: There were 1158 patients (47.7% transcatheter AVR and 52.3% surgical AVR), with 41.5% females, a mean age of 81.3 years, and a mean body mass index of 21.5. Overall, 8.7% of patients were classified as malnourished and 52.3% were at risk for malnutrition. The Mini Nutritional Assessment—Short Form scores were modestly correlated with Short Physical Performance Battery scores (Pearson r 0.30). The 30-day mortality was 4.40% in the transcatheter AVR group (19.1/100 patient-years) and 30 deaths in the surgical AVR group (7.5/100 patient-years).

Conclusions: Preprocedural nutritional status is associated with mortality in older adults undergoing AVR. Clinical trials are needed to determine whether pre- and postprocedural nutritional interventions can improve clinical outcomes in these vulnerable patients.
Inactivity

Central Illustration: Distribution of Baseline HPA and Kaplan-Meier Survival Curves

A

B

Inactivity

Sathananthan J, Afilalo J, et al. JACC 2019

Habitual Physical Activity in Older Adults Undergoing TAVR
Insights From the FRAILTY-AVR Study


Abstract

Objective: The authors sought to assess the distribution and prognostic significance of habitual physical activity (HPA) in older adults undergoing transcatheter aortic valve replacement (TAVR).

Background: Low HPA is associated with mortality and disability in community-dwelling older adults. In the setting of TAVR, it is unclear whether low HPA is a risk factor for downstream mortality or independent of severe aortic stenosis that improved following its correction.

Methods: Older adults undergoing TAVR in the prospective multicenter FIT-IT AVR (Frailty in Aortic Valve Replacement) study were characterized to quantify their HPA in baseline/week using a validated questionnaire at baseline and follow-up. The primary endpoint was all-cause mortality at 2 years.

Results: The cohort consisted of 705 patients with a median age of 84.0 years (interquartile range [IQR] 79.6-87.0 years). At baseline, median number of weeks with HPA ≥150 kcal/wk (237.7 to 2,775 kcal/wk) was 7.5 (75% of patients had < 1,151 kcal/wk [QC 237.7 to 775 kcal/wk]; 50% had < 1,151 kcal/wk). Multivariate analysis of independent predictors of HPA using the logistic regression model adjusting for these covariates, HPA was found to be associated with mortality at 12 months (odds ratio: 0.840/72 kcal/wk, 95% confidence interval: 0.73-0.96). HPA was associated with mortality at less than 12 months (log-rank test: 0.840/72 kcal/wk, 95% confidence interval: 0.73-0.96). HPA was associated with mortality at less than 12 months (log-rank test: 0.840/72 kcal/wk, 95% confidence interval: 0.73-0.96). HPA was associated with mortality at less than 12 months (log-rank test: 0.840/72 kcal/wk, 95% confidence interval: 0.73-0.96).

Conclusions: Sedentary patients have a higher risk of mortality and functional decline following TAVR.

Depression

Patients without depression

Patients with depression

Survival

OR, 1.77; 95% CI, 1.24-2.54

Time Since AVR, mo

No. at risk

<table>
<thead>
<tr>
<th>No depression</th>
<th>Depression</th>
</tr>
</thead>
<tbody>
<tr>
<td>709</td>
<td>326</td>
</tr>
<tr>
<td>670</td>
<td>295</td>
</tr>
<tr>
<td>653</td>
<td>283</td>
</tr>
<tr>
<td>636</td>
<td>273</td>
</tr>
<tr>
<td>214</td>
<td>93</td>
</tr>
</tbody>
</table>

Drudi LM, Afilalo J, et al. JAMA Cardiol 2018
Anxiety

Table 4
Multivariable model to predict mortality or major morbidity

<table>
<thead>
<tr>
<th>Predictor</th>
<th>OR (95% CI)</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Society of Thoracic Surgeons predicted risk of mortality or major morbidity</td>
<td>1.06 (1.01–1.10)</td>
<td>0.01</td>
</tr>
<tr>
<td>Age</td>
<td>1.02 (0.93–1.12)</td>
<td>0.62</td>
</tr>
<tr>
<td>Female gender</td>
<td>3.49 (1.52–7.99)</td>
<td>0.003</td>
</tr>
<tr>
<td>Depression (Hospital Anxiety and Depression Scale—Depression score ≥11)</td>
<td>1.28 (0.25–6.59)</td>
<td>0.77</td>
</tr>
<tr>
<td>Anxiety (Hospital Anxiety and Depression Scale—Anxiety score ≥11)</td>
<td>5.1 (1.27–20.2)</td>
<td>0.02</td>
</tr>
</tbody>
</table>

The present study examined the association between patient-reported anxiety and post-cardiac surgery mortality and major morbidity. A prospective multicenter cohort study of elderly patients undergoing cardiac surgery (hospital stay >3 days preoperatively and hospital stay >7 days postoperatively) was performed. The primary outcome was mortality or major morbidity, which included death, myocardial infarction, reoperation for bleeding, and reoperation for other cardiac problems. The study included 1,000 patients who underwent cardiac surgery at 10 different hospitals. The patients were divided into two groups: those with anxiety and depression (AD group) and those without (non-AD group). The AD group had a significantly higher risk of mortality or major morbidity compared to the non-AD group (OR: 1.6; 95% CI: 1.1–2.4; p = 0.01). This study highlights the importance of preoperative anxiety and depression in predicting mortality or major morbidity in elderly patients undergoing cardiac surgery.
Disability

**Frailty**
- 5-meter gait speed
- CHS frailty scale
- Modified CHS frailty scale
- MSSA subdimensions

**Comorbidity**
- Parsonnet score
- STS-PROMM
- STS-PROM
- Logistic EuroSCORE
- ACEF score

**Disability**
- Nagi items
- ADL
- IADL

<table>
<thead>
<tr>
<th>Category</th>
<th>BADL</th>
<th>IADL</th>
<th>Frailty</th>
<th>5-year mortality N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Independent</td>
<td>Independent</td>
<td>Not frail</td>
<td>1 (1.3)</td>
</tr>
<tr>
<td>2</td>
<td>Independent</td>
<td>Impairment</td>
<td>Not frail</td>
<td>13 (10.5)</td>
</tr>
<tr>
<td>3</td>
<td>Independent</td>
<td>Independent</td>
<td>Pre-frail</td>
<td>12 (6.9)</td>
</tr>
<tr>
<td>4</td>
<td>Independent</td>
<td>Impairment</td>
<td>Pre-frail</td>
<td>42 (23.2)</td>
</tr>
<tr>
<td>5</td>
<td>BADL independent</td>
<td>Frail</td>
<td></td>
<td>19 (38.8)</td>
</tr>
<tr>
<td>6</td>
<td>Mild BADL impairment</td>
<td></td>
<td></td>
<td>86 (51.2)</td>
</tr>
<tr>
<td>7</td>
<td>Moderate BADL impairment</td>
<td></td>
<td></td>
<td>36 (75.0)</td>
</tr>
<tr>
<td>8</td>
<td>Severe BADL impairment</td>
<td></td>
<td></td>
<td>82 (78.8)</td>
</tr>
</tbody>
</table>
Frailty + Sex

Sex-Specific Determinants of Outcomes After Transcatheter Aortic Valve Replacement

BACKGROUND: Women account for a large proportion of patients treated with transcatheter aortic valve replacement, yet there remain conflicting reports about the effect of sex on outcomes. Moreover, the sex-specific prevalence and prognostic impact of frailty has not been systematically studied in the context of transcatheter aortic valve replacement.

METHODS AND RESULTS: A preplanned analysis of the FRAGILITY-AVR (frailty Aortic Valve Replacement) study was performed to analyze the determinants of outcomes in older women and men undergoing transcatheter aortic valve replacement. FRAGILITY-AVR was a multinational, prospective, observational cohort assembled at 14 institutions in North America and Europe from 2012 to 2017. Multivariable logistic regression models were stratified by sex and adjusted for covariates. Interactions between sex and each of these covariates were assessed. The primary outcome was 12-month mortality, and the secondary outcome was 1-month composite mortality or major morbidity. The cohort consisted of 340 women and 419 men. Women were older and had higher predicted risk of mortality. Women were more likely to have physical frailty traits, but not cognitive or psychosocial frailty traits, and global indices of frailty were similarly associated with adverse events regardless of sex. Women were more likely to require discharge to a rehabilitation facility, particularly those with physical frailty at baseline, although their functional status was similar to men at 12 months. The risk of 1-month mortality or major morbidity was greater in women, particularly those treated with larger prostheses. The risk of 12-month mortality was not greater in women, with the exception of those with pulmonary hypertension, in whom there was a significant interaction for increased mortality.

CONCLUSIONS: The present study highlights sex-specific differences in older adults undergoing transcatheter aortic valve replacement and draws attention to the impact of physical frailty in women and their potential risk associated with oversized prostheses and pulmonary hypertension.

Frailty + Access

Frailty Conundrum

Prevalence of frailty

- SHARE-Groningen Frailty Indicator
- SHARE-Tilburg Frailty Indicator
- SHARE-Frailty Index
- SHARE-FI-CGA
- SHARE-Clinical Frailty Scale
- SHARE-Frailty phenotype
- SHARE-Edmonton Frail Scale
- SHARE-FRAIL Scale

Theou O. J Am Geriatr Soc 2013
Lord Kelvin

"If you can not measure it, you can not improve it."

1824-1907
Prospective cohort study of older adults aged ≥70 years undergoing TAVR or SAVR for aortic stenosis at 14 hospitals in Canada, USA, and France between 2012-2017
## Essential Frailty Toolset

### Chair Rise Time
- Five chair rises <15 seconds → 0 points
- Five chair rises ≥15 seconds → 1 point
- Unable to complete → 2 points

### Cognitive Impairment
- No cognitive impairment → 0 points
- Cognitive impairment → 1 point

### Hemoglobin
- Male ≥13.0 g/dL
- Female ≥12.0 g/dL → 0 points
- Male <13.0 g/dL
- Female <12.0 g/dL → 1 point

### Serum Albumin
- ≥3.5 g/dL → 0 points
- <3.5 g/dL → 1 point

### Other Measures
- Gait speed
- Standing balance
- Handgrip strength
- Body mass index
- Weight loss
- Exhaustion
- Inactivity
- Falls
- Visual impairment
- Hearing impairment
- Cognitive impairment
- Depressed mood
- Anxious mood
- Hemoglobin
- Leukocyte count
- Platelet count
- Serum albumin
- Malnutrition
- Nagi items
- OARS items

### Graph
- EFT (Eastern Frailty Toolset)
- # Patients
- Percentages for Death, Disability, and Neither are shown in the legend.
**Final Risk Model**

<table>
<thead>
<tr>
<th>TABLE 4 Multivariable Model to Predict 1-Yr Mortality</th>
<th>Adjusted OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, per yr</td>
<td>1.03 (0.99-1.08)</td>
</tr>
<tr>
<td>Female</td>
<td>1.07 (0.70-1.62)</td>
</tr>
<tr>
<td>BMI, per kg/m²</td>
<td>0.95 (0.91-0.98)</td>
</tr>
<tr>
<td>Atrial fibrillation</td>
<td>1.59 (1.06-2.41)</td>
</tr>
<tr>
<td>Home oxygen</td>
<td>3.33 (1.06-10.47)</td>
</tr>
<tr>
<td>Cancer</td>
<td>1.31 (0.79-2.19)</td>
</tr>
<tr>
<td>Prior stroke</td>
<td>0.93 (0.48-1.81)</td>
</tr>
<tr>
<td>Prior gastrointestinal bleed</td>
<td>1.47 (0.72-3.00)</td>
</tr>
<tr>
<td>GFR, per 10 ml/min/1.73 m²</td>
<td>0.88 (0.78-0.99)</td>
</tr>
<tr>
<td>Mean aortic gradient, per 10 mm Hg</td>
<td>0.87 (0.75-1.01)</td>
</tr>
<tr>
<td>LVEF, per %</td>
<td>1.01 (0.99-1.02)</td>
</tr>
<tr>
<td>PASP ≥60 mm Hg</td>
<td>2.08 (1.19-3.63)</td>
</tr>
<tr>
<td>Procedure type</td>
<td></td>
</tr>
<tr>
<td>TAVR transfemoral</td>
<td>1 (Referent)</td>
</tr>
<tr>
<td>TAVR nonfemoral</td>
<td>1.82 (1.09-3.05)</td>
</tr>
<tr>
<td>SAVR isolated</td>
<td>0.40 (0.16-1.01)</td>
</tr>
<tr>
<td>SAVR with bypass</td>
<td>1.39 (0.75-2.59)</td>
</tr>
<tr>
<td>Frailty*, ordinal (per EFT point)</td>
<td>1.87 (1.57-2.24)</td>
</tr>
<tr>
<td>dichotomous (EFT ≥3 of 5)</td>
<td>3.42 (2.29-5.12)</td>
</tr>
</tbody>
</table>
Results

Your patient's EFT score is 1 out of 5 😊
The 1-year risk of mortality is 7.5%

Patient information
90° TAVR with 6.3% operative risk

Essential Frailty Toolset (EFT)
Chair rise
0.5 seconds
Cognition
Not cognitively impaired
Hemoglobin
117 g/L
Albumin
41 g/L

Results

Your patient's EFT score is 5 out of 5 😊
The 1-year risk of mortality is 57.3%

Patient information
80° TAVR with 7.1% operative risk

Essential Frailty Toolset (EFT)
Chair rise
Unable to complete
Cognition
Cognitively impaired
Hemoglobin
112 g/L
Albumin
31 g/L

Results

Your patient's EFT score is 3 out of 5 😊
The 1-year risk of mortality is 22.1%

Patient information
94° TAVR with 6.0% operative risk

Essential Frailty Toolset (EFT)
Chair rise
Unable to complete
Cognition
Not cognitively impaired
Hemoglobin
103 g/L
Albumin
35 g/L
Action Items
Comprehensive Geriatric Assessment ("CGA")

① Mobility and balance
② Sarcopenia
③ Nutrition
④ Cognition
⑤ Mood
⑥ Hearing and vision
⑦ Polypharmacy
⑧ Disability
⑨ Social support
⑩ Advance directives
CGA ➔ Targeted Interventions
**Therapeutic Interventions for Frail Elderly Patients: Part I. Published Randomized Trials**

Lior Bibaz\(^a,b\), Michael Levi\(^a,b\), Melissa Bendayan\(^c\), Louis Mullie\(^d\),
Daniel E. Forman\(^d,e\), Jonathan Afilalo\(^b,c,f,g\)

666 studies identified using the search strategy

Excluded 535 studies based on their title or abstract

131 manuscripts retrieved for detailed analysis

Excluded 93 studies that did not meet our inclusion/exclusion criteria or were duplicate publications from the same trial

38 trials included in this review

- Exercise + Nutritional Supplements: 7 trials
- Exercise: 13 trials
- Multi-Dimensional Programs / Home-Based Services: 5 trials
- Pharmaceutical Agents: 8 trials
- Nutritional Supplements: 4 trials

---

Cardiac Rehab: Start Early (In Hospital)

The usual-care group received habitual hospital care, which included physical rehabilitation when needed. The intervention was programmed in 2 daily sessions (morning and evening) of 20 minutes’ duration during 5 to 7 consecutive days (including weekends). An experienced fitness specialist with in-depth training on safe patient handling techniques (F.Z.-F.) supervised each patient’s session and provided instructions and encouragement. Adherence to the exercise intervention program was documented in a daily register. A session was considered completed when 90% or more of the programmed exercises were successfully performed. Participants and their family members were familiarized with the training procedures before the start of the intervention.
# Cardiac Rehab: Start *Earlier* (In ICU)

<table>
<thead>
<tr>
<th>Level of Function 1 (Maximum Assistance) Bed/Cardiac Chair Activity</th>
<th>Level of Function 2 (Moderate Assistance) Able to Sit/Stand</th>
<th>Level of Function 3 (Minimal Assistance) Walks &lt; 50 feet</th>
<th>Level of Function 4 (Independent of Modified Independence) Walks &gt; 50 feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activities</td>
<td>Activities</td>
<td>Activities</td>
<td>Activities</td>
</tr>
<tr>
<td>Turn Q2h</td>
<td>Active exercises</td>
<td>Regular or cardiac chair &lt; 60 min</td>
<td>Bed to chair 3x/day</td>
</tr>
<tr>
<td>Passive ROM by RN, CP, or family</td>
<td>Sitting at end of bed</td>
<td>Begin transfer bed to chair via lift</td>
<td>Perform ADLs without assist</td>
</tr>
<tr>
<td>Bed in chair position or cardiac chair with full assist as tolerated</td>
<td>Sitting position during ADLs</td>
<td>Standing and gait activities</td>
<td>Progressive walking 2-3x/day with RN, RT (if on ventilator)</td>
</tr>
<tr>
<td>IIOB &gt; 45 degree</td>
<td>Begin transfer bed to chair via lift</td>
<td>Walk short distances 3x/day</td>
<td></td>
</tr>
<tr>
<td>Use equipment to lift or turn patient</td>
<td>Sitting and standing activities</td>
<td>Active transfers bed to chair 3x/day</td>
<td></td>
</tr>
</tbody>
</table>

**Exclusion Criteria**
- Neuromuscular blocking agents
- Acute neurological event(s) (acute stroke < 24h, SAH with vasospasm, ICP, unstable spine fractures)
- Mechanically ventilated with FiO2 > 80% and/or PEEP > 12
- Significant dose of vasopressors for hemodynamic instability and/or MAP < 60
- Antidysrhythmics agents given <24h
- HR < 50 or > 120
- Active cardiac ischemia < 24h
- Open chest/abdomen
- Active bleeding
- Unstable extremity fractures
- Transitioning to comfort care
- Bed rest order

**Graph**

- Prehospital: Non-Frail = 3.6, Frail = 2.6
- CICU Admission: Non-Frail = 2.1, Frail = 1.5
- CICU discharge: Non-Frail = 1.9, Frail = 1.5

Goldfarb M. J Crit Care 2018
10 days in bed = 1.5 kg of muscle lost

<table>
<thead>
<tr>
<th>Table. Effects of 10 Days of Bed Rest in Older Adults</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Participants (N = 12)*</td>
</tr>
<tr>
<td><strong>Muscle fractional synthetic rate, % per h†</strong></td>
</tr>
<tr>
<td>% Change</td>
</tr>
<tr>
<td>10</td>
</tr>
<tr>
<td>0.077 (0.059 to 0.095)</td>
</tr>
<tr>
<td>0.051 (0.035 to 0.067)</td>
</tr>
<tr>
<td>−0.027 (−0.007 to −0.047)</td>
</tr>
<tr>
<td>.02</td>
</tr>
<tr>
<td><strong>DEXA lean mass, kg‡</strong></td>
</tr>
<tr>
<td>% Change</td>
</tr>
<tr>
<td>10</td>
</tr>
<tr>
<td>48.05 (40.61 to 55.49)</td>
</tr>
<tr>
<td>46.51 (39.57 to 53.45)</td>
</tr>
<tr>
<td>−1.50 (−0.62 to −2.48)</td>
</tr>
<tr>
<td>.004</td>
</tr>
<tr>
<td><strong>Isokinetic muscle strength, Nm per s§</strong></td>
</tr>
<tr>
<td>% Change</td>
</tr>
<tr>
<td>11</td>
</tr>
<tr>
<td>120 (96 to 145)</td>
</tr>
<tr>
<td>101 (81 to 121)</td>
</tr>
<tr>
<td>−19 (−11.6 to −26.6)</td>
</tr>
<tr>
<td>Kortebein P. JAMA 2007</td>
</tr>
</tbody>
</table>

**Why is it acceptable care if the PT does not come every day but not acceptable if antibiotics are not given daily?**
Protein Deficits in Cardiac Surgery Patients

Cardiac Rehab: Start *Even Earlier* (Prehab)

**BMJ Open** Protocol for the PREHAB study — Pre-operative Rehabilitation for reduction of Hospitalization After coronary Bypass and valvular surgery: a randomised controlled trial

Andrew N Stammers,¹,² D Scott Kehler,¹,² Jonathan Afilalo,³ Lorraine J Avery,⁴ Sean M Bagshaw,⁵ Hilary P Grocott,⁶,⁷ Jean-Francois Légaré,⁸ Sarvesh Logsetty,⁶ Colleen Metge,⁴,⁹ Thang Nguyen,¹⁰ Kenneth Rockwood,¹¹ Jitender Sareen,⁹,¹² Jo-Ann Sawatzky,²,¹³ Navdeep Tangri,¹⁴ Nicholas Giacomantonio,¹⁵ Ansar Hassan,¹⁶ Todd A Duhamel,¹,²,¹⁷ Rakesh C Arora²,⁶
**PERFORM-TAVR Trial**

*Pan-Canadian CIHR-funded randomized clinical trial to improve physical functioning and health-related quality of life in N=250 frail older adults undergoing TAVR*

**Intervention Group**
- **Protein supplement**
  - HMB-enriched beverage containing 20 g protein and 1.5 g HMB consumed twice daily after meals
- **Home-based exercise program**
  - Weight-bearing exercise (WEBB program) guided by a therapist performed 2 days per week
  - Moderate-intensity walking exercise guided by an accelerometer performed 5 days per week

**Lifestyle Counselling Group**
- **Usual care**
  - Advice for balanced nutrition and walking exercise guided by AHA recommendations for healthy living

**Endpoints**
1. Physical performance (SPPB test)
2. Health-related quality of life (SF-36 scale)
3. Cognitive function (MoCA)
4. Muscle mass (portable bioimpedance)
5. Composite of death, injurious fall, AKI, admission for worsening angina, arrhythmia, or heart failure

---

Afilalo J. 2019
Take Home Messages
# Frailty 1

## Frailty: implications for clinical practice and public health

Eniël O Hoogendijk, Jonathan Afilalo, Kristine E Ensrud, Paul Kowal, Graziano Onder, Linda P Fried

<table>
<thead>
<tr>
<th>Frailty Care Level</th>
<th>Frailty Events</th>
<th>Prevention Level</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Primary care</strong></td>
<td>Older adult</td>
<td>Primary prevention</td>
</tr>
<tr>
<td></td>
<td>Adoption of unhealthy lifestyle behaviours</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Accumulation of frailty deficits and risk factors for disease</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Diagnosis of chronic disease</td>
<td>Secondary prevention</td>
</tr>
<tr>
<td><strong>Acute care</strong></td>
<td>Acute decompensation of disease</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cycle of stabilisation and destabilisation</td>
<td></td>
</tr>
<tr>
<td><strong>Specialist care</strong></td>
<td>Progression of disease to advanced stage</td>
<td>Tertiary prevention</td>
</tr>
<tr>
<td></td>
<td>Intensive medical or surgical therapy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Iatrogenic complication from therapy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Prolonged hospitalisation</td>
<td></td>
</tr>
<tr>
<td><strong>Post-acute care</strong></td>
<td>Functional decline</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Admission to long-term care facility</td>
<td></td>
</tr>
<tr>
<td><strong>Palliative care</strong></td>
<td>Readmission</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Death</td>
<td></td>
</tr>
</tbody>
</table>
In the CICU: Lots to Learn

Research Gaps in the Cardiac Intensive Care Unit: Care of Patients with Geriatric Syndromes

- Validated tools to assess frailty in older patients in CICU
- Integration of frailty, cognition, multimorbidity, and other domains into a CICU risk score
- Development of a scientifically, legally, and ethically acceptable definition of frailty
- Refinement of a multidimensional (medical, physical, cognitive, nutritional, and pharmaceutical) therapeutic approach to acute and longitudinal care
- Enhanced strategies to facilitate patient-centered long-term goals of care
- Validated approaches to incorporate preventative care in CICU patients with frailty

2-Minute Drill

- Screen for physical, cognitive, and social frailty
- Plan to treat modifiable frailty deficits
  - Physical: PT as often as possible
  - Malnutrition: Nutritionist +/- ONS
  - Anemia with iron deficiency: IV iron
  - Cognitive impairment: R/O delirium
- Elicit patient preferences and values
- Identify red flags (A-B-C-D-E mnemonic)

Essential Frailty Toolset

- Five chair rises without arms >15 sec [1 point] or unable [2 points]
- Three word recall 0/3 or 1-2/3 with abnormal clock draw [1 point]
- Hemoglobin <13.0 g/dL in men or <12.0 g/dL in women [1 point]
- Albumin <3.5 g/dL [1 point]

EFT score = sum of points out of 5

Malnutrition screener

- Have you lost weight in the past 6 mo without trying?
- Have you been eating less than usual?

Depression screener

- Have you been feeling down, depressed, or hopeless?
- Have you been taking little pleasure or interest in doing things?

Disability

- Do you need help to transfer, toilet, bathe, dress, or feed yourself?
- Do you usually use a wheelchair or have marked difficulty walking?
The F-word: Futility

- **A** • Advanced dementia
- **B** • Bedbound; non-mobile
- **C** • Cachexia or severe sarcopenia
- **D** • Disability for all/most ADLs
- **E** • End-stage renal, liver, lung disease

2019 Canadian Cardiovascular Society Position Statement for TAVI
The P-word: Preferences

- **Costs/Burden**
  - Direct Medical Costs
  - Indirect Costs
  - Lost Opportunities
  - Caregiver Burden

- **Quality of Life**
  - Symptoms
  - Physical Function
  - Mental
  - Emotional
  - Social

- **Outcomes Relevant to an Individual Patient**

- **Survival**
Conclusions

• Sarcopenia and frailty are major risk factors for postoperative M&M
  • Increasingly prevalent
  • → Death, complications, functional decline, resource use
  • Technological advances can help us assess rapidly and objectively
  • Not to withhold care, rather deliver individualized patient-centered care

• Echocardiographic findings of restrictive filling and RV dysfunction, but not LVEF, add incremental value for operative risk stratification
Mr. R

18 months later
It is much more important to know what sort of a patient has a disease than what sort of a disease a patient has.

William Osler
Geriatric Cardiology Fellowship

The primary mission of the Geriatric Cardiology Fellowship Program is to train specialists to become highly skilled in providing integrated care for complex older adults with cardiovascular conditions, particularly those with multiple chronic conditions and geriatric syndromes. Secondly, to generate and present new knowledge by conducting meaningful research in the field of geriatric cardiology. Thirdly, to sensitize the cardiology and geriatric communities (including trainees) to the special considerations that are important to optimize care for our challenging geriatric cardiology patients. Fourthly, to demonstrate vision as early adopters/leaders in adding this emerging fellowship program to our robust portfolio of sub specialty training programs offered by the Division of Cardiology at McGill University.

Official Fellowship Document

Content
1. Overview
2. Academic Facilities
3. Fellow Duties and Responsibility
4. Curriculum
5. Eligibility
6. Clinical Roles and Responsibilities
7. Research and Academia
## Key Questions

<table>
<thead>
<tr>
<th>Key question</th>
<th>Red flags</th>
</tr>
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<tbody>
<tr>
<td><strong>Short-term risks</strong></td>
<td>Is the patient at risk for a major procedural complication?</td>
</tr>
<tr>
<td></td>
<td>• High TAVR risk score</td>
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<td></td>
<td>• Comorbidity-complication dyads</td>
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<td></td>
<td>• Technically complex procedure</td>
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</table>

| **Mid-term recovery**  | Is the patient likely to return home and recover function following TAVR?  |
|  | • Physical frailty  |
|  | • Poor social support  |
|  | • Active depression  |

| **Long-term benefits**  | Is the patient likely to gain meaningful longevity and quality of life from TAVR?  |
|  | • Advanced dementia  |
|  | • Bedbound  |
|  | • Cachexia or severe sarcopenia  |
|  | • Disability for all or most ADLs  |
|  | • End-stage kidney, liver, lung disease  |

| **Patient preference**  | Does the patient understand the expected benefits/risks and want to proceed?  |
|  | • Limited comprehension  |
|  | • Unrealistic expectations  |
|  | • External pressure to proceed  |
Frailty Laboratory Biomarkers

**Systemic Inflammation**
- ↑TNF-α, IL-6, CRP
- ↓Hemoglobin
- ↓Albumin

**Oxidative Stress**
- Protein Carbonylation
- Lipid Peroxidation
- ↑AGEs

**Anorexia/Starvation**
- ↓Micronutrients

**↓Muscle Anabolism**
- ↓Androgens
- ↓Insulin Sensitivity
- ↓IGF-1

**↑Muscle Catabolism**
- ↑P3NP
- ↑CAF
- ↑eHsp72

**Accelerated Sarcopenia**
Rockwood’s Clinical Frailty Scale

<table>
<thead>
<tr>
<th>Frailty Level</th>
<th>Description</th>
<th>Examples</th>
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<tbody>
<tr>
<td>1 Very Fit</td>
<td>People who are robust, active, energetic and motivated. These people commonly exercise regularly. They are among the fittest for their age.</td>
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<tr>
<td>2 Well</td>
<td>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.</td>
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<tr>
<td>3 Managing Well</td>
<td>People whose medical problems are well controlled, but are not regularly active beyond routine walking.</td>
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<tr>
<td>4 Vulnerable</td>
<td>While not dependent on others for daily help, other symptoms limit activities. A common complaint is being &quot;slowed up&quot;, and/or being tired during the day.</td>
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<tr>
<td>5 Mildly Frail</td>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>6 Moderately Frail</td>
<td>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 (using, standing) with dressing.</td>
<td></td>
</tr>
<tr>
<td>7 Severely Frail</td>
<td>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).</td>
<td></td>
</tr>
<tr>
<td>8 Very Severely Frail</td>
<td>Completely dependent, approaching the end of life. Typically, they could not recover even from a minor illness.</td>
<td></td>
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<tr>
<td>9 Terminal Ill</td>
<td>Approaching the end of life. This category applies to people with a life expectancy ~6 months, who are not otherwise evidently frail.</td>
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Scoring frailty in people with dementia

The degree of frailty corresponds to the degree of dementia. Common symptoms in mild dementia include forgetting the details of a recent event, though still remembering the event itself, repeating the same question/story and social withdrawal. In moderate dementia, recent memory is very impaired, even though they seemingly can remember their past life events well. They can do personal care with prompting. In severe dementia, they cannot do personal care without help.