FRAILTY IN CARDIAC SURGERY

Assoc Prof Julie Mundy
Director, Dept of Cardiothoracic Surgery
Princess Alexandra Hospital. Brisbane
Which old people should we operate on?
Which old people should we operate on?
Which old people should we operate on?
An issue that is not going to go away

From Pyramid to Coffin
Changing Age Structure of the Australian Population, 1925-2045
Source: Productivity Commission 2005
Reasons for the ageing population

• past falls in fertility

• increasing life expectancy

• the effect of the 'baby boomer' generation moving through older age groups in coming decades
Australian population projections

- Number of people aged over 65 years will increase from the current 2.5 million to around 7.2 million by 2050.

- Proportion of people aged over 65 years will grow from the current 13%, to one quarter of the population by 2050.

- Proportion of people over 85 years will grow from the current 1.4% to approximately 6% by 2050.

- Proportion of the population aged between 15-64 years (labour force age) will fall from the current 67%, to around 59% by 2050.
The increased costs of an ageing population

- Aged care services
- Infrastructure
- Housing
- Transport
- Health promotion programs
- Community facilities
PAH Cardiac Surgery

Data obtained from
- prospectively collected data
- Using ANZSCTS registry fields and definitions
- All patients undergoing cardiac surgery at PAH
- 1999 to mid-2014
- Over 10,000 patients
How big is the “elderly” problem and is it increasing?
Operation status

percent

Elective

Urgent

Emergent/Salvage

<70 yrs

70-79 yrs

>80 yrs

percent
Operation type

- CABG
- AVR
- AVR/CABG
- MVR/Repair
- MVRRep/CABG

percent

- <70
- 70-79
- >80
## Postoperative stay

### Discharge day

<table>
<thead>
<tr>
<th></th>
<th>&lt;50</th>
<th>50-59</th>
<th>60-69</th>
<th>70-79</th>
<th>&gt;80</th>
</tr>
</thead>
<tbody>
<tr>
<td>By day 5</td>
<td>71.7%</td>
<td>73.5%</td>
<td>69.0%</td>
<td>55.8%</td>
<td>41.1%</td>
</tr>
<tr>
<td>By day 7</td>
<td>85.0%</td>
<td>87.3%</td>
<td>86.9%</td>
<td>79.8%</td>
<td>72.6%</td>
</tr>
</tbody>
</table>

### Mortality

<table>
<thead>
<tr>
<th></th>
<th>&lt;50</th>
<th>50-59</th>
<th>60-69</th>
<th>70-79</th>
<th>&gt;80</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total cases</td>
<td>1183</td>
<td>2187</td>
<td>3394</td>
<td>3105</td>
<td>577</td>
</tr>
<tr>
<td>Deaths (%)</td>
<td>17   (1.4%)</td>
<td>30   (1.4%)</td>
<td>63   (1.9%)</td>
<td>67   (2.2%)</td>
<td>14   (2.4%)</td>
</tr>
</tbody>
</table>
# Morbidity

<table>
<thead>
<tr>
<th></th>
<th>&lt;50 yrs</th>
<th>50–59 yrs</th>
<th>60–69 yrs</th>
<th>70 – 79 yrs</th>
<th>&gt;80 yrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>New AF</td>
<td>10.7%</td>
<td>18.7%</td>
<td>27.2%</td>
<td>33.1%</td>
<td>36.9%</td>
</tr>
<tr>
<td>Insertion PPM</td>
<td>2.0%</td>
<td>1.1%</td>
<td>1.6%</td>
<td>2.0%</td>
<td>4.0%</td>
</tr>
<tr>
<td>Stroke</td>
<td>0.9%</td>
<td>0.8%</td>
<td>1.1%</td>
<td>1.8%</td>
<td>0.7%</td>
</tr>
<tr>
<td>Deep sternal infection</td>
<td>0.3%</td>
<td>0.7%</td>
<td>0.9%</td>
<td>1.0%</td>
<td>0.5%</td>
</tr>
</tbody>
</table>
Logistic Euroscore

Does it adequately predict
- morbidity
- length of hospital stay

Or do we need to look at other factors?

### Patient Factors
- Age 85yr
- Sex
- Chronic pulmonary disease
- Extracardiac arteriopathy
- Neurological dysfunction
- Previous cardiac surgery
- Serum creatinine >200 µmol/ L
- Active endocarditis
- Critical preoperative state

### Cardiac Factors
- Unstable angina
- LV dysfunction moderate or LVEF 30-50%
- LV dysfunction poor or LVEF<30
- Recent myocardial infarct
- Pulmonary hypertension

### Operation Factors
- Emergency
- Other than isolated CABG
- Surgery on thoracic aorta

### Additive EuroSCORE
- 11

### Logistic EuroSCORE (mortality %)
- 19.07%
Frailty: the missing element in predicting operative risk?

Risk stratification scores e.g. Logistic Euroscore address the disparity between chronological and biological age by considering

- Patient demographics
- Co-morbidities
- Operative variables
- Age

BUT

Do not take physiological reserve into account and therefore tend to

- Overestimate operative risk in robust elderly patients
- Underestimate operative risk in frail patients
Frailty

-defined as a state of increased vulnerability to stressors caused by deterioration across multiple physiological systems

-can be quantified to a certain extent by the use of scoring systems

-is a well recognised predictor of decreased event-free survival in the community.*

* Rockwood K et al. Lancet 353:205. 1999
What about the cardiac surgical cohort?

Frailty has only recently been investigated as a risk for adverse outcomes after cardiac surgery, partly because:

- effective assessment requires prospective evaluation
- Until recently the only alternatives to conventional valve surgery carried unacceptably high morbidity and mortality, obviating the need for more sophisticated patient selection
- Spiralling health care costs
Studies to date

- There have been 5 studies to date

**Lee DH et al. Circulation 121:973. 2010**
- Analysed prospectively collected data on 3826 adult patients (2004+)
- Age 15 to 91 yrs
- Divided into frail n=157 and non-frail n=3669 on the presence of any impairment of
  - The KATZ index of daily living
  - Independence of ambulation
  - Previous diagnosis of dementia by a specialised physician

- Frail patients were
  - Older
  - More likely to be women
  - Have other risk factors for adverse postoperative outcomes
Frailty was an independent risk factor for
- in hospital mortality (OR 1.8)
- Reduced mid-term survival (OR 1.5)
- Prolonged institutional care (OR 6.3)

Focussed on 400 patients with a mean age of 80.2 years including 59 having a trans-catheter valve

Assessed
- Logistic Euroscore
- Self-reported
  - Unintentional weight loss
  - Exhaustion
  - Low activity
- Assessment of
  - Grip strength
  - Balance
  - Gait speed
  - Co-ordination
- Spirometry
- Biochemical panel

Adds an additional 20+ mins to the assessment per patient

- Median logistic Euroscore was 8.5%

- Correlation between the risk score and the frailty measure was low to moderate

- Frailty predicted 30 day mortality almost as closely as the predictive risk score however their predictive accuracy was only “fair” (area under ROC 0.79)

- Authors concluded that combining frailty scores with cardiac surgery risk scores may offer the potential to optimize accuracy of predictive scoring systems.
Modified their “CAF” score, which takes 10-20 mins to perform and requires special equipment to

Frailty predicts death One year after Elective Cardiac Surgery Test “FORECAST” - using those factors which showed the best discrimination concerning 1 year mortality with good accuracy

The modified test includes

- **Chair rise**: patient is asked to get up and down from a chair 3 times and time is measured
- **Weak**: patient is asked if they felt weak in the last 2 weeks
- **Stair**: patient is asked to climb as many stairs as they are able
- **CFS**: Clinical frailty scale independently assessed by a cardiac surgeon and physician
- **Creatinine**: serum creatinine level
This was performed as a sub-analysis of a randomised trial of stentless versus stented aortic valve replacement.

The ability of patients to walk further than 300 metres in a standardised 6 minute walk test was the only independent predictor of the composite endpoint of death, myocardial infarction or stroke at 12 months.

- Gait speed as an incremental predictor of major morbidity and mortality in elderly patients undergoing cardiac surgery
- Multi-centre
- Age >70 yrs
- CABG and/or valve surgery (non-emergent)
- “Slow walkers” defined as taking more than 6 seconds to walk 5 metres.
  Able to use an aid.

Primary endpoint was
- in hospital mortality
- major morbidity
  - Stroke
  - renal failure
  - prolonged ventilation >24 hours
  - deep sternal wound infection
  - re-operation
Secondary endpoints

- Discharge to a health care facility
  - (rehab, convalescence, other hospital, nursing home)
- Prolonged postoperative length of stay
  - >14 days after the index surgery

Principal finding

- 5 metre gait speed is an incremental predictor of mortality and major morbidity in elderly patients undergoing cardiac surgery
- Associated with a 2 to 3-fold increase in mortality risk
- Associated
  - Higher rates of complications
  - Higher rates of discharge to a health care facility
  - Longer lengths of hospital stay
- Simple, easy to administer test
Other issues

Mental toughness

When the going gets tough......

......... the frail **watch** the dominoes fall
Other issues

- Mental toughness

Unmasked early dementia
- Acute confusion in first couple of days
- “Sundowning”
- Collateral history (usually from daughters) that patient has been undergoing mental decline
- Often evident preop but subtle and difficult for doctors without English as a first language
Other issues

- Mental toughness

- Unmasked early dementia

Social supports

- Increasingly patients have no family or friends
- Men commonly die before their wives
- When family are around they are increasingly reluctant to provide after care because of their own “busy” lives
Other issues

- Mental toughness
- Unmasked early dementia
- Social supports

**Long term QOL**
- It musn’t just be about 30 day survival
HEALTH ECONOMICS
Health Expenditure - % of GDP

% GDP

Public  Private


States: United States, France, Germany, Denmark, Canada, Switzerland, Austria, Belgium (2), New Zealand (2008), Portugal, United Kingdom, Ireland, Greece (2007), Norway, Iceland, OECD, Spain, Italy, Slovenia, Finland, Slovak Republic (2008), Australia (2008), Japan (2008), Chile, Czech Republic, Israel, Hungary, Poland, Estonia, Korea, Luxembourg, Mexico (2008), Turkey (2008).
Health expenditure trends - % of GDP
Government Debt - % of GDP
Australian Govt Debt - % of GDP

AUSTRALIA GOVERNMENT DEBT TO GDP
Percentage of the GDP

SOURCE: WWW.TRADINGECONOMICS.COM | AUSTRALIAN OFFICE OF FINANCIAL MANAGEMENT (AOFM)
So when you are broke
So when you are broke you need to be mindful about how you spend your money!
What criteria do we currently use?

- Age
- Comorbidities
- Who can afford to pay for it
  - But Medicare pays 75% of the private patient fee!
- Risk stratification scores
The ideal older patient

- Survive the operation with minimal morbidity
- Return to independent living
- Good quality of life
- Life expectancy to match age-adjusted norms
What to look at

- Multiple 'frailty indicators' have already been identified in the literature

- Assessment tools must be simple, quick and easily performed

- Additive "frailty" scores utilised in combination with other validated risk scores

- Composite endpoint including morbidity and quality of life indices not just mortality
Frailty in Cardiac Surgery Study
Methodology

• Prospectively collected data

• Informed consent

• All patients >70yo undergoing elective or urgent cardiac surgical cases eligible

• Assessment done preoperatively

• Demographic information retrieved from database

• Postoperative follow-up
Demographics

- Mean age 77.1 yrs (70-92yo)
- 85 males, 38 females
- 88 Elective, 35 Urgent
- All 'on pump'

- Operation
  - 56 - CABG
  - 35 - AVR
  - 13 - AVR & CABG
  - 5 - MVR or MVRepair
  - 4 - CABG & MVRepair
  - 4 - MVR & TVRepair
### Biochemical Markers

<table>
<thead>
<tr>
<th>Biochemical Marker</th>
<th>Frail Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creatinine</td>
<td>Frail if &gt; 120mmol/L</td>
</tr>
<tr>
<td>Albumin</td>
<td>Frail if &lt; 33g/L</td>
</tr>
<tr>
<td>Haematocrit</td>
<td>Frail if &lt; 0.35</td>
</tr>
</tbody>
</table>
## Self Reported Markers

| Low Activity          | Q: How often do you engage in activities that require a low to moderate level of activity (gardening, cleaning the car, going for a walk)?  
|                       | Frail if responds “1-3 times a month” or “Hardly ever”  
| Exhaustion            | Q: How often in the last week did you feel you could not get going?  
|                       | Q: How often in the last week did you feel everything you did was an effort?  
|                       | Frail if responds “Most of the time” or “All of the time”  
| Falls                 | Frail if any falls in the past 6 months  
| Dependence            | Frail if dependent in Katz Index of ADLs  

Who is ‘Frail’?
Who is 'Frail'?  

### Physical Assessment Markers

<table>
<thead>
<tr>
<th></th>
<th>Frail if</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Weight Loss</strong></td>
<td>&gt;4.5kg unintentional weight loss in 12 months or BMI &lt;18.5</td>
</tr>
<tr>
<td><strong>5m Walk Test</strong></td>
<td>average walk time ≥ 6 seconds</td>
</tr>
<tr>
<td><strong>Chair Rise</strong></td>
<td>total chair rise (3 times) ≥ 11 seconds</td>
</tr>
<tr>
<td><strong>Weakness</strong></td>
<td>best grip strength</td>
</tr>
</tbody>
</table>

#### Weakness

<table>
<thead>
<tr>
<th></th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BMI</strong></td>
<td>Grip (kg)</td>
<td><strong>BMI</strong></td>
</tr>
<tr>
<td>≤ 24</td>
<td>≤ 29</td>
<td>≤ 23</td>
</tr>
<tr>
<td>24-28</td>
<td>≤ 30</td>
<td>23-26</td>
</tr>
<tr>
<td>&gt; 28</td>
<td>≤ 32</td>
<td>26-29</td>
</tr>
<tr>
<td></td>
<td>&gt; 29</td>
<td>≤ 21</td>
</tr>
</tbody>
</table>
Number of Frail Indices

Exhaustion: 47
Activity: 37
Walk speed: 37
Creatinine: 24
Chair rise: 15
Falls: 15
Hct: 13
Weight loss: 11
Katz index: 11
Grip strength: 6
Albumin: 6
Total Summative Frailty Score

Frailty Grouping

- Normal: 60 (49%)
- Borderline: 46 (37%)
- Frail: 17 (14%)

Zero: 0
1: 1
2: 2
3: 3
4: 4
5: 5
6: 6
7: 7
8: 8

Total Summative Frailty Score

Bar Chart

- 30: 3
- 20: 4
- 10: 5
- 0: 6

Pie Chart

- Normal: 60 (49%)
- Borderline: 46 (37%)
- Frail: 17 (14%)
<table>
<thead>
<tr>
<th>Demographic Variable</th>
<th>Normal Population</th>
<th>Borderline Population</th>
<th>Frail Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Age (yrs)</td>
<td>76.0</td>
<td>77.0</td>
<td>80.6</td>
</tr>
<tr>
<td>Male (%)</td>
<td>78</td>
<td>65</td>
<td>47</td>
</tr>
<tr>
<td>Mean BMI (kg/m(^2))</td>
<td>28.0</td>
<td>29.6</td>
<td>28.7</td>
</tr>
<tr>
<td>LVEF &lt;40% (%)</td>
<td>7</td>
<td>17</td>
<td>12</td>
</tr>
<tr>
<td>Median Log Euroscore</td>
<td>5.85</td>
<td>7.25</td>
<td>15.67</td>
</tr>
<tr>
<td>Median Euroscore II</td>
<td>1.90</td>
<td>2.48</td>
<td>3.65</td>
</tr>
<tr>
<td>Smoking History</td>
<td>65%</td>
<td>48%</td>
<td>47%</td>
</tr>
<tr>
<td>Family History</td>
<td>27%</td>
<td>28%</td>
<td>24%</td>
</tr>
<tr>
<td>Hyperlipidaemia</td>
<td>82%</td>
<td>76%</td>
<td>76%</td>
</tr>
<tr>
<td>Hypertension</td>
<td>90%</td>
<td>80%</td>
<td>88%</td>
</tr>
<tr>
<td>Diabetes</td>
<td>20%</td>
<td>43%</td>
<td>24%</td>
</tr>
<tr>
<td>Cross Clamp (mins)</td>
<td>73.6</td>
<td>63.5</td>
<td>75.5</td>
</tr>
<tr>
<td>Bypass Time (mins)</td>
<td>102.5</td>
<td>91.7</td>
<td>107.6</td>
</tr>
</tbody>
</table>
# Composite Outcome

<table>
<thead>
<tr>
<th>Composite “Poor Outcome”</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Death</td>
</tr>
<tr>
<td>2. Deep Sternal Wound Infection</td>
</tr>
<tr>
<td>3. Length Of Stay ≥ 11 days</td>
</tr>
<tr>
<td>4. Inter-facility Transfer at discharge</td>
</tr>
</tbody>
</table>

- Increase the ability to detect clinically significant differences in outcome

- A LOS of 11 days is greater than twice the median stay in this cohort
Risk of unfavourable outcome by frailty

P=0.003
Individual Measures

Four measures showed independent relationship (p< 0.05) to the composite outcome:

- Walking speed
- Chair Rise
- Grip Strength
- Serum Albumin
Blood Usage

- Frailty also predicts need for blood product transfusion
- Independent of HCT in scoring system
- \( p=0.01 \)
## Predicted Mortality

<table>
<thead>
<tr>
<th></th>
<th>Mean Logistic Euroscore</th>
<th>Mean Euroscore II</th>
<th>Actual In Hospital Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>9.0</td>
<td>3.6</td>
<td>4/123 (3.3%)</td>
</tr>
<tr>
<td>Non-Frail Subset</td>
<td>7.8</td>
<td>3.2</td>
<td>3 / 106 (2.8%)</td>
</tr>
<tr>
<td>Frail Subset</td>
<td>16.2</td>
<td>6.1</td>
<td>1 / 17 (5.8%)</td>
</tr>
</tbody>
</table>
Quality of Life at Three Months

Assessed preoperatively and at three months postoperatively

SF-36 Questionnaire
- Eight Domains of Function

Follow-up at 3 months was 94% complete
- (110 of 117 survivors)
Preoperative QoL

SF-36 Score

Physical, Role Physical, Emotional, Role Emotional, Energy, Social, Pain, Overall Health

Normal, Borderline, Frail
Postoperative QoL

SF-36 Score

Physical
Role Physical
Emotional
Role Emotional
Energy
Social
Pain
Overall Health

Normal
Borderline
Frail
Change in QoL

Change in SF-36 Score

- Physical
- Role Physical
- Emotional
- Role Emotional
- Energy*
- Social*
- Pain
- Overall Health

Normal
Borderline
Frail

*p < 0.05
2 year follow-up -living status

1. In own home without services
2. In own home with in-home services
3. With family who provide daily care
4. In low care nursing facility or hostel
5. In high care nursing facility

<table>
<thead>
<tr>
<th>percent</th>
<th>Normal</th>
<th>Borderline</th>
<th>Frail</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. In own home without services</td>
<td>90%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. In own home with in-home services</td>
<td>10%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. With family who provide daily care</td>
<td>0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. In low care nursing facility or hostel</td>
<td>0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. In high care nursing facility</td>
<td>0%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Legend:
- Blue: Normal
- Purple: Borderline
- Red: Frail
2 year follow-up
ADL's requiring assistance

percent

Normal
Borderline
Frailty

Bathing
Dressing
Mobility
Home maintenance
Kaplan-Meier Survival Curves

- Group
- Normal
- Borderline
- Frail

months
So where does this leave us?

- We will need to become increasingly selective about who we spend this precious resource on.

- We will need to improve our risk stratification of patients to encompass factors such as frailty.

- We will need to consider QOL outcomes not just mortality/morbidity.
So where does this leave us?

- We will need to become increasingly selective about who we spend this precious resource on.

- We will need to improve our risk stratification of patients to encompass factors such as frailty.

- We will need to consider QOL outcomes not just mortality/morbidity.

WE WILL NEED TO BECOME HEALTH ECONOMISTS
The IMF said health costs will be the biggest burden for governments, and that the main driver is not ageing populations but generous health care systems, costly procedures based on new technologies, and the rising incomes that have so far afforded rising medical costs.
The IMF said health costs will be the biggest burden for governments, and that the main driver is not ageing populations but generous health care systems, costly procedures based on new technologies, and the rising incomes that have so far afforded rising medical costs.

**HOWEVER**

The end goal must be a substantial reduction in the unsustainable costs in health, quality of life and resources incurred by flawed decision making in this large (and increasing) patient population