Here Come the Centenarians!

M. Roseann Cannon-Diehl, CRNA, MHS
Clinical Faculty
Sanford-MeritCare Healthcare system
Fargo, ND
Objectives

- Discuss age-related changes
  - CV, Pulmonary, CNS, Pharmacokinetics
- Apply evidence-based ACC/AHA guidelines to aging population
- Anesthetic implications
## "Size of Treatment Effect"

<table>
<thead>
<tr>
<th>Level A</th>
<th>Class I</th>
<th>Benefit &gt;&gt; Risk</th>
<th>Procedure/Treatment SHOULD be performed/administered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple (3-5) population risk strata evaluated*</td>
<td>Recommendation that procedure or treatment is useful/effective</td>
<td>Sufficient evidence from multiple randomized trials or meta-analyses</td>
<td></td>
</tr>
<tr>
<td>General consistency of direction and magnitude of effect</td>
<td>IT IS REASONABLE to perform procedure/administer treatment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level B</td>
<td>Class II</td>
<td>Benefit &gt;&gt; Risk</td>
<td>Additional studies with focused objectives needed</td>
</tr>
<tr>
<td>Limited (2-3) population risk strata evaluated*</td>
<td>Recommendation in favor of treatment or procedure being useful/effective</td>
<td>Some conflicting evidence from multiple randomized trials or meta-analyses</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Class IIb</td>
<td>Benefit ≥ Risk</td>
<td>Additional studies with broad objectives needed; Additional registry data would be helpful</td>
</tr>
<tr>
<td></td>
<td>Procedure/Treatment MAY BE CONSIDERED</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level C</td>
<td>Class III</td>
<td>Risk ≥ Benefit</td>
<td>No additional studies needed</td>
</tr>
<tr>
<td>Very limited (1-2) population risk strata evaluated*</td>
<td>Recommendation’s usefulness/efficacy less well established</td>
<td>Greater conflicting evidence from multiple randomized trials or meta-analyses</td>
<td></td>
</tr>
</tbody>
</table>

### Suggested phrases for writing recommendations †

- **should** is recommended
- **is** indicated
- **may/might** be considered
- **is not** recommended

- **is** useful/effective/beneficial
- **may/might** be reasonable usefulness/effectiveness is unknown/unclear/uncertain or not well established
- **is** not useful/effective/beneficial

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*Data available from clinical trials or registries about the usefulness/efficacy in different sub-populations, such as gender, age, history of diabetes, history of prior MI, history of heart failure, and prior aspirin use. A recommendation with Level of Evidence B or C does not imply that the recommendation is weak. Many important clinical questions addressed in the guidelines do not lend themselves to clinical trials. Even though randomized trials are not available, there may be a very clear clinical consensus that a particular test or therapy is useful or effective.

† In 2003, the ACC/AHA Task Force on Practice Guidelines developed a list of suggested phrases to use when writing recommendations. All recommendations in this guideline have been written in full sentences that express a complete thought, such that a recommendation, even if separated and presented apart from the rest of the document (including headings above sets of recommendations), would still convey the full intent of the recommendation. It is hoped that
Current Aging Statistics

Which is more important to perioperative morbidity and mortality?

Chronological age or co-morbid disease?
National Surgical Quality Improvement Program

Relative Importance of Preoperative Health Status Versus Intraoperative Factors in Predicting Postoperative Adverse Outcomes in Geriatric Patients

Journal of American Geriatric Society

• Prospective cohort study N = 544
• 70 years older undergoing noncardiac surgery
• 74.5% GETA
• 15.6% Regional anesthesia
• 9.9% Combination of general and regional
<table>
<thead>
<tr>
<th>Preoperative Chronic Health Conditions</th>
<th>Proportion of Patients (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetes mellitus</td>
<td>14.9</td>
</tr>
<tr>
<td>Hypertension</td>
<td>58.1</td>
</tr>
<tr>
<td>History of angina pectoris</td>
<td>16.4</td>
</tr>
<tr>
<td>History of myocardial infarction</td>
<td>9.1</td>
</tr>
<tr>
<td>History of vascular disease</td>
<td>17.7</td>
</tr>
<tr>
<td>Coronary artery bypass graft</td>
<td>5.9</td>
</tr>
<tr>
<td>Percutaneous transluminal coronary angioplasty</td>
<td>3.7</td>
</tr>
<tr>
<td>History of congestive heart failure</td>
<td>7.8</td>
</tr>
<tr>
<td>History of dysrhythmias</td>
<td>19.6</td>
</tr>
<tr>
<td>History of valvular disease</td>
<td>5.7</td>
</tr>
<tr>
<td>Pulmonary disease</td>
<td>21.9</td>
</tr>
<tr>
<td>History of smoking</td>
<td>39.9</td>
</tr>
<tr>
<td>Current smoking</td>
<td>6.9</td>
</tr>
<tr>
<td>History of neurologic disease</td>
<td>22.4</td>
</tr>
<tr>
<td>History of renal disease</td>
<td>7.6</td>
</tr>
<tr>
<td>0 preoperative conditions</td>
<td>16</td>
</tr>
<tr>
<td>1 Preoperative condition</td>
<td>27.5</td>
</tr>
<tr>
<td>2 Preoperative conditions</td>
<td>26.9</td>
</tr>
<tr>
<td>≥3 Preoperative conditions</td>
<td>29.3</td>
</tr>
<tr>
<td>Intraoperative Events</td>
<td>Proportion of Patients with Events (%)</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>----------------------------------------</td>
</tr>
<tr>
<td>Heart rate &gt; 100 bpm</td>
<td>7.5</td>
</tr>
<tr>
<td>Systolic blood pressure &lt; 80 mmHg</td>
<td>0.55</td>
</tr>
<tr>
<td>Systolic blood pressure &gt; 80 mmHg</td>
<td>14.7</td>
</tr>
<tr>
<td>Intraoperative desaturation ( (O_2) saturation &lt; 95% )</td>
<td>2</td>
</tr>
<tr>
<td>Use of neosynephrine or ephedrine</td>
<td>56</td>
</tr>
<tr>
<td>Use of other vasoactive agents*</td>
<td>4.2</td>
</tr>
<tr>
<td>Use of beta blockers</td>
<td>24</td>
</tr>
<tr>
<td>0 Intraoperative events</td>
<td>77.6</td>
</tr>
<tr>
<td>1 Intraoperative event</td>
<td>20.0</td>
</tr>
<tr>
<td>2 Intraoperative events</td>
<td>2.4</td>
</tr>
<tr>
<td>Total patients/total events</td>
<td>122/135</td>
</tr>
</tbody>
</table>

*Other vasoactive agents = calcium, dobutamine, dopamine or epinephrine.
<table>
<thead>
<tr>
<th>Types of postoperative adverse outcomes</th>
<th>Number (%) of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Death</td>
<td>20 (3.7)</td>
</tr>
<tr>
<td>Cardiac complications</td>
<td>56 (10.3)</td>
</tr>
<tr>
<td>Ischemic complications</td>
<td>29 (5.3)</td>
</tr>
<tr>
<td>Myocardial infarctions</td>
<td>10 (1.8)</td>
</tr>
<tr>
<td>Heart failure</td>
<td>18 (3.3)</td>
</tr>
<tr>
<td>Dysrhythmia</td>
<td>32 (5.9)</td>
</tr>
<tr>
<td>Hepatic/gastrointestinal</td>
<td>3 (0.5)</td>
</tr>
<tr>
<td>Infection</td>
<td>27 (4.9)</td>
</tr>
<tr>
<td>Neurological complications</td>
<td>42 (7.7)</td>
</tr>
<tr>
<td>Delirium</td>
<td>37 (6.8)</td>
</tr>
<tr>
<td>CVA/TIA</td>
<td>5 (0.9)</td>
</tr>
<tr>
<td>Pulmonary complications</td>
<td>30 (5.5)</td>
</tr>
<tr>
<td>Respiratory failure</td>
<td>18 (3.3)</td>
</tr>
<tr>
<td>Aspiration pneumonia</td>
<td>6 (1.1)</td>
</tr>
<tr>
<td>Pleural effusion</td>
<td>7 (1.2)</td>
</tr>
<tr>
<td>Renal complications</td>
<td>14 (2.6)</td>
</tr>
<tr>
<td>Reoperation</td>
<td>19 (3.5)</td>
</tr>
<tr>
<td>Surgical complications</td>
<td>21 (3.9)</td>
</tr>
<tr>
<td>Thrombo-embolic events</td>
<td>6 (1.1)</td>
</tr>
<tr>
<td>Others*</td>
<td>12 (2.2)</td>
</tr>
<tr>
<td>Total patients/total events</td>
<td>112/250</td>
</tr>
<tr>
<td>0 Postoperative adverse outcomes</td>
<td>432 (79.4)</td>
</tr>
<tr>
<td>1 Postoperative adverse outcome</td>
<td>61 (11.2)</td>
</tr>
<tr>
<td>2 Postoperative adverse outcomes</td>
<td>21 (3.9)</td>
</tr>
<tr>
<td>3 Postoperative adverse outcomes</td>
<td>30 (5.5)</td>
</tr>
</tbody>
</table>
Aging
Cardiovascular Changes

Elderly vs Young
HR =
BP >
EF =
LVEDV <
SV <
CO <

CO ↓ 1% per year after 20 yrs

Aging
Cardiovascular system

1. Stiffening of connective tissue
   – Systolic hypertension
   – Diastolic dysfunction
2. ↓ response to Beta stimulation
   – Overall decreased heart rate
3. ↑ SNS activity
4. ↑ SVR
5. ↓ basal vagal tone

Aging
A stiffer CV system

Arterial stiffening--->Systolic HTN--->Reflected waves to thoracic aorta--->increased myocardial stress--->dysfunction)--->increased atrial pressure-->increased Atrial fibrillation

Venous stiffening--->less reservoir for venous return--->increased lability to changes in preload

Aging

*Diastolic Dysfunction*

- Systolic HTN
- Ventricular hypertrophy
- Increased left atrial volume


74 year-old woman in preoperative clinic before elective right shoulder arthroplasty.
PMH: HTN, osteoarthritis, +Tob history (quit 20 yrs ago), mild COPD. Denies CV problems, exertional dyspnea while walking dog up hill, Medications: HCTZ, lisinopril
VS: 158/64, pulse 78 bts/min, RASPO$_2$ 98%
Exam: lungs clear, regular rhythm
ECG: NSR, non-specific S-T changes
Echo: EF 65%, impaired LV relaxation, moderate concentric LVH, and LAE
Aging
Risk factors for Diastolic HF

- Age > 70, HTN woman
- Systolic HTN, increased pulse pressure > 60 mmHg
- Diabetes, CRI
- Echo: Normal EF, delayed relaxation, LAE, LVH
- Recent weight gain
- Exercise intolerance
- B-type natriuretic peptide (BNP) >120 pg/mL

Aging
A stiffer CV system

Aging

Changes in blood volume

Aging

Decreased baroreceptor response

Aging

**Beta-blockers (BB)**

- Continue throughout the perioperative period if high cardiac risk (IB)
- Continue throughout perioperative period when used to treat angina, symptomatic dysrrhythmias, HTN (IC)
- BB “probably” recommended for patients (IIaB) – undergoing vascular surgery with CHD
- Uncertain in patients undergoing vascular surgery with no clinical risk factors (IIbC)

**ACC/AHA Clinical risk factors**
- **IHD**
- History of heart failure
- History of cerebrovascular disease
- Diabetes mellitus
- Renal insufficiency

Eagle, et al, ACC/AHA guidelines, 2007 (Guidelines)
85 year-old man presents for nephrectomy for renal cell carcinoma

**PMH:** +tob history (150 pack yrs), COPD, O2 2L/NC nightly, stable infrarenal abdominal aneurysm, history of SVT, T2DM (well controlled).

**Internal medicine:** Optimized for surgery. started on a beta blocker 3 days before surgery (metoprolol 25 mg PO daily).

**Contraindications to beta blockade**
- Symptomatic bradycardia
- 2nd or 3rd degree AVB
- Severe HF or EF < 30%
- Hypotension
- Cardiogenic shock
- COPD with strong reactive component
- Severe asthma requiring steroids
- Aortic valve stenosis

It was decided to cancel the case.
Aging

Response to anesthesia

Aging

Functional status

- Men: improved LV function, CO and SV with aerobic activity and beta stimulation
- Women: improved oxygen consumption, but no cardiac adaptation

Aging
Angina Protection--Preconditioning

Aging
Dysrhythmias

- Atrial fibrillation (most common)
  - Affects nearly 10% over 80 years
- SA node dysfunction
- AV slowed conduction
- Ventricular ectopy
- Heart block

Aging
Dysrhythmias

ACC/AHA Clinical risk factors
IHD
History of heart failure
History of cerebrovascular disease
Diabetes mellitus
Renal insufficiency

• Asymptomatic and low-risk procedures--not

ACC/AHA Guidelines, 2007
Aging

**Active CV Conditions Further Testing**

- Unstable coronary syndromes (IB)
- Decompensated HF (IB)
- Significant dysrhythmias (IB)
  - 2nd or 3rd AVB
  - Ventricular dysrhythmias
  - Bradycardia
- Severe valvular disease (IB)

ACC/AHA Guidelines, 2007
ACC/AHA Guidelines, 2007
Mr. W is admitted to hospital with a painful, ischemic leg and scheduled for a fem-pop bypass. His family is concerned that over the past 3 weeks, he has also become more confused. After neuropsychological testing it is deemed that his mental status is impaired by pain, and additional medications.

**PMH:** IHD, prior MI (5 years ago), CABG (5 years ago), poorly controlled T2DM, peripheral neuropathy, retinopathy, peripheral vascular disease, left-sided stroke (3 years ago), baseline AF, ADL’s with no assistance

**Medications:** ASA, atorvastatin, clopidogrel, duoxetine, furosemide, metoprolol, potassium, warfarin, sliding scale insulin, gabapentin, hydrocodone, acetaminophen, tramadol and oxycodone
Preoperative 12-Lead
Revised Cardiac Risk Index

6 independent predictors of major cardiac complications

High-risk surgery
Preoperative treatment with insulin
Preoperative Cr $>2.0$ mg/dL
History of ischemic heart disease
History of CHF
History of cerebrovascular disease

0 factors = 0.4-0.5% risk
1 factor = 0.9-1.3% risk
2 factors = 4-7% risk
3 or more factors = 9-11% risk

Lee: Circulation, 100(10). September 7, 1999. 1043-1049
ACC/AHA Guidelines 2007
Cardiac Risk Stratification for Non-cardiac Surgical Procedures

Risk Stratification                                           Procedure Examples
• Vascular (cardiac risk often > 5%)                      Aortic and other major vascular surgery
                                           Peripheral vascular surgery
• Intermediate (cardiac risk 1% to 5%)                     Intraperitoneal and intrathoracic surgery
                                           Carotid endarterectomy
                                           Head and neck surgery
                                           Orthopedic surgery
                                           Prostate surgery
• Low (reported cardiac risk generally less than 1%)       Endoscopic procedures
                                           Superficial procedure
                                           Cataract surgery
                                           Breast surgery
                                           Ambulatory surgery

ACC/AHA Guidelines, 2007
Step 1: Need for emergency noncardiac surgery?
  Yes (Class I, LOE C) → Operating room → Perioperative surveillance and postoperative risk stratification and risk factor management
  No →

Step 2: Active cardiac conditions*
  Yes (Class I, LOE B) → Evaluate and treat per ACC/AHA guidelines → Consider operating room
  No →

Step 3: Low risk surgery
  Yes (Class I, LOE B) → Proceed with planned surgery
  No →

Step 4: Good functional capacity (MET level greater than or equal to 4) without symptoms†
  Yes (Class I, LOE B) → Proceed with planned surgery
  No or unknown →

Step 5: No or unknown
  3 or more clinical risk factors‡ → Vascular surgery
    Class IIa, LOE B → Consider testing if it will change management§
  1 or 2 clinical risk factors‡ → Intermediate risk surgery
  No clinical risk factors‡ → Proceed with planned surgery

ACC/AHA Guidelines, 2007
Aging

Pulmonary function changes

- ↓ Elastic recoil
- ↑ Static compliance
- ↑ Residual volume
- ↑ Anatomical and functional deadspace
  - ↓ Vital capacity
  - ↑ Small airway closure
- ↓ FEV$_1$ (Normal 70% at age 70)

Aging

Oxygenation changes

• PAO$_2$ (No change)
• ↓PaO$_2$
  – $(102 - 0.5 \times \text{age})$ or
  – ↓.31 mmHg/yr after 20
• PaCO$_2$ (No change)
• ↓CNS sensitivity to hypoxemia and hypercapnia

Aging

Renal function

- ↓ Renal mass
  - Glomerulosclerosis
  - Chronic infiltration by inflammatory cells
  - Fibrosis
- ↓ Creatinine
- ↓ Ability to concentrate urine
- ↓ Ability to conserve Na
- Comorbidities
  - HTN, T2DM, impaired glucose tolerance

Aging

Co-medication

• >70% (over 70 years old) one drug

• CV drugs
  – Stopped for less than 48 hours (12%)
  – >48 hours 27% (p = .07)


Aging

Polypharmacy

The morning following admission he undergoes a lower extremity angiogram and receives fentanyl 50 mcg and midazolam 1.5 mg. Tolerates the procedure well, but becomes progressively more agitated later that evening.

Bleeding develops around the site and hematocrit drops from 34% to 24%, necessitating 2 units of PRBCs. There is further concern that he will have bleeding from the site and haloperidol is ordered and given. By morning he is extremely sedated and minimally responsive. VSS.

Labs are drawn at this point. Na 131, HCT 32%. All other electrolytes normal. He remains hospitalized for the next 10 days and is discharged to a rehab facility.

Surgery is scheduled in 4 weeks.
Aging Polypharmacy

- Multiple comorbidities
- Drug-drug interactions
- Age related metabolism issues
- CNS increased sensitivity to sedation
- Complicated medication regimens
- Multiple providers

Aging

Beer’s Criteria

• **Inappropriate (always avoid)**
  – Flurazepam (Dalmane)
  – Pentozocine (Talwin)
  – Meperidine (Demerol)

• **Risky (avoid if possible)**
  – Long-acting benzodiazepines: diazepam (Valium)
  – Limit doses: intermediate acting benzodiazepines: lorazepam (Ativan)

• **Ineffective or a better alternative exists**
  – Diphenhydramine (Benadryl)
  – Chlorpheniramine (Chlor-trimetron)
  – Ketorolac (Toradol)
  – Clopidogrel (Plavix)

Aging

Anticholinergic Risk Scale

• 1 point
  – Haloperidol (Haldol)
  – Metoclopramine (Reglan)
  – Paroxetine (Paxil)

• 2 points
  – Baclofen
  – Prochlorperazine (Compazine)
  – Cyclobenzaprine (Flexeril)

• 3 points
  – Atropine-like medications
  – Chlorpheniramine (Chlor-trimeton)
  – Diphenhydramine (Benedryl)
  – Promethazine (Phenergan)
  – Fluphenazine (Prolixin)
  – Chlorpromazine (Thorazine)

Aging

Drug Issues

- **Meperidine** (delirium)
  - with MAOIs can induce serotonergic crisis
- **Diphenhydramine** (delirium)
- **MAOI’s** (exaggerated responses to indirect-acting catecholamines, direct-acting exaggerated response to a lesser extent)
- **Levodopa** (orthostatic hypotension, hypovolemia)
  - Metoclopramide and phenothiazines can worsen Parkinson symptoms
- **ACE inhibitors** (exaggerated hypotension)

Pharmacokinetic Issues

- ↓Lean body mass
- ↓Water
- ↑Fat mass
- Plasma protein
  - ↓Albumin
  - ↑Alpha-1-glycoprotein

Aging

Anesthetic Drug Issues

- STP, Propofol ↓ dose 20%
- Etomidate (↓ VD)
- Midazolam (↑ potency)
- Opioids (↑ potency, ↓ clearance)
- Succinylcholine (prolonged duration)
- Non-depolarizers (variable action)
- Volatile agents (↑ potency)
- Local anesthetics (increased spread)

Sadean, & Glass. (2003). Pharmacokinetics in the elderly. Best Practice & Research Clinical Anesthesiology, 17 (2), 191-205 (Review)
Aging
Pharmacological Assessment

- Pain meds
- OTC and herbal remedies
- Narrow therapeutic index
  - Oral hypoglycemics
  - Calcium channel blockers
  - TCA
  - Warfarin
  - Digoxin
  - Phenytoin
- Comorbidities
Aging CNS

- Loss of neuronal substance
- ↓ brain weight
- ↓ MAC
- ↓ epidural dose requirements

CNS Dysfunction

*Postoperative cognitive deterioration*

- Dementia
- Delirium (10%)
- Mild neurocognitive disorder
  - Postoperative cognitive dysfunction (POCD)


CNS Dysfunction

*Postoperative cognitive deterioration*

- Dementia
- Delirium (10%)
- Mild neurocognitive disorder
  - Postoperative cognitive dysfunction (POCD)

Increasing risk

- Advanced age (>75 years)
- Physical status (> II);
  - Increased co-morbid conditions
  - Electrolyte disturbances (Na++, albumin)
- Previous history psychiatric illness
- Nutritional deficiency
- ETOH and benzodiazepine withdrawal

Occurring most often between the 2nd and 7th POD

Incidence
- Ortho > CV surgery
CNS Dysfunction

Postoperative Delirium

- Impaired cognition
- Fluctuating levels of consciousness
- Memory and perception abnormalities
- Language difficulties
- Emotional lability (anxiety, fear, anger, depression)

CNS Dysfunction

*Mechanisms of injury*

<table>
<thead>
<tr>
<th>Metabolic issues</th>
<th>Neurological injury</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Electrolyte abnormalities</td>
<td>• Hypoxia</td>
</tr>
<tr>
<td>• Hypoglycemia/hyperglycemia</td>
<td>• Low CPP</td>
</tr>
<tr>
<td>• Renal dysfunction</td>
<td>• Embolic/thrombotic stroke</td>
</tr>
<tr>
<td>• Hypothyroidism</td>
<td>• Cerebral edema</td>
</tr>
<tr>
<td>• Hypo-, hyperthermia</td>
<td>• Infection</td>
</tr>
<tr>
<td>• Hepatic dysfunction</td>
<td>• Seizures</td>
</tr>
</tbody>
</table>

CNS dysfunction

Perioperative issues

- Drug combinations
- Episodes of hypotension, hypoxemia, anemia, electrolyte imbalances, hypoglycemia, hypovolemia
- Type of anesthesia???

CNS dysfunction

Perioperative issues

• Look for underlying cause
• Treat pain
• Pharmacological solutions: haloperidol
• ETOH w/d treat with benzodiazepines

Relationship between pain and opioids analgesics on development of delirium following hip fracture

R. S. Morrison et al.

- Prospective study N = 541
- 65 years older with hip fractures
- 16% incidence of postoperative delirium
- Undertreated pain 9 times more likely to develop delirium

Gerontology Applied Biological Sciences, 2003
Aging Neuropathic Pain

• Decreased CNS involvement
  – Brain atrophy
  – Increased peripheral sensitivity

• Degenerative changes of spine
  – Facet hypertrophy
  – Enlargement of ligamentum flavum

• Osteoporosis

CNS Dysfunction

Best Evidence for Treatment of Pain?

• Neuraxial techniques
  – Mixed improvement in morbidity/mortality
    • 2 large RCT’s (Park, Thompson & Lee, Annals of Surgery, 2001; Rigg, Jamrozik, & Myles, Lancet, 2002)
  – Better analgesia/patient satisfaction
    • Meta-analysis (Block, Liu, Rowlingson, et al, JAMA, 2003)

• Parenteral opioids

• Multimodal approach

“Start low and go slow”
CNS Dysfunction
Mini-Mental Status Exam

- What is your age?
- Please tell me the current time.
- Tell the patient an address and have them repeat it now and at the end of the test.
- What year is it?
- Where are you right now?
- What is the name of the hospital?
- Can you recognize (name) or (name)?
  - 2 people
- When were you born?
- Who is the current president?
- Count backwards down from 20.

A score of 6 or less suggests possible CNS dysfunction

CNS Dysfunction

*POCD*

- Impairment
  - Memory (decreased recall)
  - Concentration
  - Language comprehension
  - Social integration

50-80% on discharge post-CABG
20-60% Several months post-CABG
25% Noncardiac surgery

CNS Dysfunction

Factors associated with POCD

- Preoperative medication
- Hypothermia
- Hypotension
- Hypoxia
- Catecholamines
- Anticholinergics
- Glycemic control
- Carotid endarterectomy
- Cardiopulmonary bypass

Orthopedic Surgery

*General vs Regional*

- Mobility
- Pain
- Dementia

No evidence exists supporting one type of anesthesia to reduce morbidity and mortality, although continuous regional anesthesia appears promising (IIbC)

Ophthalmologic Surgery

Perioperative Issues

- Minimally invasive
- Presence of co-morbid disease
- Resting 12-lead not predictive of cardiac risk

AHA ACC guidelines recommend resting 12-lead on only those with recent episodes of chest pain and asymptomatic diabetes patients, or worsening disease. Routine CXR not indicated in absence of pre-existing lung disease.

Aging

Anesthetic recommendations

- Thorough preanesthetic evaluation
  - Comorbidities, CNS function, CV functional status, polypharmacy

- Prepare for hypotension
  - Fluids, pressors

- Titrate anesthesia carefully

- Consider avoiding drugs that may contribute to POCD and delirium

“Start low and go slow”
Don’t you wish everyone aged like a superhero?
Orthopedic Surgery

Distinctive Features

• Osteoarthritis
• Rheumatoid arthritis
• Hip fractures
  – 1 in 50 > 60 yrs old
• Fat/air embolism

Ophthalmologic Surgery

Perioperative Issues

- Remifentanil (0.3 mcg/kg)
- Propofol (0.5 mg/kg)
- Fentanyl
- Midazolam