

# Here Come the Centenarians!



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# Objectives

- Discuss age-related changes
  - CV, Pulmonary, CNS, Pharmacokinetics
- Apply evidence-based ACC/AHA guidelines to aging population
- Anesthetic implications

“Estimate of Certainty (Precision) of Treatment Effect”

“Size of Treatment Effect”

|   | Class I<br><i>Benefit &gt;&gt;&gt; Risk</i>   | Class IIa<br><i>Benefit &gt;&gt; Risk</i><br><i>Additional studies with focused objectives needed</i>   | Class IIb<br><i>Benefit ≥ Risk</i><br><i>Additional studies with broad objectives needed; Additional registry data would be helpful</i>   | Class III<br><i>Risk ≥ Benefit</i><br><i>No additional studies needed</i>   |
|---|---|---|---|---|
|   | Procedure/Treatment <b>SHOULD</b> be performed/administered   | IT IS REASONABLE to perform procedure/administer treatment  | Procedure/Treatment <b>MAY BE CONSIDERED</b>  | Procedure/Treatment should <b>NOT</b> be performed/administered <b>SINCE IT IS NOT HELPFUL AND MAY BE HARMFUL.</b>  |
| Level A<br><br><i>Multiple (3-5) population risk strata evaluated*</i><br><br><i>General consistency of direction and magnitude of effect</i> | <ul style="list-style-type: none"> <li>• Recommendation that procedure or treatment is useful/effective</li> <li>• Sufficient evidence from multiple randomized trials or meta-analyses</li> </ul>    | <ul style="list-style-type: none"> <li>• Recommendation in favor of treatment or procedure being useful/effective</li> <li>• Some conflicting evidence from multiple randomized trials or meta-analyses</li> </ul>        | <ul style="list-style-type: none"> <li>• Recommendation’s usefulness/efficacy less well established</li> <li>• Greater conflicting evidence from multiple randomized trials or meta-analyses</li> </ul>       | <ul style="list-style-type: none"> <li>• Recommendation that procedure or treatment not useful/effective and may be harmful</li> <li>• Sufficient evidence from multiple randomized trials or meta-analyses</li> </ul>    |
| Level B<br><br><i>Limited (2-3) population risk strata evaluated*</i>   | <ul style="list-style-type: none"> <li>• Recommendation that procedure or treatment is useful/effective</li> <li>• Limited evidence from single randomized trial or non-randomized studies</li> </ul> | <ul style="list-style-type: none"> <li>• Recommendation in favor of treatment or procedure being useful/ effective</li> <li>• Some conflicting evidence from single randomized trial or non-randomized studies</li> </ul> | <ul style="list-style-type: none"> <li>• Recommendation’s usefulness/efficacy less well established</li> <li>• Greater conflicting evidence from single randomized trial or non-randomized studies</li> </ul> | <ul style="list-style-type: none"> <li>• Recommendation that procedure or treatment not useful/effective and may be harmful</li> <li>• Limited evidence from single randomized trial or non-randomized studies</li> </ul> |
| Level C<br><br><i>Very limited (1-2) population risk strata evaluated*</i>  | <ul style="list-style-type: none"> <li>• Recommendation that procedure or treatment is useful/effective</li> <li>• Only expert opinion, case studies, or standard-of-care</li> </ul>                  | <ul style="list-style-type: none"> <li>• Recommendation in favor of treatment or procedure being useful/ effective</li> <li>• Only diverging expert opinion, case studies, or standard-of-care</li> </ul>                 | <ul style="list-style-type: none"> <li>• Recommendation’s usefulness/efficacy less well established</li> <li>• Only diverging expert opinion, case studies, or standard-of-care</li> </ul>                    | <ul style="list-style-type: none"> <li>• Recommendation that procedure or treatment not useful/effective and may be harmful</li> <li>• Only expert opinion, case studies, or standard-of-care</li> </ul>                  |

**Suggested phrases for writing recommendations †**

|   |   |   |   |
|---|---|---|---|
| <p>should</p> <p>is recommended</p> <p>is indicated</p> <p>is useful/effective/beneficial</p> | <p>is reasonable</p> <p>can be useful/effective/ beneficial</p> <p>is probably recommended or indicated</p> | <p>may/might be considered</p> <p>may/might be reasonable</p> <p>usefulness/effectiveness is unknown /unclear/uncertain or not well established</p> | <p>is not recommended</p> <p>is not indicated</p> <p>should not</p> <p>is not useful/effective/beneficial</p> <p>may be harmful</p> |
|---|---|---|---|

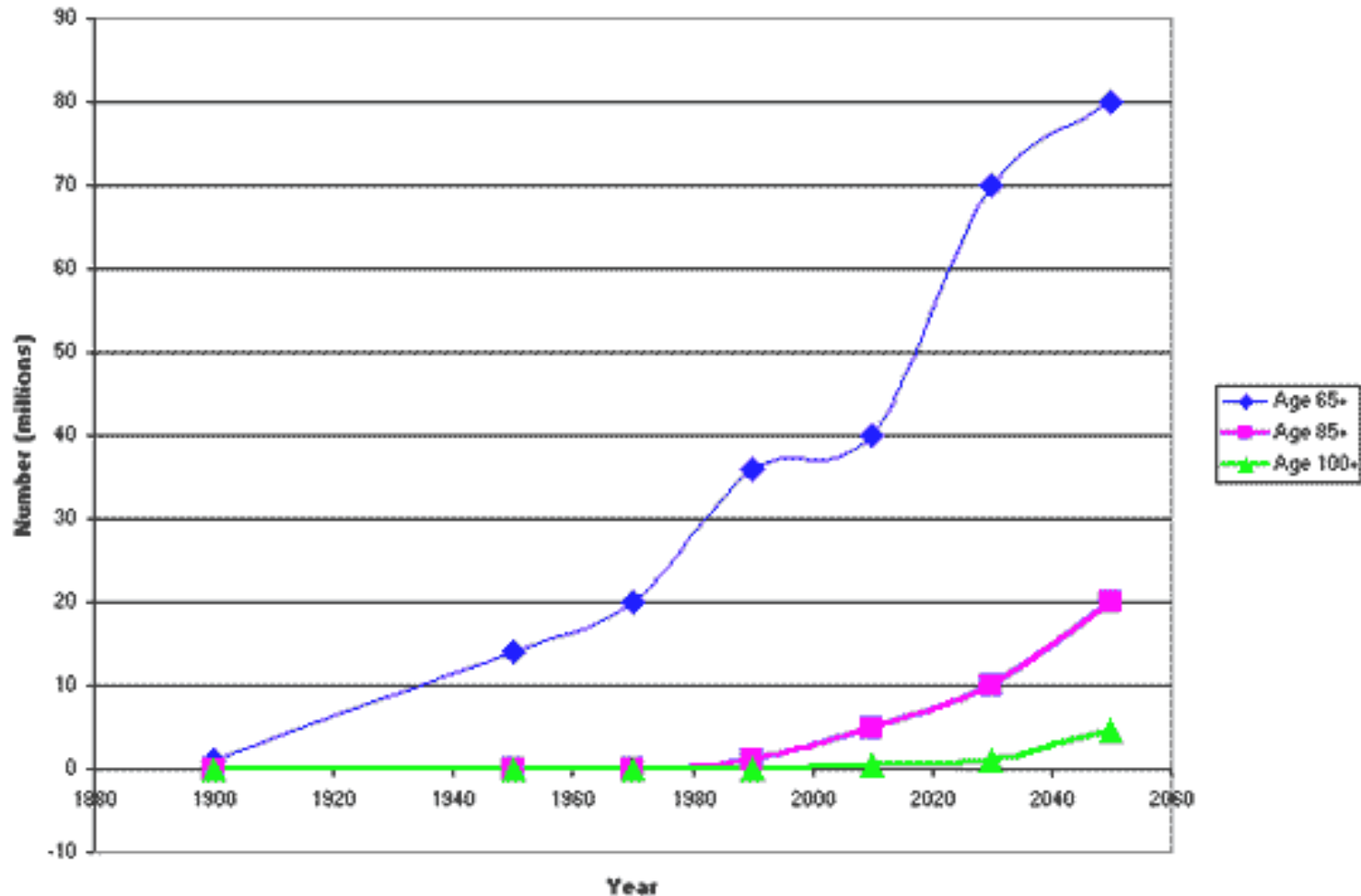
\*Data available from clinical trials or registries about the usefulness/efficacy in different sub-populations, such as gender, age, history of diabetes, history of prior MI, history of heart failure, and prior aspirin use. A recommendation with Level of Evidence B or C does not imply that the recommendation 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

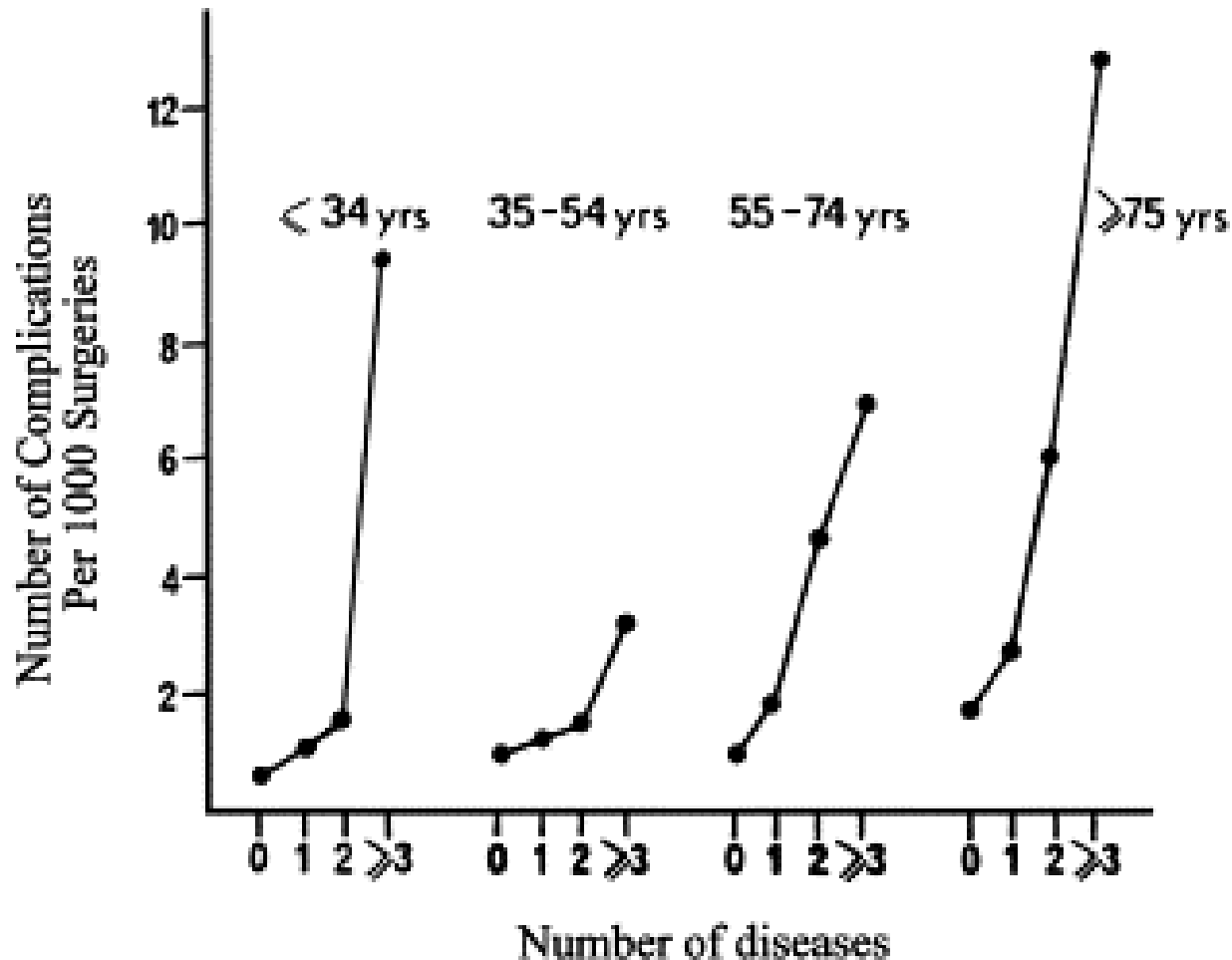


from Federal Interagency Forum on Aging-Related Statistics, "Older Americans 2000: Key Indicators of Well-Being," at [www.agingstats.gov/chartbook2000](http://www.agingstats.gov/chartbook2000); Centenarians in the United States -- Current Population Reports 1990

Which is more important to  
perioperative morbidity and mortality?

Chronological age or co-morbid disease?

# National Surgical Quality Improvement Program



Rooke. (2003). Cardiovascular aging and anesthetic implications. *Journal of Cardiothoracic and Vascular Anesthesia*, 17 (4), 512-23. (Review)

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

**J.M. Leung & S. Dzankic. (2002).  
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 1. Preoperative Chronic Health Conditions**

| Preoperative Conditions                           | Proportion of Patients (%) |
|---|----------------------------|
| Diabetes mellitus                                 | 14.9                       |
| Hypertension                                      | 58.1                       |
| History of angina pectoris                        | 16.4                       |
| History of myocardial infarction                  | 9.1                        |
| History of vascular disease                       | 17.7                       |
| Coronary artery bypass graft                      | 5.9                        |
| Percutaneous transluminal<br>coronary angioplasty | 3.7                        |
| History of congestive heart failure               | 7.8                        |
| History of dysrhythmias                           | 19.6                       |
| History of valvular disease                       | 5.7                        |
| Pulmonary disease                                 | 21.9                       |
| History of smoking                                | 39.9                       |
| Current smoking                                   | 6.9                        |
| History of neurologic disease                     | 22.4                       |
| History of renal disease                          | 7.6                        |
| 0 preoperative conditions                         | 16                         |
| 1 Preoperative condition                          | 27.5                       |
| 2 Preoperative conditions                         | 26.9                       |
| ≥3 Preoperative conditions                        | 29.3                       |

### Table 3. Adverse Intraoperative Events

| Intraoperative Events  | Proportion of Patients with Events (%) |
|--|--|
| Heart rate > 100 bpm   | 7.5                                    |
| Systolic blood pressure <80 mmHg                                 | 0.55                                   |
| Systolic blood pressure >80 mmHg                                 | 14.7                                   |
| Intraoperative desaturation<br>(O <sub>2</sub> saturation < 95%) | 2                                      |
| Use of neosynephrine or ephedrine                                | 56                                     |
| Use of other vasoactive agents*                                  | 4.2                                    |
| Use of beta blockers   | 24                                     |
| 0 Intraoperative events  | 77.6                                   |
| 1 Intraoperative event   | 20.0                                   |
| 2 Intraoperative events  | 2.4                                    |
| Total patients/total events                                      | 122/135                                |

\*Other vasoactive agents = calcium, dobutamine, dopamine or epinephrine.

**Table 4. Adverse Postoperative Events**

| Types of postoperative adverse outcomes | Number (%) of patients |
|---|------------------------|
| Death                                   | 20 (3.7)               |
| Cardiac complications                   | 56 (10.3)              |
| Ischemic complications                  | 29 (5.3)               |
| Myocardial infarctions                  | 10 (1.8)               |
| Heart failure                           | 18 (3.3)               |
| Dysrhythmia                             | 32 (5.9)               |
| Hepatic/gastrointestinal                | 3 (0.5)                |
| Infection                               | 27 (4.9)               |
| Neurological complications              | 42 (7.7)               |
| Delirium                                | 37 (6.8)               |
| CVA/TIA                                 | 5 (0.9)                |
| Pulmonary complications                 | 30 (5.5)               |
| Respiratory failure                     | 18 (3.3)               |
| Aspiration pneumonia                    | 6 (1.1)                |
| Pleural effusion                        | 7 (1.2)                |
| Renal complications                     | 14 (2.6)               |
| Reoperation                             | 19 (3.5)               |
| Surgical complications                  | 21 (3.9)               |
| Thrombo-embolic events                  | 6 (1.1)                |
| Others*                                 | 12 (2.2)               |
| Total patients/total events             | 112/250                |
| 0 Postoperative adverse outcomes        | 432 (79.4)             |
| 1 Postoperative adverse outcome         | 61 (11.2)              |
| 2 Postoperative adverse outcomes        | 21 (3.9)               |
| 3 Postoperative adverse outcomes        | 30 (5.5)               |

# Aging

## *Cardiovascular Changes*

Elderly vs Young

HR =

BP >

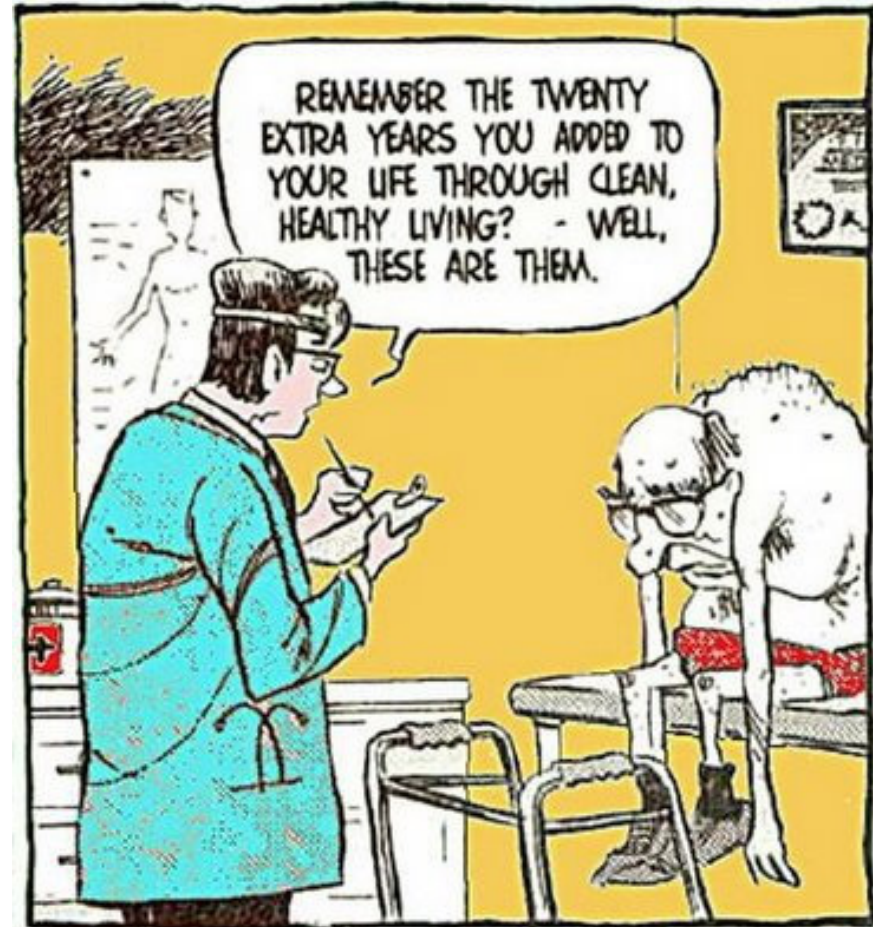
EF =

LVEDV <

SV <

CO <

CO ↓ 1% per year after 20 yrs



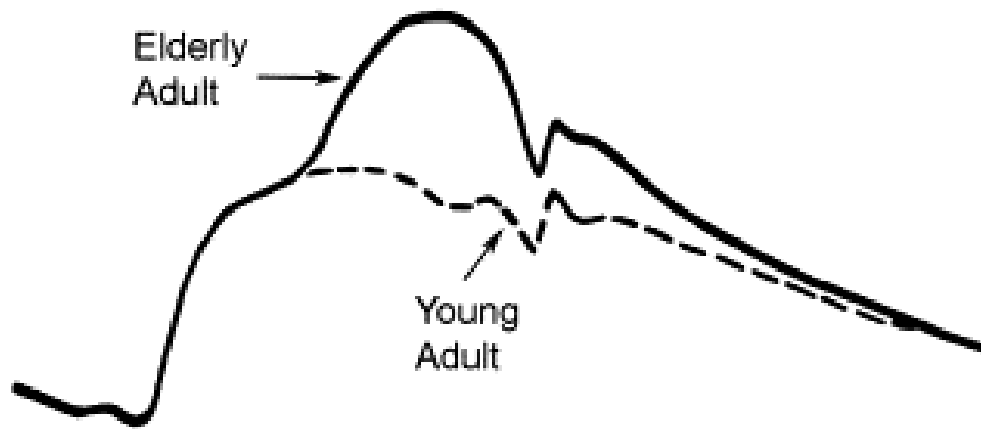
Rooke. (2003). Cardiovascular aging and anesthetic implications. *Journal of Cardiothoracic and Vascular Anesthesia*, 17 (4), 512-23.

# 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

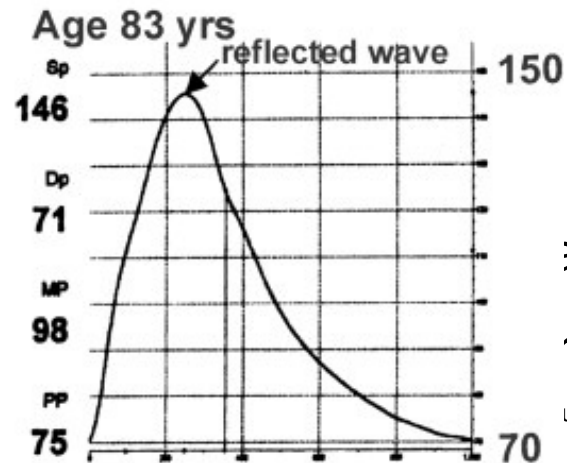
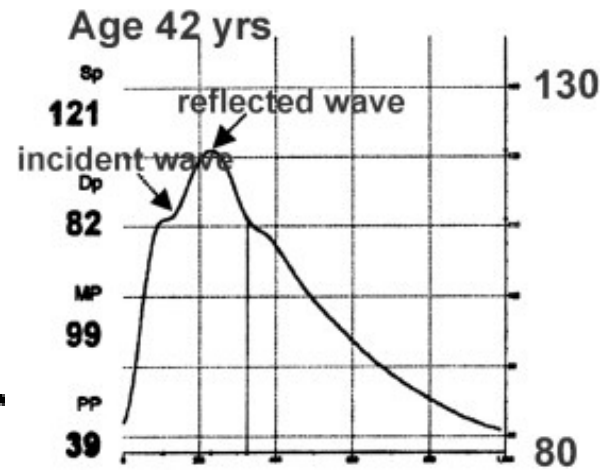
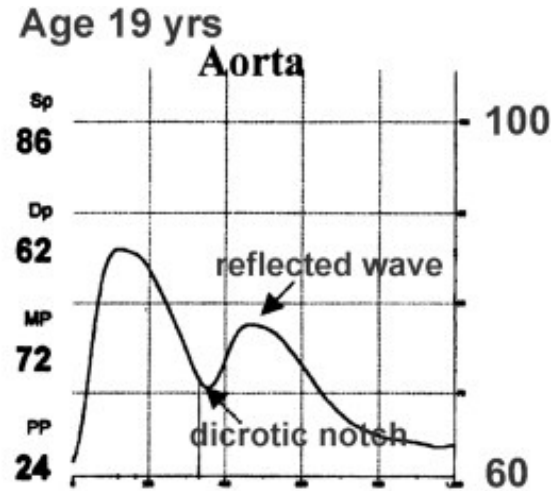
# Aging A stiffer CV



**Arterial stiffening**--> Systolic HTN--> R...  
 aorta--> increased myocardial stress-->  
 dysfunction)--> increased atrial pressure

**Venous stiffening**--> less reservoir for  
 lability to changes in preload

Rooke. (2003).  
 and Vascular A



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urnal of Cardiothoracic

# Aging

## *Diastolic Dysfunction*

- Systolic HTN
- Ventricular hypertrophy
- Increased left atrial volume



Rooke. (2003). Cardiovascular aging and anesthetic implications. *Journal of Cardiothoracic and Vascular Anesthesia*, 17 (4), 512-23.

Tonner, Kampen, & Scholz (2003). Pathophysiological changes in the elderly. *Best Practice & Research Clinical Anaesthesiology*, 17 (2), 163-177.

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<sub>2</sub> 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

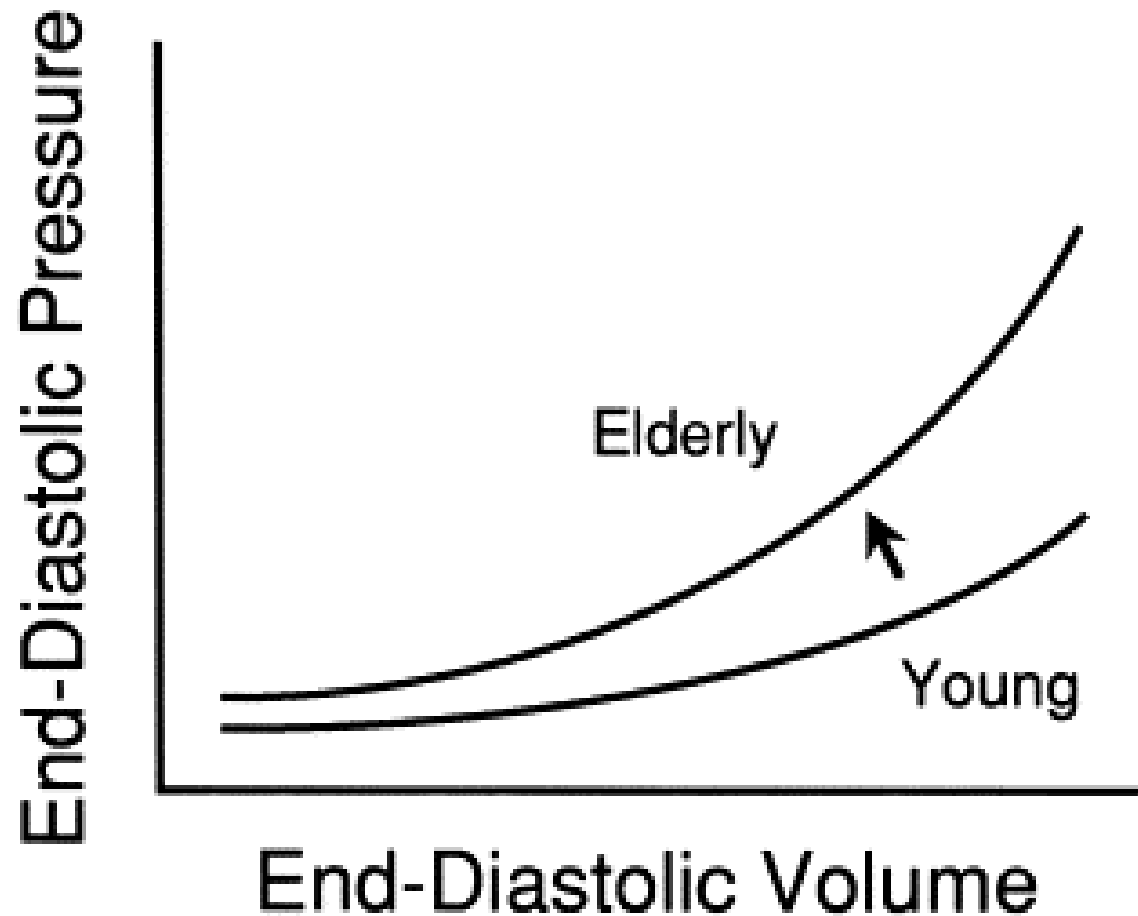
## *Risk factors for Diastolic HF*

- 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

Sanders, Dudley, & Grobin. (2009). Diastolic dysfunction, cardiovascular aging. *Anesthesiology Clinics*, 27, 497-517.

# Aging

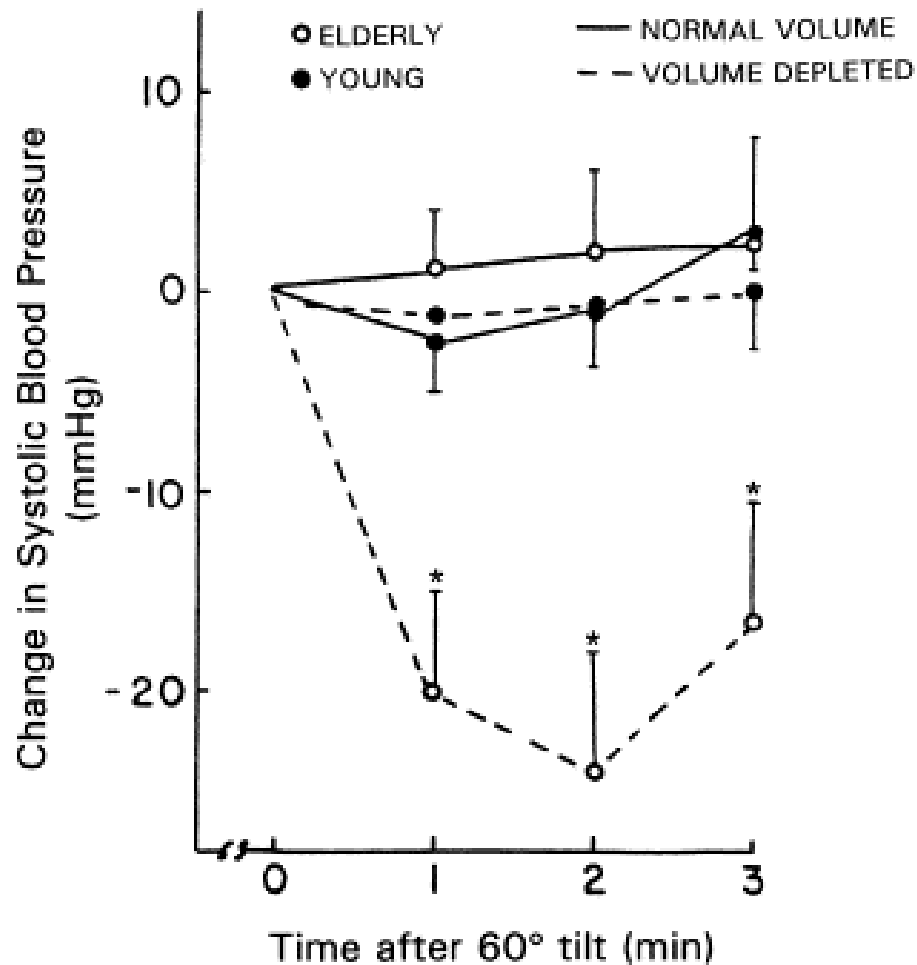
*A stiffer CV system*



Rooke. (2003). Cardiovascular aging and anesthetic implications. *Journal of Cardiothoracic and Vascular Anesthesia*, 17 (4), 512-23.

# Aging

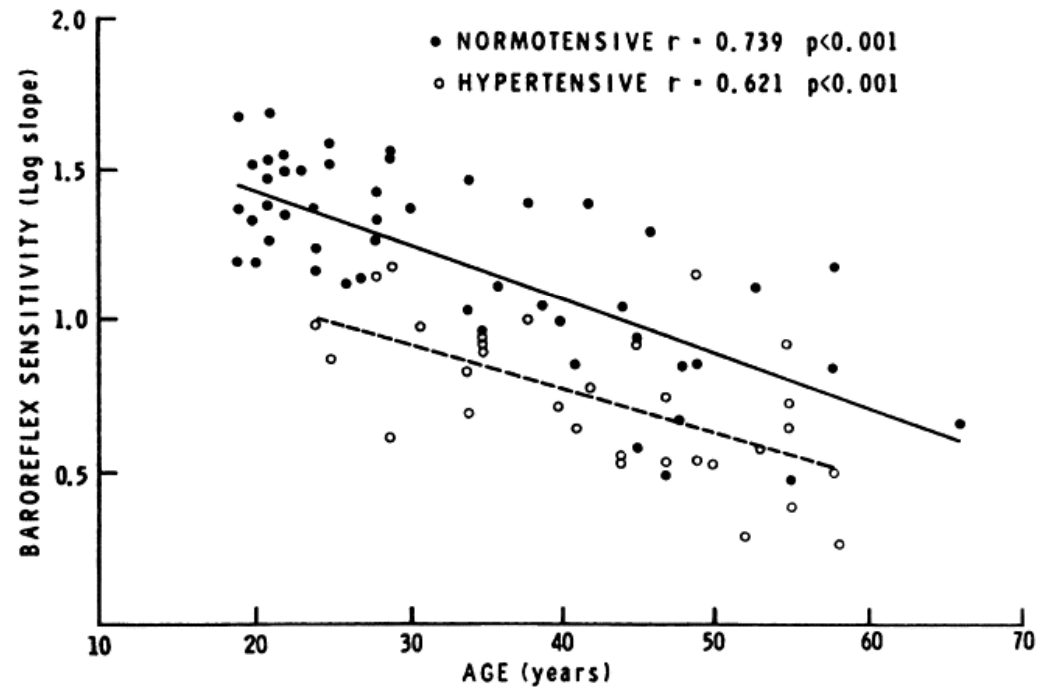
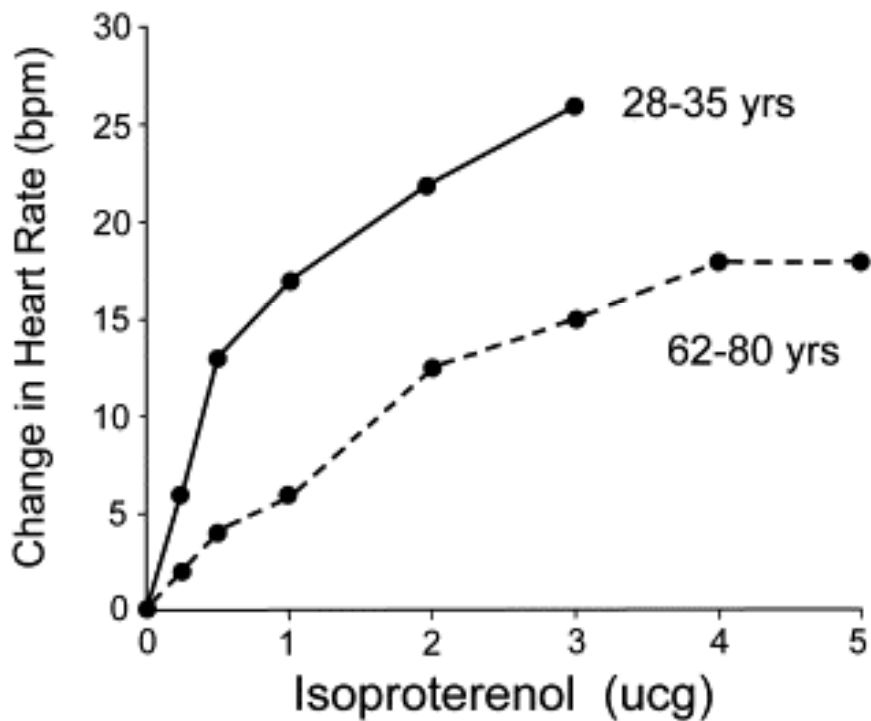
## *Changes in blood volume*



Rooke. (2003). Cardiovascular aging and anesthetic implications. *Journal of Cardiothoracic and Vascular Anesthesia*, 17 (4), 512-23.

# Aging

## *Decreased baroreceptor response*



Rooke. (2003). Cardiovascular aging and anesthetic implications. *Journal of Cardiothoracic and Vascular Anesthesia*, 17 (4), 512-23.

# Aging

## *Beta-blockers (BB)*

- Continue throughout the perioperative period if high cardiac risk (IB)
- Continue through the perioperative period when used to treat angina (IC)
- BB “p”
  - ur
  - th
  - hi
- Uncer  
no clinic

### **ACC/AHA Clinical risk factors**

IHD

History of heart failure

History of cerebrovascular disease

Diabetes mellitus

Renal insufficiency

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 med:**

beta

started on a

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

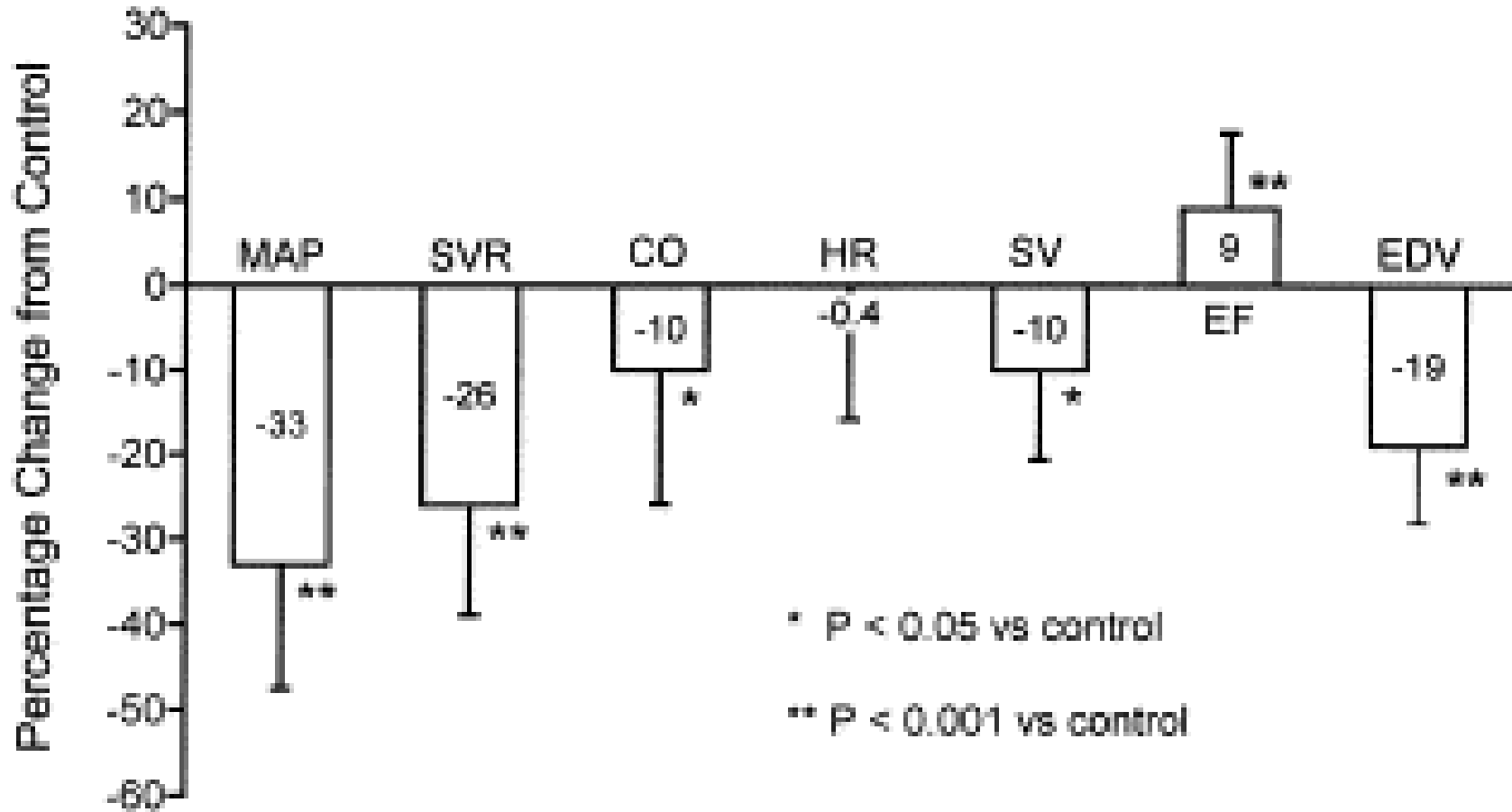
Severe asthma requiring steroids

Aortic valve stenosis

It w

# Aging

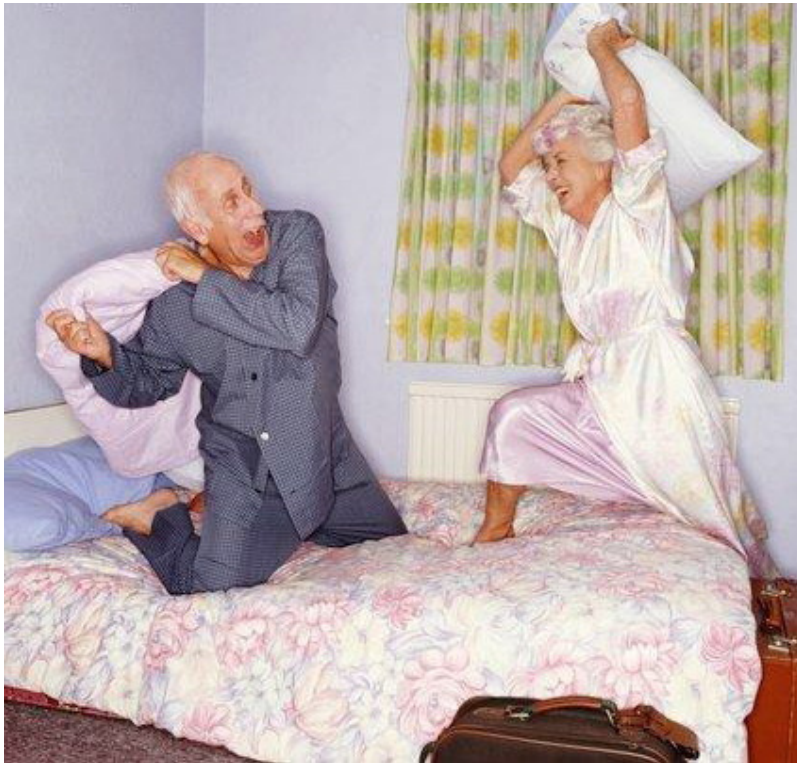
## *Response to anesthesia*



Rooke. (2003). Cardiovascular aging and anesthetic implications. *Journal of Cardiothoracic and Vascular Anesthesia*, 17 (4), 512-23.

# Aging

## *Functional status*

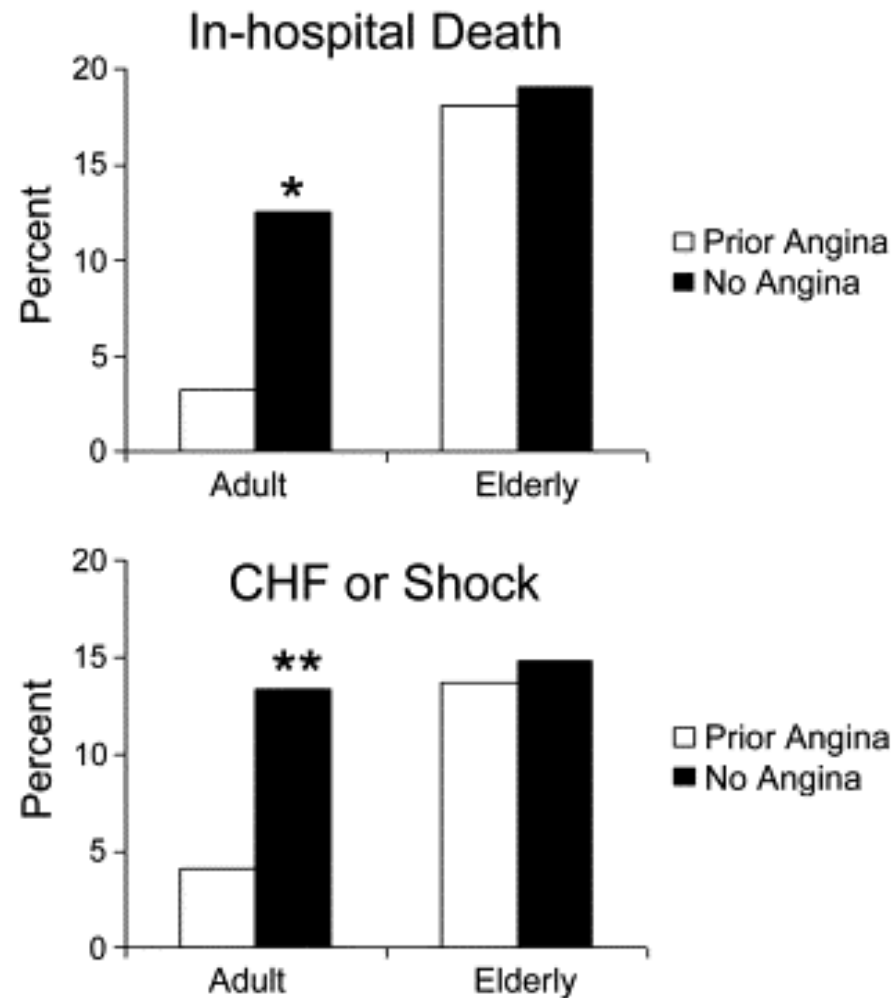


- Men: improved LV function, CO and SV with aerobic activity and beta stimulation
- Women: improved oxygen consumption, but no cardiac adaptation

Tonner, Kampen, & Scholz (2003). Pathophysiological changes in the elderly. *Best Practice & Research Clinical Anaesthesiology*, 17 (2), 163-177.

# Aging

## *Angina Protection--Preconditioning*



Rooke. (2003). Cardiovascular aging and anesthetic implications. *Journal of Cardiothoracic and Vascular Anesthesia*, 17 (4), 512-23.

# Aging

## *Dysrhythmias*

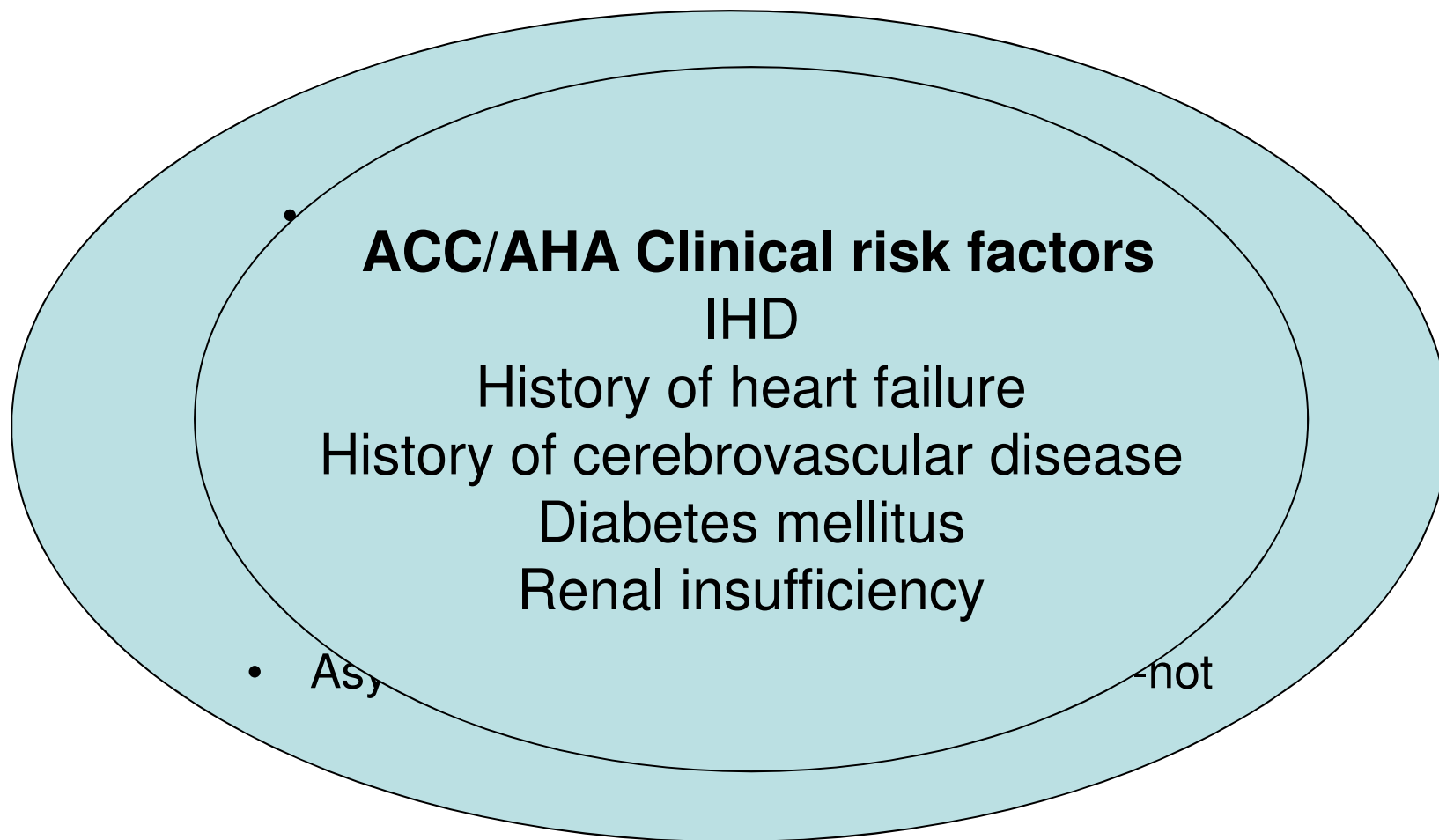
- Atrial fibrillation (most common)
  - Affects nearly 10% over 80 years
- SA node dysfunction
- AV slowed conduction
- Ventricular ectopy
- Heart block



Rooke. (2003). Cardiovascular aging and anesthetic implications. *Journal of Cardiothoracic and Vascular Anesthesia*, 17 (4), 512-23.

# Aging

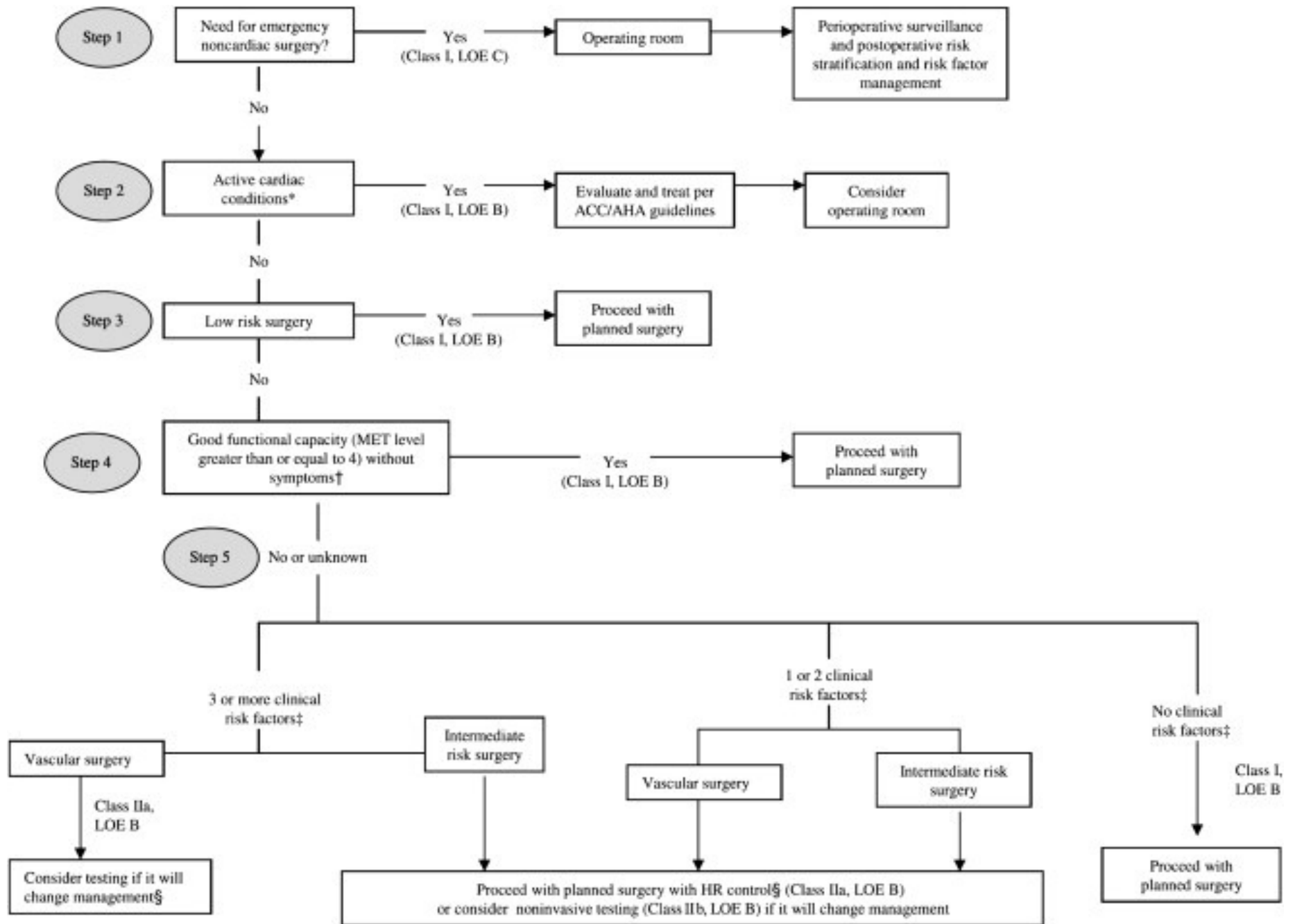
## *Dysrhythmias*



# 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)



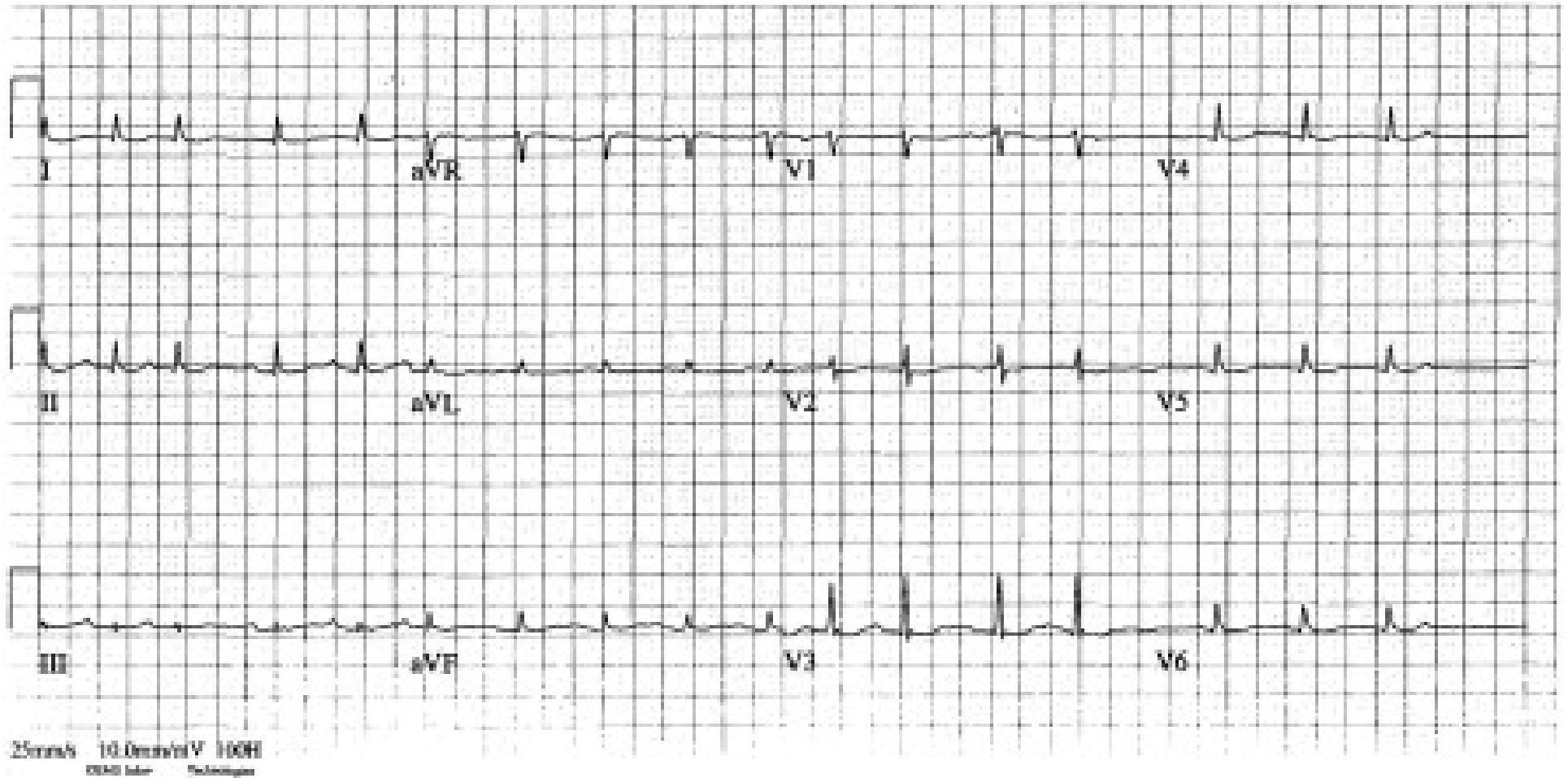
ACC/AHA Guidelines, 2007

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

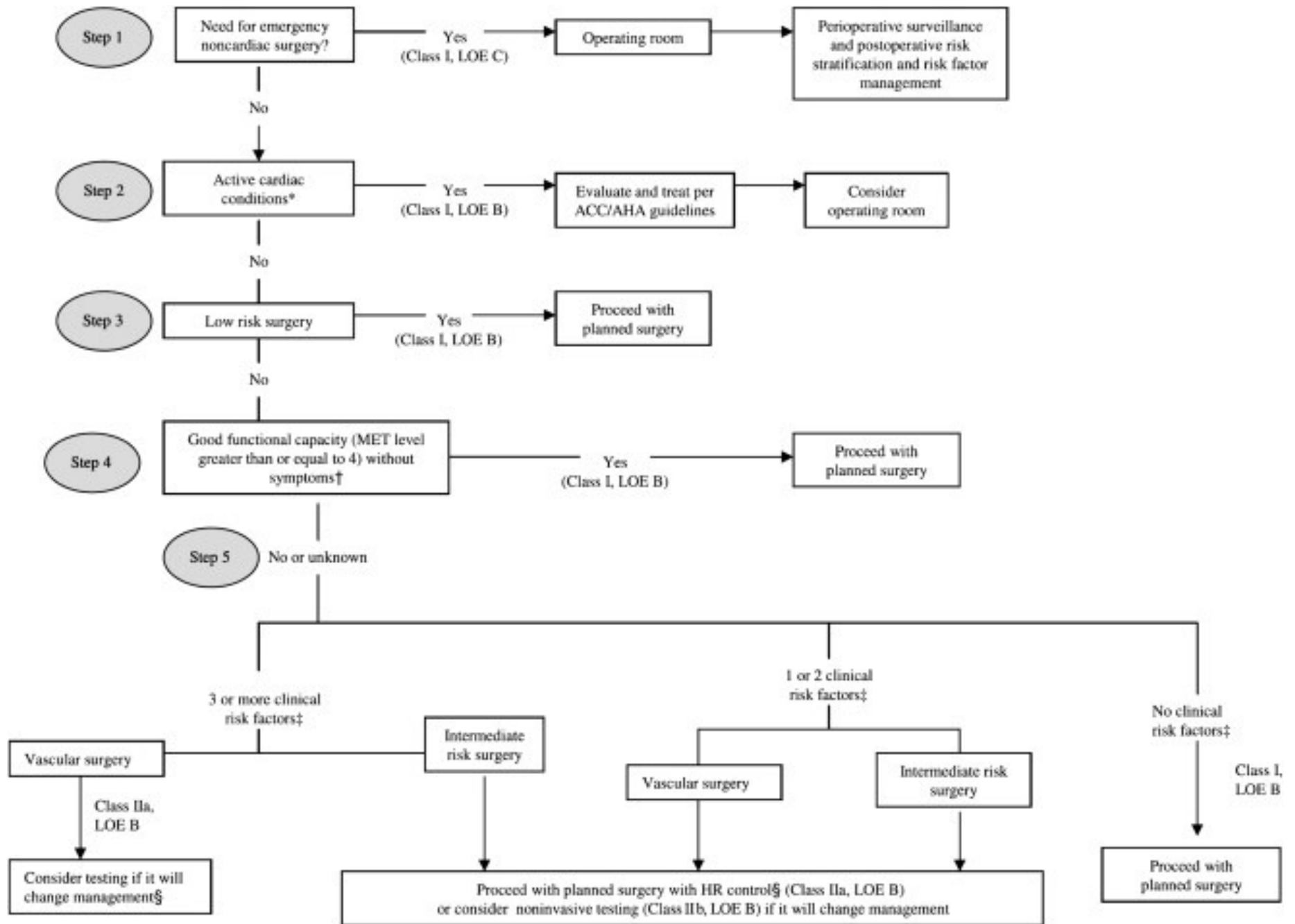
2 factors=4-7% risk

1 factor = 0.9-1.3% risk

3 or more factors=9-11% risk

## Cardiac Risk Stratification for Non-cardiac Surgical Procedures

| Risk Stratification                                  | Procedure Examples   |
|--|--|
| • Vascular (cardiac risk often > 5%)                 | Aortic and other major vascular surgery<br>Peripheral vascular surgery   |
| • Intermediate (cardiac risk 1% to 5%)               | Intraperitoneal and intrathoracic surgery<br>Carotid endarterectomy<br>Head and neck surgery<br>Orthopedic surgery<br>Prostate surgery |
| • Low (reported cardiac risk generally less than 1%) | Endoscopic procedures<br>Superficial procedure<br>Cataract surgery<br>Breast surgery<br>Ambulatory 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<sub>1</sub> (Normal 70% at age 70)



# Aging

## *Oxygenation changes*

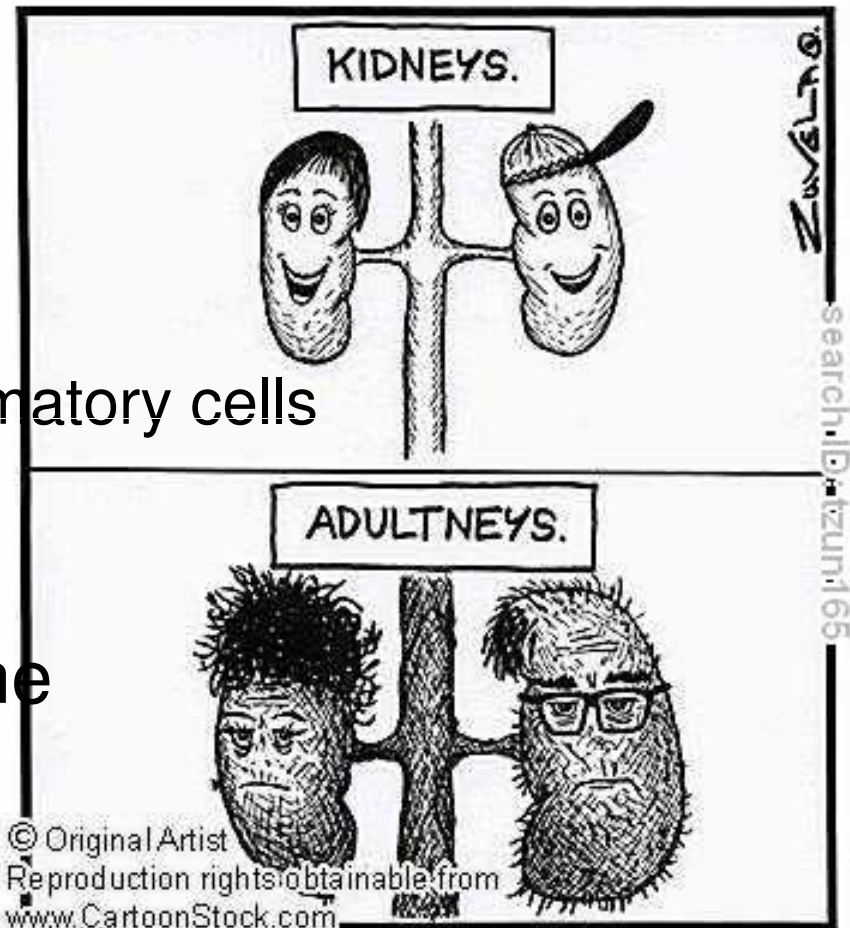
- $PAO_2$  (No change)
- $\downarrow PaO_2$ 
  - $(102 - 0.5 \times \text{age})$  or
  - $\downarrow .31 \text{ mmHg/yr}$  after 20
- $PaCO_2$  (No change)
- $\downarrow$  CNS sensitivity to hypoxemia and hypercapnia



# 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



Tonner, Kampen, & Scholtz. (2003). Pathophysiological changes in the elderly. *Best Practice & Research Clinical Anaesthesiology*, 17 (2), 163-177.

# Aging

## *Co-medication*

- >70% (over 70 years old) one drug
- CV drugs
  - Stopped for less than 48 hours (12%)
  - >48 hours 27% (p = .07)

Bruessel. (2003). Co-medications, pre-medication and common diseases in the elderly. *Best Practice & Research Clinical Anaesthesiology*, 17 (2), 179-192 (Review)

Kennedy, et al. (2000). Polypharmacy in a general surgical unit and consequences of drug withdrawal. *British Journal of Clinical Pharmacology*, 49, 353-362. (Retrospective, observational, IIbC)

# 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

Barnett. (September 2009). Polypharmacy and perioperative medications in the elderly. *Anesthesiology Clinics*, 27 (3), 377-89. (Review)

# 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)

Barnett. (September 2009). Polypharmacy and perioperative medications in the elderly. *Anesthesiology Clinics*, 27 (3), 377-89. (Review)

# 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 phenothizines can worsen Parkinson symptoms
- **ACE inhibitors** (exaggerated hypotension)

Barnett. (September 2009). Polypharmacy and perioperative medications in the elderly. *Anesthesiology Clinics*, 27 (3), 377-89. (Review)

# 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)

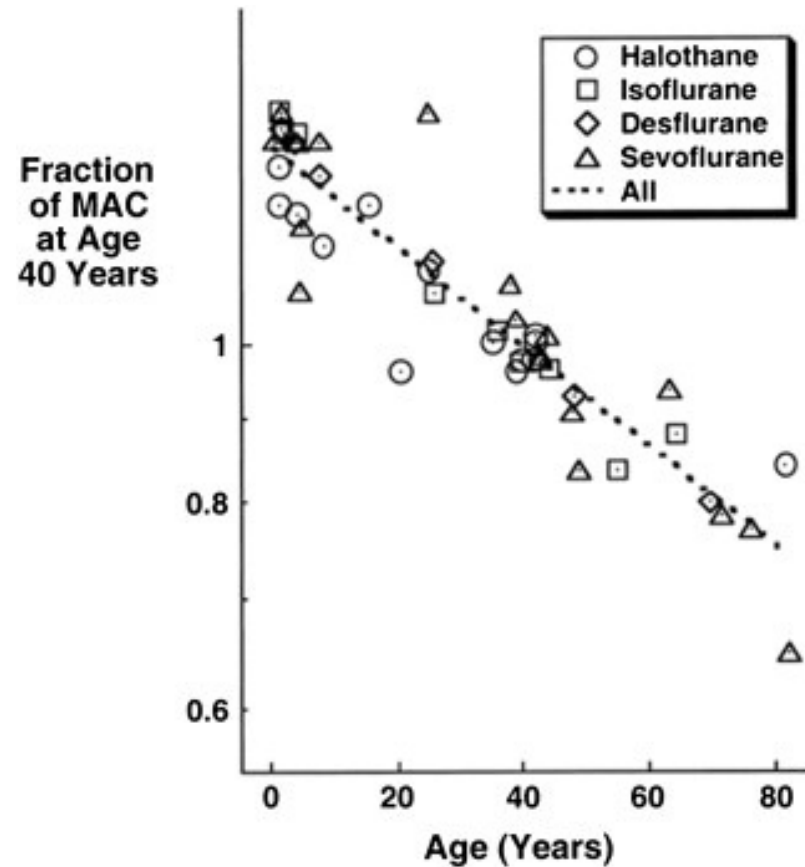
# Aging

## *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



Tonner, Kampen, & Scholz (2003). Pathophysiological changes in the elderly. *Best Practice & Research Clinical Anaesthesiology*, 17 (2), 163-177.

# CNS Dysfunction

## *Postoperative cognitive deterioration*

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

Most common complication  
in the geriatric population



Borgeat, & Ekatodramis (2003). Best Practice & Research Clinical Anaesthesiology, 17 (2), 235-44.

Bekker & Weeks. (2003). Cognitive function after anesthesia in the elderly, Best Practice & Research Clinical Anaesthesiology, 17 (2), 259 - 272.

# CNS Dysfunction

## *Postoperative cognitive deterioration*

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

Occurring most often between the  
2nd and 7th POD

### Increases risk

Advanced age (>75 years)

Physical status (> II);

Increased co-morbid conditions

Electrolyte disturbances (Na<sup>++</sup>, albumin)

Previous history psychiatric illness

Nutritional deficiency

ETOH and benzodiazepine withdrawal

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*

### **Metabolic issues**

- Electrolyte abnormalities
- Hypoglycemia/hyperglycemia
- Renal dysfunction
- Hypothyroidism
- Hypo-, hyperthermia
- Hepatic dysfunction

### **Neurological injury**

- Hypoxia
- Low CPP
- Embolic/thrombotic stroke
- Cerebral edema
- Infection
- Seizures

# CNS dysfunction

## *Perioperative issues*



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

Bekker & Weeks. (2003). Cognitive function after anesthesia in the elderly, *Best Practice & Research Clinical Anaesthesiology*, 17 (2), 259 - 272.

# CNS dysfunction

## *Perioperative issues*



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

Bekker & Weeks. (2003). Cognitive function after anesthesia in the elderly, *Best Practice & Research Clinical Anaesthesiology*, 17 (2), 259 - 272.

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

**R. S. Morrison et al.**

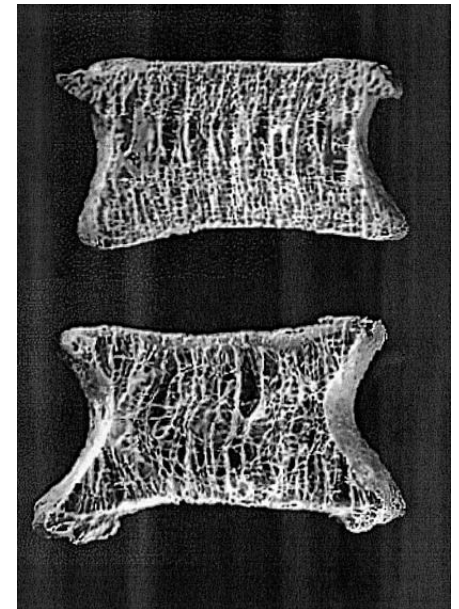
- Prospective study N = 541
- 65 years older with hip fractures
- 16% incidence of postoperative delirium
- Undertreated pain 9 times more likely to develop delirium

Gerontology Applied Biological Sciences, 2003

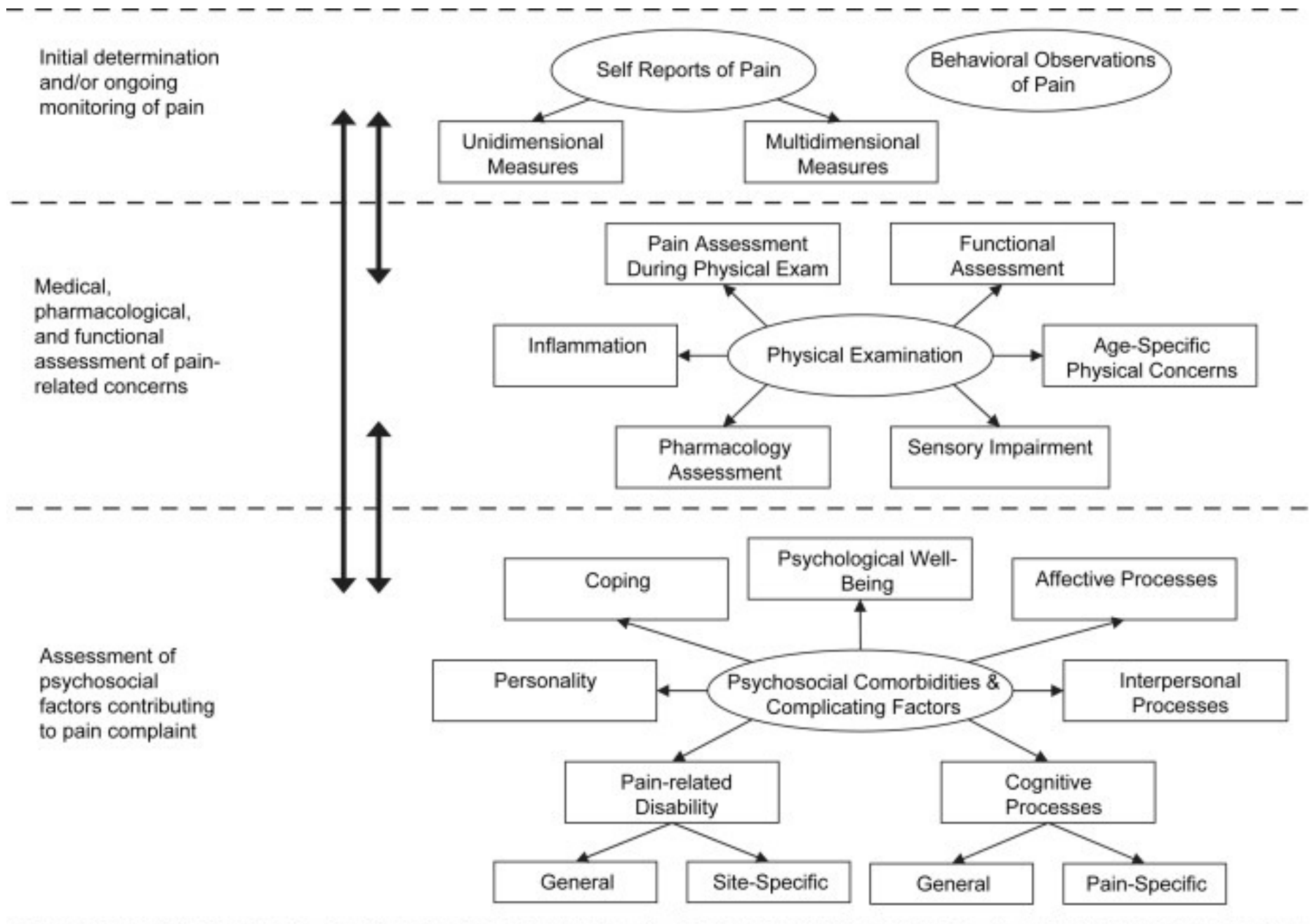
# Aging

## *Neuropathic Pain*

- Decreased CNS involvement
  - Brain atrophy
  - Increased peripheral sensitivity
- Degenerative changes of spine
  - Facet hypertrophy
  - Enlargement of ligamentum flavum
- Osteoporosis



Fine. (2009). Chronic pain management in older adults: Special considerations, *Journal of Pain and Symptom Management*, 38, 2S



Fine. (2009). Chronic pain management in older adults: Special considerations, *Journal of Pain and Symptom Management*, 38, 2S

# 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
  - Non-randomized, prospective studies (Aubrun, et al, Anesthesiology, 2002; Aubrun, et al., Anesthesiology, 2003)
- Multimodal approach
  - RCT (Du Manoir, et al, British Journal of Anaesthesia, 2003)

“Start low and go slow”

# CNS Dysfunction

## *Mini-Mental Status Exam*

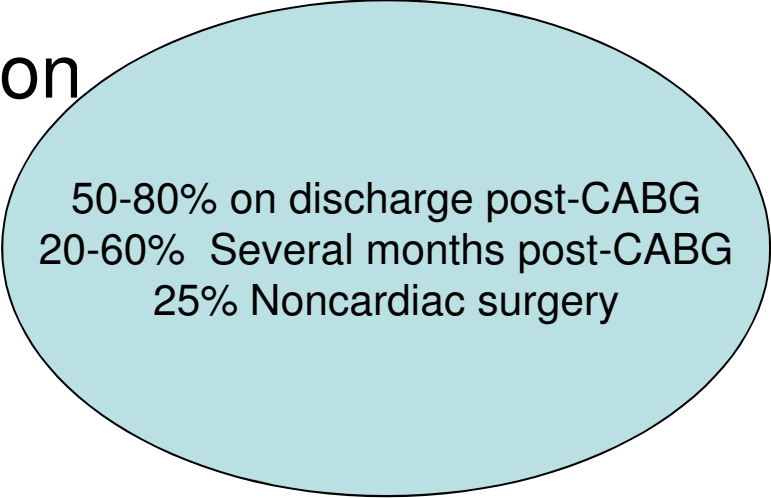
- What is your age?
- Please tell me the current time.
- Tell the patient an address and have them repeat it now and at the end of the test.
- What year is it?
- Where are you right now?
- What is the name of the hospital?
- Can you recognize (name) or (name)?
  - 2 people
- When were you born?
- Who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

AHAACC 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*

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