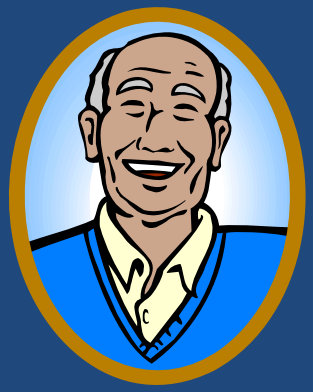


PERIOPERATIVE ANESTHETIC RISK IN THE GERIATRIC PATIENT

Susan H. Noorily, M.D.
Clinical Professor of Anesthesiology
Medical Director
University Preoperative Medicine Center

OBJECTIVES

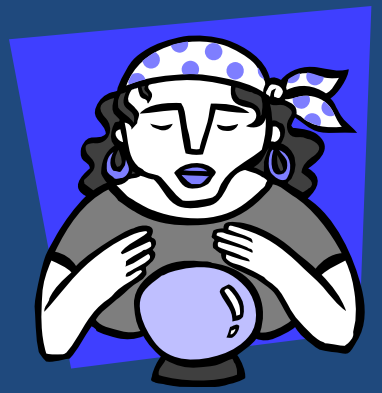
- *Briefly* review geriatric anesthetic risks
  - This is not a physiology lecture
- Provide overview of risk assessment tools
  - Cardiovascular
    - Review updated ACC/AHA Guidelines
  - Pulmonary
- Summarize current thinking

ANESTHETIC RISKS SPECIFIC TO AGE

- More sensitive to anesthetic agents
  - Physiologic changes occur with aging
    - All body systems
- However, age does not imply a level of function
  - Important to determine functional capacity in each patient
  - Risk correlates with coexisting disease and procedure
- Post-operative concerns

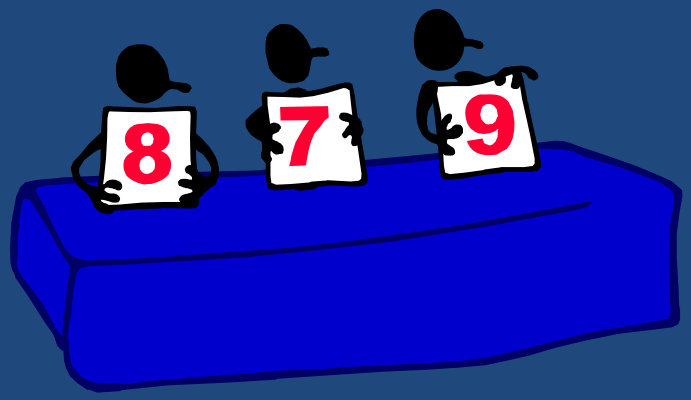
WHY PREDICT PERIOP RISK?

- Proper informed consent
- Fitness for surgery
  - Risk may be too high to proceed in unfit patient
- Best choice of surgical procedure
  - May choose less aggressive/invasive therapy
- Peri-operative surveillance
  - Invasive monitoring, ICU care



HOW DO WE PREDICT RISK?

- CLASSIFYING SYSTEMS AND CARDIAC AND PULMONARY RISK INDICES
  - ASA Classification (1941)
  - GOLDMAN (1977)
  - DETSKY MODIFICATION (1986)
  - REVISED CARDIAC RISK INDEX (1999)
    - Part of ACC/AHA current guidelines (2007)
  - ACP Guidelines for PPCs (2006)
  - RFI (2007)
  - MICHIGAN (2009)



ASA PHYSICAL STATUS CLASSIFICATION SYSTEM (1941)

CLASS	DESCRIPTION
1	A normal healthy patient
2	A patient with mild systemic disease
3	A patient with severe systemic disease
4	A patient with severe systemic disease that is a constant threat to life
5	Emergency in Class 1 or 2 patient
6	Emergency in Class 3 or 4 patient

Original classification developed in 1941.
Its intended use was descriptive rather than predictive of outcome or risk.
(This was the first attempt at risk stratification developed for patients.)

Saklad M. Grading of patients for surgical procedures. Anesthesiology. 1941; 2(3):281-284.

ASA PHYSICAL STATUS CLASSIFICATION SYSTEM (1963)

CLASS	DESCRIPTION
PS 1	A normal healthy patient
PS 2	A patient with mild systemic disease
PS 3	A patient with severe systemic disease
PS 4	A patient with severe systemic disease that is a constant threat to life
PS 5	A moribund patient who is not expected to survive without the operation
E	Modification for emergency operation

Revised in 1963 to include 5 categories.

ASA PHYSICAL STATUS CLASSIFICATION SYSTEM (1994)

CLASS	DESCRIPTION
PS 1	A normal healthy patient
PS 2	A patient with mild systemic disease
PS 3	A patient with severe systemic disease
PS 4	A patient with severe systemic disease that is a constant threat to life
PS 5	A moribund patient who is not expected to survive without the operation
PS 6	A declared brain-dead patients whose organs are being harvested
E	Modification for emergency operation

Expanded in 1994 to include organ donors.

MORTALITY AFTER EMERGENCY SURGERY IN THE ELDERLY

	ASA I-II	ASA III	ASA IV	ASA V
MORTALITY (%)	6	18	44	89

Rix TE. Pre-operative risk scores for the prediction of outcome in elderly people who require emergency surgery. World Journal of Emergency Surgery 2007; 2:16.

ASA PHYSICAL STATUS

- Subjective
  - Variability in scoring between evaluators
- Score is irrespective of planned surgical procedure
  - Emergency surgery is given special classification
- Age is not an independent factor

  Still in use! and has been revalidated many times.

PREDICTING RISK (1977)

The NEW ENGLAND JOURNAL of MEDICINE

Multifactorial index of cardiac risk in noncardiac surgical procedures.

Goldman et al. NEJM 1977; 297:845-850

October 20, 1977 Number 16

First cardiac risk index
Retrospective data
1001 patients

GOLDMAN Risk Index

CRITERIA	SCORE
HISTORY	
Age > 70	5
Myocardial infarct in prev 6 months	10
PHYSICAL EXAM	
S_3 or JVD	11
Valvular aortic stenosis	3
ECG	
Rhythm other than sinus or PACs	7
> 5 PVCs/min documented at any time	7
GENERAL STATUS	
PO2 < 60 or PCO2 > 50, K < 3, HCO3 < 20, BUN > 50, Cr > 3, abn SGOT or chronic liver disease or patient bedridden	3
OPERATION	
Intraperitoneal, intrathoracic, or aortic	3
Emergency	4
TOTAL POSSIBLE POINTS	53

GOLDMAN RISK INDEX

CLASS	POINT TOTAL	NO or MINOR COMPLICATIONS	LIFE-THREATENING COMPLICATION	CARDIAC DEATHS
I	0-5	532 (99%)	4 (0.7%)	1 (0.2%)
II	6-12	295 (93%)	16 (5%)	5 (2%)
III	13-25	112 (86%)	15 (11%)	3 (2%)
IV	≥ 26	4 (22%)	4 (22%)	10 (56%)

5 points for age > 70

GOLDMAN RECOMMENDATIONS

- **Class IV**
  - Only life-saving procedures
- **Class III**
  - Preoperative cardiac consultation
  - Risk might be lower if operation is delayed until patient is medically stabilized

GOLDMAN AND AGE

RISK FACTOR			LIFE-THREATENING COMPLICATION	CARDIAC DEATH
Age > 70	No	677	20 (3%)	3 (0.4%)
	Yes	324	19 (6%)	16 (5%)

↑ 2x

↑ 12 x

DETSKY MODIFICATION (1986)

JGIM Journal of General Internal Medicine

Predicting cardiac complications in patients undergoing noncardiac surgery.

- **Detsky et al. J Gen Intern Med. 1986; 1:211-9.**

Prospective study refined the Goldman index, adding new categories

DETSKY MODIFICATION

VARIABLE	POINTS
Angina	
Class IV	20
Class III	10
Unstable angina < 3 months	10
Suspected critical aortic stenosis	20
MI	
< 6 months	10
> 6 months	5
Alveolar pulmonary oedema	
< 1 week	10
Ever	5
Emergency surgery	10
Rhythm other than sinus or sinus rhythm with PACs	5
> 5 PVCs at any time	5
Poor general medical status	5
Age > 70	5

AS only 3 pts in Goldman

90 poss pts

DETSKY INTERPRETATION

CLASS	POINTS	RISK
1	0 - 15	Low
2	20 - 30	Moderate
3	> 30	High

GOLDMAN and DETSKY

- **Still useful?**
  - **Predated advances in surgery and anesthesia**

REVISED CARDIAC RISK INDEX (1999)

Derivation and Prospective Validation of a Simple Index for Prediction of Cardiac Risk of Major Noncardiac Surgery

Thomas H. Lee, et al. *Circulation 1999;100;1043-1049.*

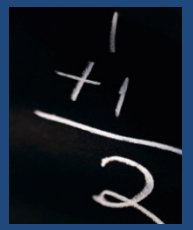
Prospective cohort study
4315 patients
- **Retrospectively derived predictors in cohort of 2893 patients**
- **Prospectively validated results in cohort of 1422 patients**

Age ≥ 50 yrs
Elective surgery
Outcome: cardiac complications

REVISED CARDIAC RISK INDEX

Study in patients undergoing major non-emergent procedures.

- **Six independent correlates of major cardiac complications**
- **Each risk factor is assigned one point:**
  - **High risk surgery**
  - **Ischemic heart disease**
  - **History of congestive heart failure**
  - **History of cerebrovascular disease**
  - **Insulin therapy for diabetes**
  - **Preoperative serum creatinine > 2.0 mg/dL**



- **Age did not correlate with complications**
  - **Authors noted that this should not be taken as evidence that age is not a worrisome prognostic factor**

REVISED CARDIAC RISK INDEX

POINTS	CLASS	RISK
0	I	0.4%
1	II	0.9%
2	III	6.6%
3 or more	IV	11%

- High risk surgery
- Ischemic heart disease
- History of congestive heart failure
- History of cerebrovascular disease
- Insulin therapy for diabetes
- Preoperative serum creatinine > 2.0 mg/dL

REVISED CARDIAC INDEX

- Recommendations
  - Not defined
  - Class III and IV patients may require more extensive preoperative evaluation and more intense peri-operative surveillance

REVISED CARDIAC RISK INDEX

- **Index used in current ACC/AHA Guidelines**

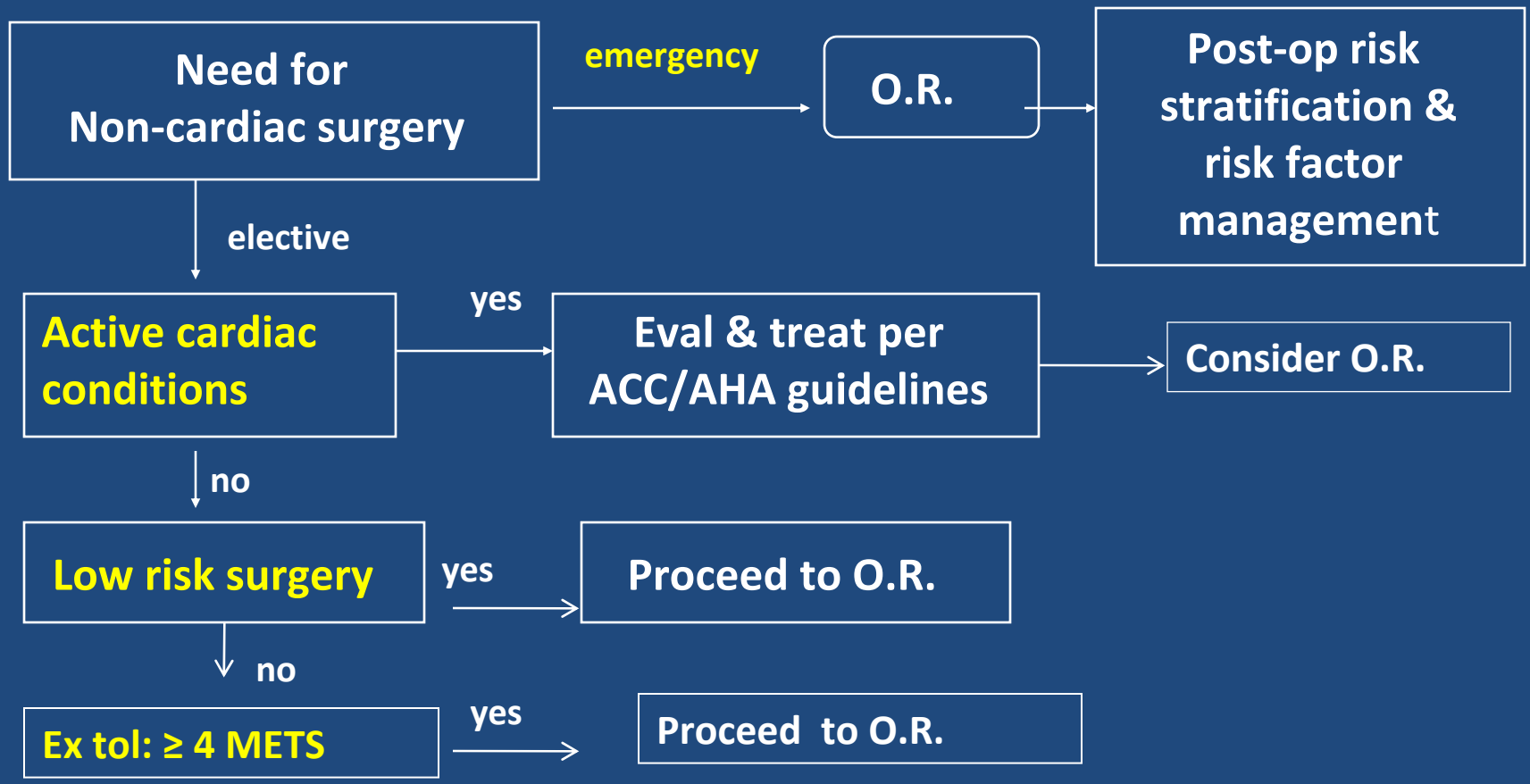
ACC/AHA 2007 GUIDELINES

Who needs further workup?

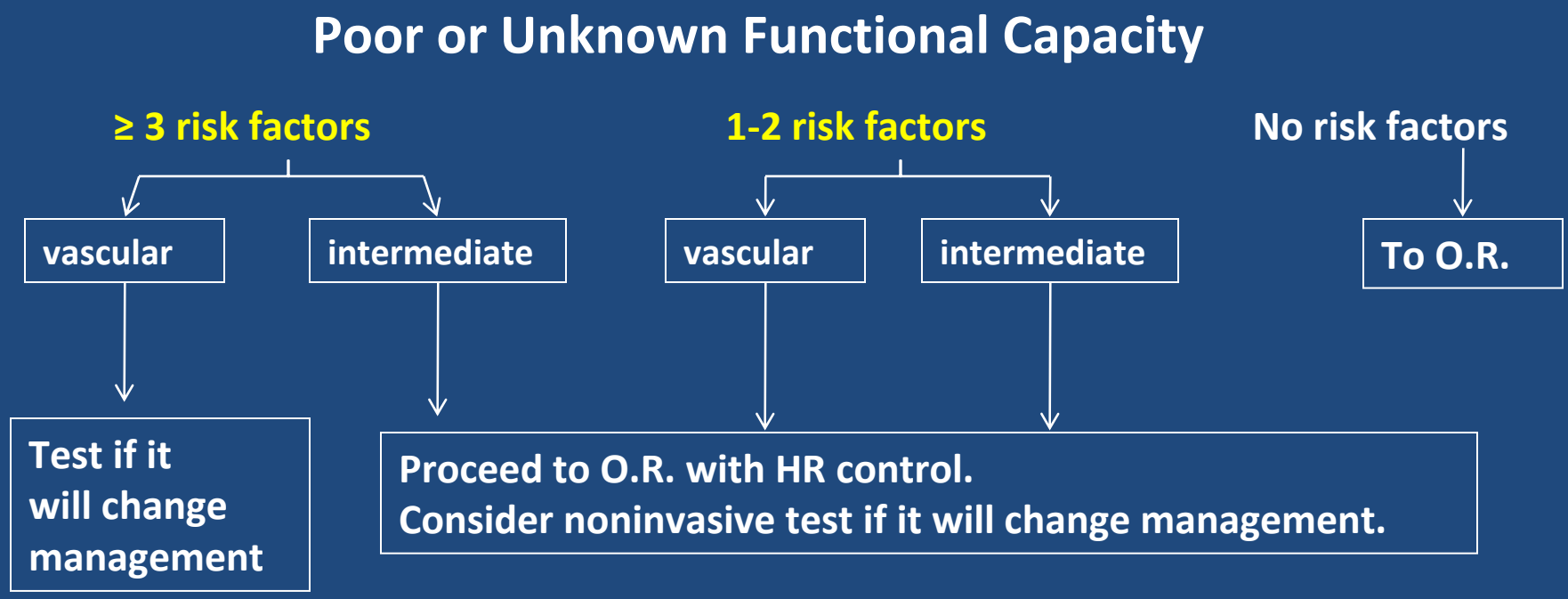
ALGORITHM

- **Evidence-Based**
  - **Fleisher LA, *et al*. ACC/AHA 2007 Guidelines on Perioperative Cardiovascular Evaluation and Care for Noncardiac Surgery. A Report of the ACC/AHA Task Force on Practice Guidelines. J Am Coll Cardiol 2007; 50(17).**

Decision Making in Cardiac Evaluation Before Non-Cardiac Surgery - I



Decision Making in Cardiac Evaluation Before Non-cardiac Surgery II



Procedure-Specific Risk

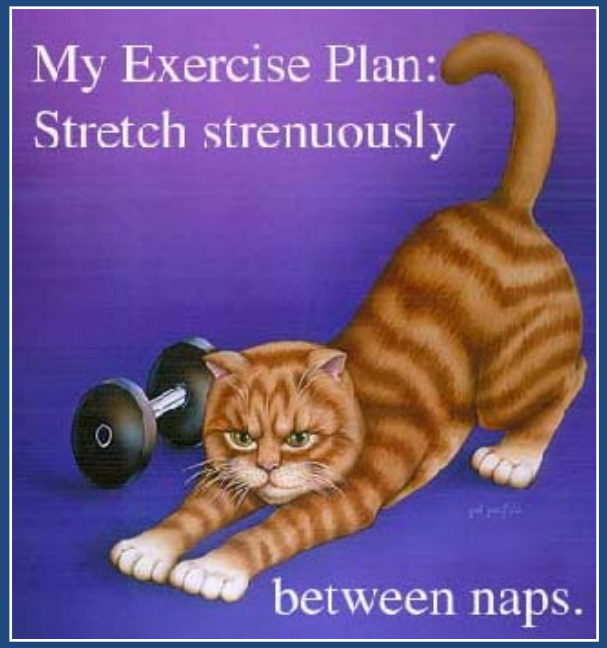
Low Risk (< 1%)

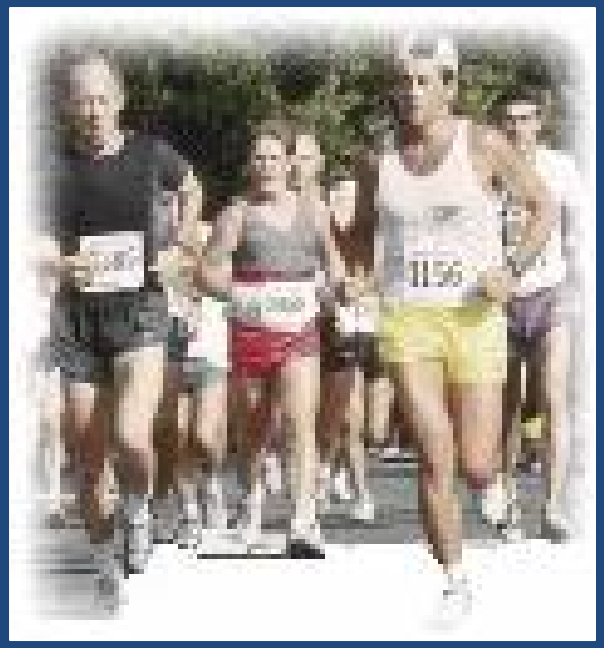
- Endoscopy
- Superficial procedures
- Cataracts
- Breast

Intermediate Risk (1-5%)

- Intraperitoneal
- Intrathoracic
- Carotid endarterectomy
- Endovascular procedures
- Head and neck
- Orthopedic
- Prostate

Exercise Tolerance





1 MET → **10 METS**

What is 4 METS?

- Walking 4 blocks
- Climbing 1-2 flights of stairs
- No limiting symptoms

Minor Predictors

- Not proven to independently increase peri-op risk
  - Advanced age (>70)
  - Abnormal EKG
  - Rhythm other than sinus
  - Uncontrolled systemic HTN
- Multiple minor predictors lead to a higher suspicion of CAD but are not incorporated into algorithm

Michigan ACS-NSQIP (2009)

- Prospective study
- 7740 non-cardiac operations
  - General, vascular, urologic
- Incidence of cardiac adverse events 1.1%
- Pre-operative and intra-operative model
- Determined 9 independent predictors

Kheterpal et al. Anesthesiology 2009; 110: 58-66

Michigan ACS-NSQIP RISK FACTORS

- Age ≥ 68
- BMI ≥ 30
- Emergency surgery
- Previous PCI or cardiac surgery
- Active CHF
- Cerebrovascular disease
- HTN
- Operative duration ≥ 3.8 hrs
- Transfusion of ≥ 1 unit pRBCs

CAE: cardiac arrest, dysrhythmia, Q-wave MI, non-STEMI

Intraop data

Absent:
IDDM
Creat > 2
High risk surgery

Kheterpal et al. Anesthesiology 2009; 110: 58-66

Frequency and Hazard Ratio of CAE Based on Number of Preop Risk Factors

PREOP RISK CLASS	FREQUENCY OF CAE	HAZARD RATIO
Class I (0 risk factors)	0.2%	
Class II (1 risk factor)	0.5%	2.3
Class III (2 risk factors)	1.3%	6.0
Class IV (3+ risk factors)	3.6%	16.7

Kheterpal et al. Anesthesiology 2009; 110: 58-66

Perioperative CAE Risk Factors and Adjusted Hazard Ratios

RISK FACTOR	HAZARD RATIO
Age ≥ 68	2.3
Active CHF	4.1
BMI ≥ 30	1.9
Emergency surgery	2.2
Prior cardiac intervention	2.0
Cerebrovascular disease	2.0
HTN	1.7
Duration of operation ≥ 3.8 hrs	2.2
PRBCs ≥ 1 unit	2.6

Kheterpal et al. Anesthesiology 2009; 110: 58-66

PULMONARY RISK FACTORS

PULMONARY RISK and ACP GUIDELINES (2006)

- Pulmonary complications
  - Highest hospital costs
  - Longest length of stay
  - Age is the most powerful risk factor
- Guidelines developed
  - A = good evidence
  - B = fair evidence
  - C = probably not a risk factor
  - D = good evidence NOT a risk factor

Smetana et al. Preoperative pulmonary risk stratification for noncardiothoracic surgery: systematic review for the American College of Physicians. Ann Intern Med 2006; 144: 581-595.

RISK FACTORS FOR POSTOP PULMONARY COMPLICATIONS

RISK FACTOR	STRENGTH OF RECOMMENDATION	ODDS RATIO
Advanced age	A (good)	2.09-3.04
ASA class ≥ II	A	2.55-4.87
CHF	A	2.93
Functionally dependent	A	1.65-2.51
COPD	A	1.79
Weight loss	B (fair)	1.62
Impaired sensorium	B	1.39
Cigarette use	B	1.26
Alcohol use	B	1.21
Abnormal chest exam	B	NA
Diabetes	C	
Obesity	D (not)	
Asthma	D	

PROCEDURAL FACTORS FOR POSTOP PULMONARY COMPLICATIONS

PROCEDURE	STRENGTH OF RECOMMENDATION	ODDS RATIO
Aortic aneurysm repair	A (good)	6.9
Thoracic surgery	A	4.24
Abdominal surgery	A	3.01
Upper abdominal surgery	A	2.91
Neurosurgery	A	2.53
Prolonged surgery	A	2.26
Head and neck surgery	A	2.21
Emergency surgery	A	2.21
Vascular surgery	A	2.1
General anesthesia	A	1.83
Peri-operative transfusion	B (fair)	1.47
Hip surgery	D	
Gynecologic or urologic surgery	D	

UPDATED RESPIRATORY FAILURE INDEX

- Major vascular and general surgery
- 180,359 patients
- 45 potential risk factors
- 28 risk factors identified as independent predictors
- Respiratory failure defined as post-op mechanical ventilation for > 48 hours or unanticipated reintubation

Johnson, et al. Respiratory failure after general and vascular surgery: results from the patient safety in surgery study. J Am Coll Surg 2007; 204: 1188-1198.

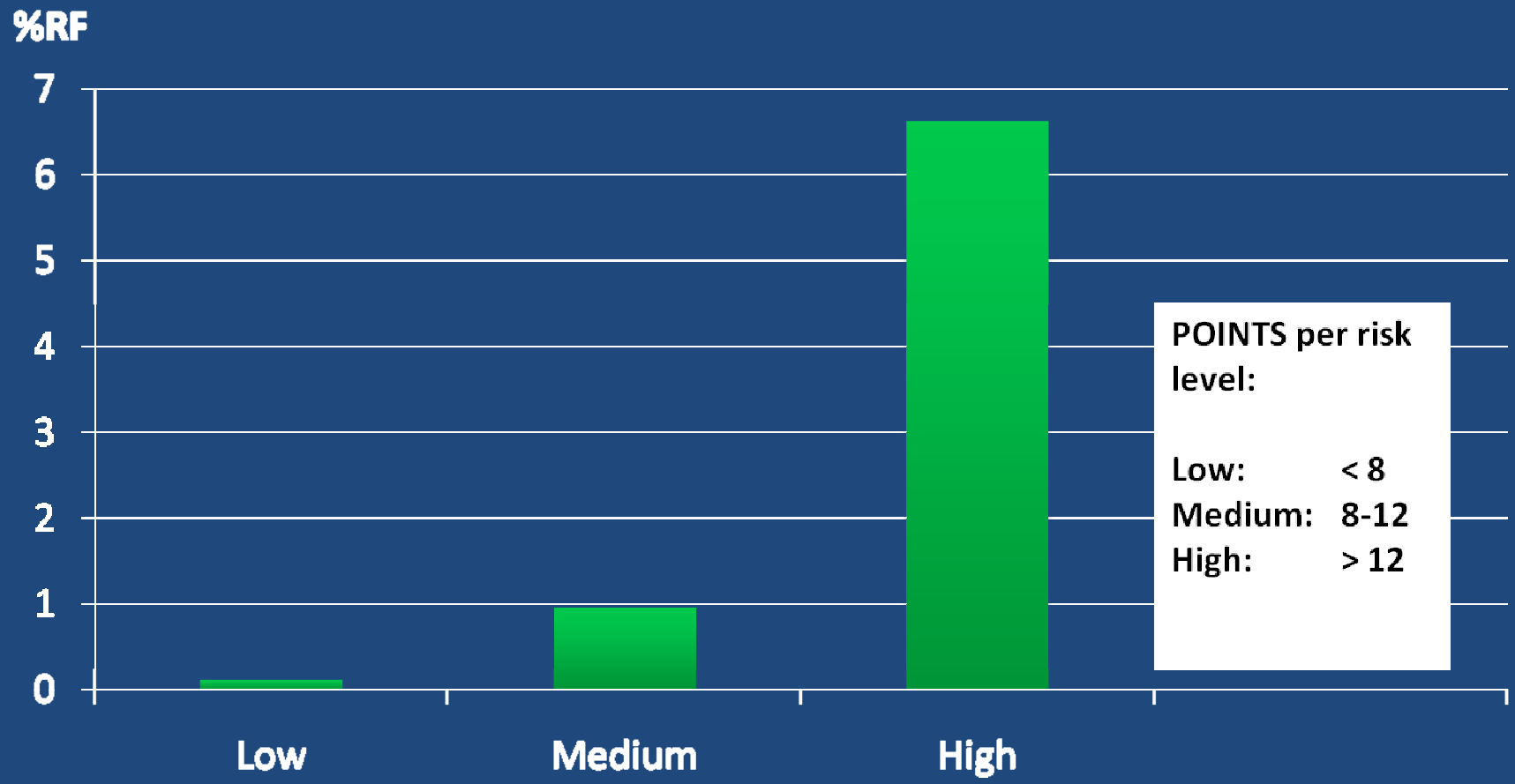
SOME IMPORTANT RISK FACTORS

VARIABLE	ODDS RATIO	SCORE
ASA class III	2.9	+3
ASA class 4 or 5	4.9	+5
Orofacial surgery	6.6	+7
Work RVU > 17	4.4	+4
Albumin < 3.5	1.5	+1
Aneurysm surgery	1.6	+2
Age > 65	2.1	+2
Smoker	1.1	+1
Emergency	2.4	+2

POINTS per risk level:

Low: **< 8**
Medium: **8-12**
High: **> 12**

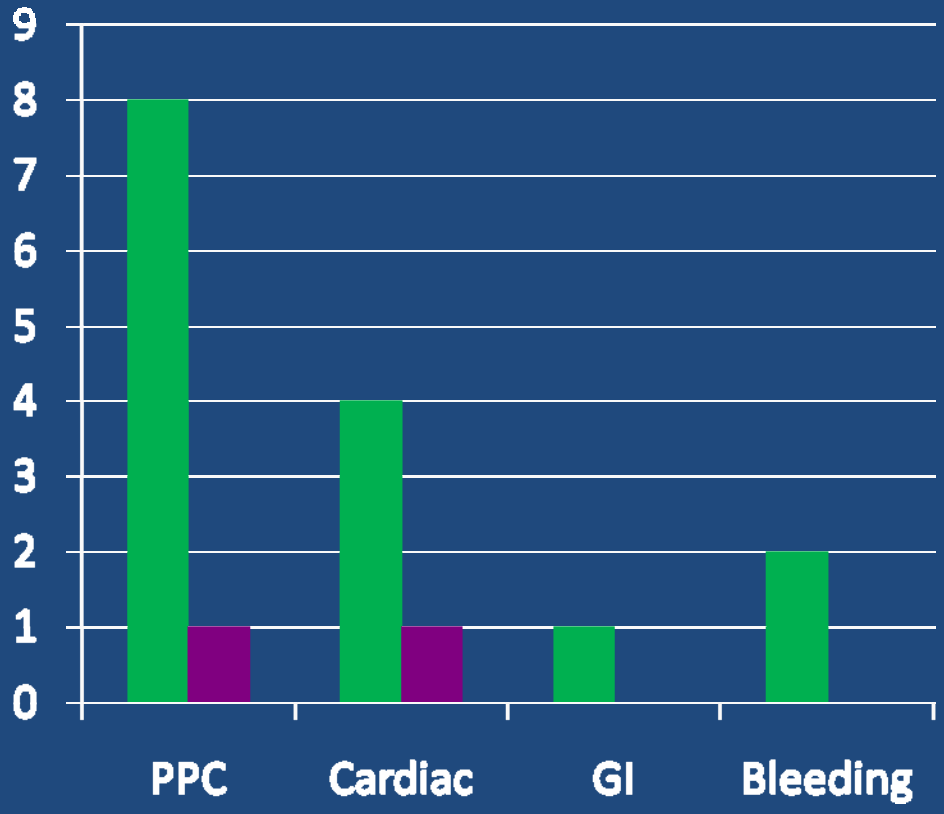
Respiratory Risk Index and Respiratory Failure Rates



Johnson, et al. Respiratory failure after general and vascular surgery: results from the patient safety in surgery study. J Am Coll Surg 2007; 204: 1188-1198.

NEW PULMONARY RISK FACTORS
OBSTRUCTIVE SLEEP APNEA

Postoperative Pulmonary Complications



172 patients

ODI = oxygen desaturation index

OSA common in the elderly, present in 24% of people > age 65 yrs

Hwang et al. Association of sleep-disordered breathing with postoperative complications. Chest 2008; 133: 1128-34.

OSA: POSTOP COMPLICATIONS

Table 5. Demographic Data and Postoperative Complications: AHI >5 versus AHI ≤5

	Total (n = 211)	AHI <5 (n = 64)	AHI >5 (n = 147)	*P* Value
Gender, M/F, n	106/105	23/41	83/64	0.01
Age, mean ± SD, yr	56 ± 13	50 ± 14	59 ± 12	<0.01
BMI, mean ± SD, kg/m²	30.5 ± 7	27.9 ± 6	32.4 ± 6	0.01
BMI >35 kg/m², n (%)	42 (19.9)	9 (14.1)	33 (22.5)	0.16
Neck circumference, cm	39.1 ± 6	36.3 ± 4	40.2 ± 6	<0.01
AHI/h	18.9 ± 22	2.5 ± 2	25.9 ± 22	<0.01
Preexisting conditions, n (%)				
Hypertension	92 (43.6)	20 (31.3)	72 (49.0)	0.02
GERD	65 (30.8)	17 (26.6)	48 (32.7)	0.38
Diabetes	38 (18.0)	7 (10.9)	31 (21.1)	0.08
Total complications, n (%)	48 (22.8)	8 (12.5)	40 (27.4)	0.02
Respiratory complication, n (%)	39 (18.5)	6 (9.2)	33 (22.6)	0.02
Total desaturation	36 (17.1)	6 (9.2)	30 (20.6)	0.04
Mild desaturation, Sao_2 90–95%	13 (6.2)	2 (3.1)	11 (7.5)	0.35
Severe desaturation, Sao_2 <90%	23 (10.9)	4 (6.2)	19 (13.0)	0.16
Cardiac complication,* n (%)	12 (5.7)	2 (3.1)	10 (6.9)	0.35
Neurologic complication,† n (%)	2 (0.95)	0	2 (1.4)	1.00
Prolong oxygen therapy	24 (11.4)	3 (4.7)	21 (14.3)	0.04
Additional monitoring	9 (4.3)	1 (1.5)	8 (5.5)	0.28
Total admission to ICU, n	13	1	12	
Planned ICU admission	9	1	8	
Unplanned ICU admission	4	0	4	
ICU admission related OSA				
Yes	9	0	9	
No	4	1	3	
Hospital stay after surgery, median (range), h	44.8 (0.2–352.8)	28.0 (0.75–215.6)	51.6 (0.2–352.8)	0.25
Readmission within 30 days, n (%)	4 (1.9)	0	4 (2.7)	0.18
ED visit within 30 days, n (%)	1 (0.5)	1 (1.5)	0	0.31

* Cardiac complications: bradycardia, tachycardia, dysrhythmia, and ischemia. † Neurologic complications: confusion, agitation, and excessive drowsiness.

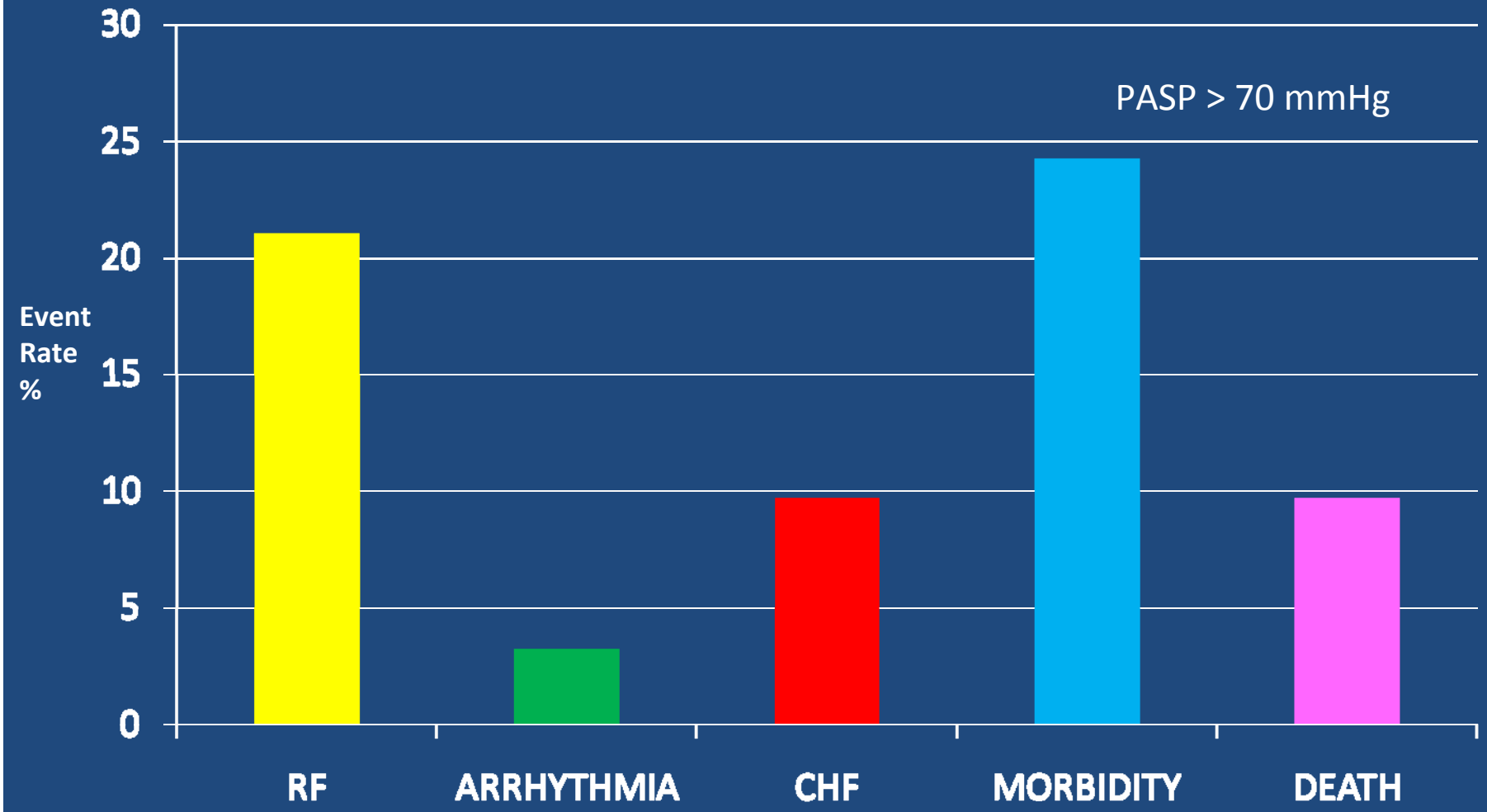
AHI = apnea-hypopnea index; BMI = body mass index; ED = emergency department; GERD = gastroesophageal reflux disease; ICU = intensive care unit; OSA = obstructive sleep apnea; Sao_2 = arterial oxygen saturation.

Chung et al. Anesthesiology 2008; 108: 822-30.

NEW PULMONARY RISK FACTORS

PULMONARY HYPERTENSION

Postoperative Adverse Events in Patients with Severe Pulmonary Hypertension



Lai et al. Severe pulmonary hypertension complicates postoperative outcome of noncardiac surgery. BJA 2007; 99: 184-190.

WHAT ANESTHESIOLOGISTS OFTEN DON'T CONSIDER IN RISK ASSESSMENT

- Frailty
- Fatigue
- Mental status
- Depression
- ADL

Preoperative assessment in elderly cancer patients

PACE

- No significant relationship between age and complications
- No relationship between co-morbidities and complications
- Fewest complications in breast cancer patients
- **Highest risk components** of PACE are
  - Dependent IADL (unable to live independently)
  - Abnormal PS (disability)
  - Moderate or severe BFI (fatigue or frailty)

Audisio RA et al. Critical Reviews in Oncology/Hematology 2008; 65: 156-163

DETSKY/GOLDMAN CALCULATOR

- Detsky analysis score
- Goldman analysis score
  - http://www.vasgbi.com/riskdetsky.htm

Cardiac Surgery Risk Calculators

- **Parsonnet**
  - Ref : Parsonnet V et al. A method of uniform stratification of risk for evaluating the results of surgery in acquired adult heart disease. *Circulation*. 1989;79:*I* 3-12.
  - http://www.sfar.org/scores2/parsonnet2.html

Cardiac Surgery Risk Calculators

- **EuroSCORE**
  - Nashef S.A.M. et al. European system for cardiac operative risk evaluation (EuroSCORE). *Eur J Cardiothorac Surg*, 1999;16:9-13
    http://www.euroscore.org/9[1].pdf
    Roques F, Michel P, Goldstone AR, Nashef SA. The logistic EuroSCORE. *Eur Heart J.* 2003 May;24(9):882
    http://www.euroscore.org/logistic.pdf
  - http://www.sfar.org/scores2/euroscore2.html

AGE AND RISK

- Older patients do worse after emergency surgery
  - More co-morbidities (deterioration of organ function)
  - Morality rate in patients > 74 are double that of patients aged 65-74
- Age is an independent risk factor for PPCs but may or may not be for CAEs.
- A physically fit elderly patient should not be denied an emergency operation based on age