Ο ρόλος του πνευμονολόγου στην προ και μετεγχειρητική φροντίδα του μη θωρακοχειρουργικού ασθενούς

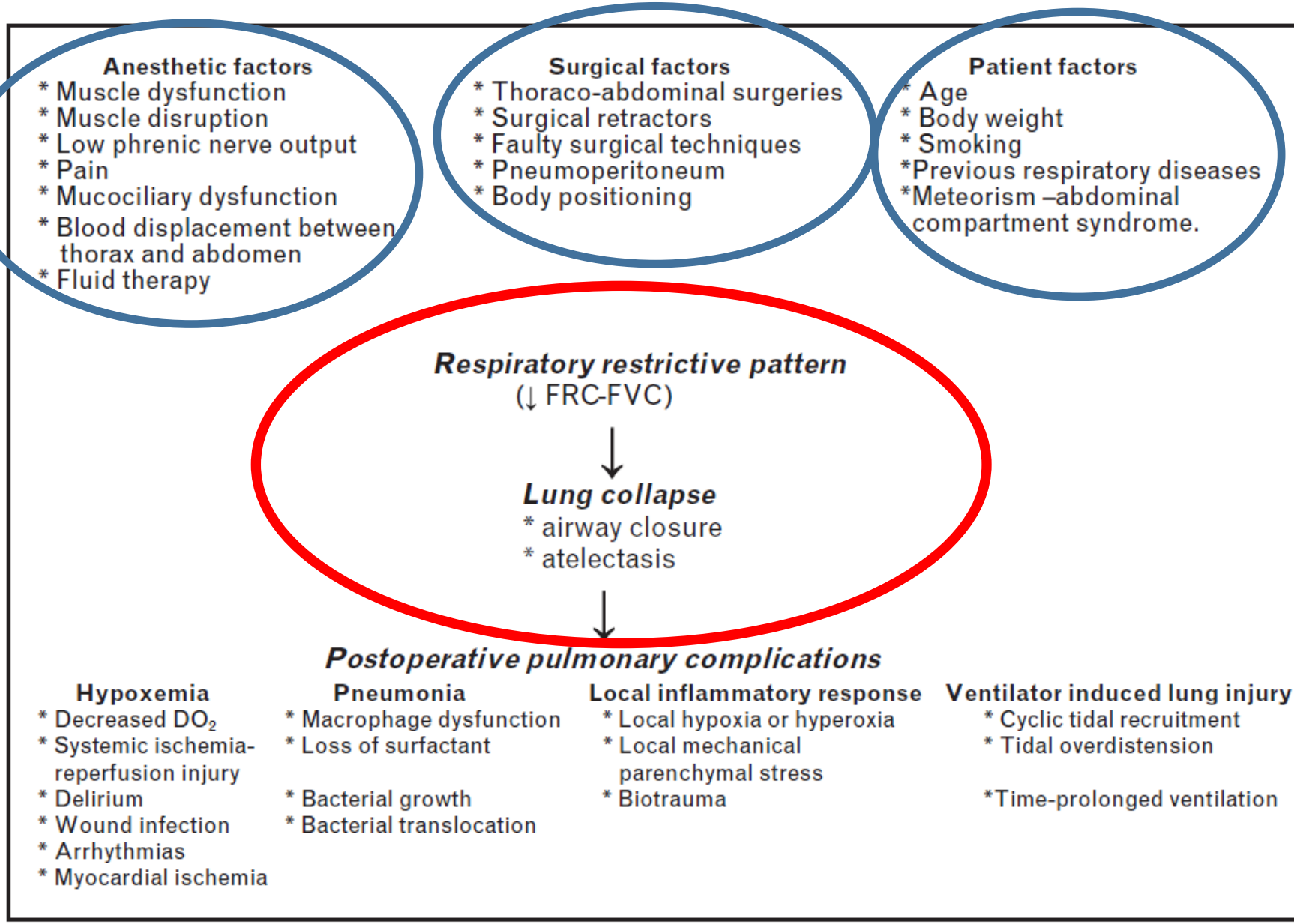
Προεγχειρητική αξιολόγηση

ΙΩΑΝΝΑ ΣΙΓΑΛΑ
Πνευμονολόγος-Εντατικολόγος
Επιμελήτρια Ά ΕΣΥ
Ά Κλινική Εντατικής Θεραπείας ΕΚΠΑ,
Νοσοκομείο «Ευαγγελισμός»

Post-operative pulmonary complications

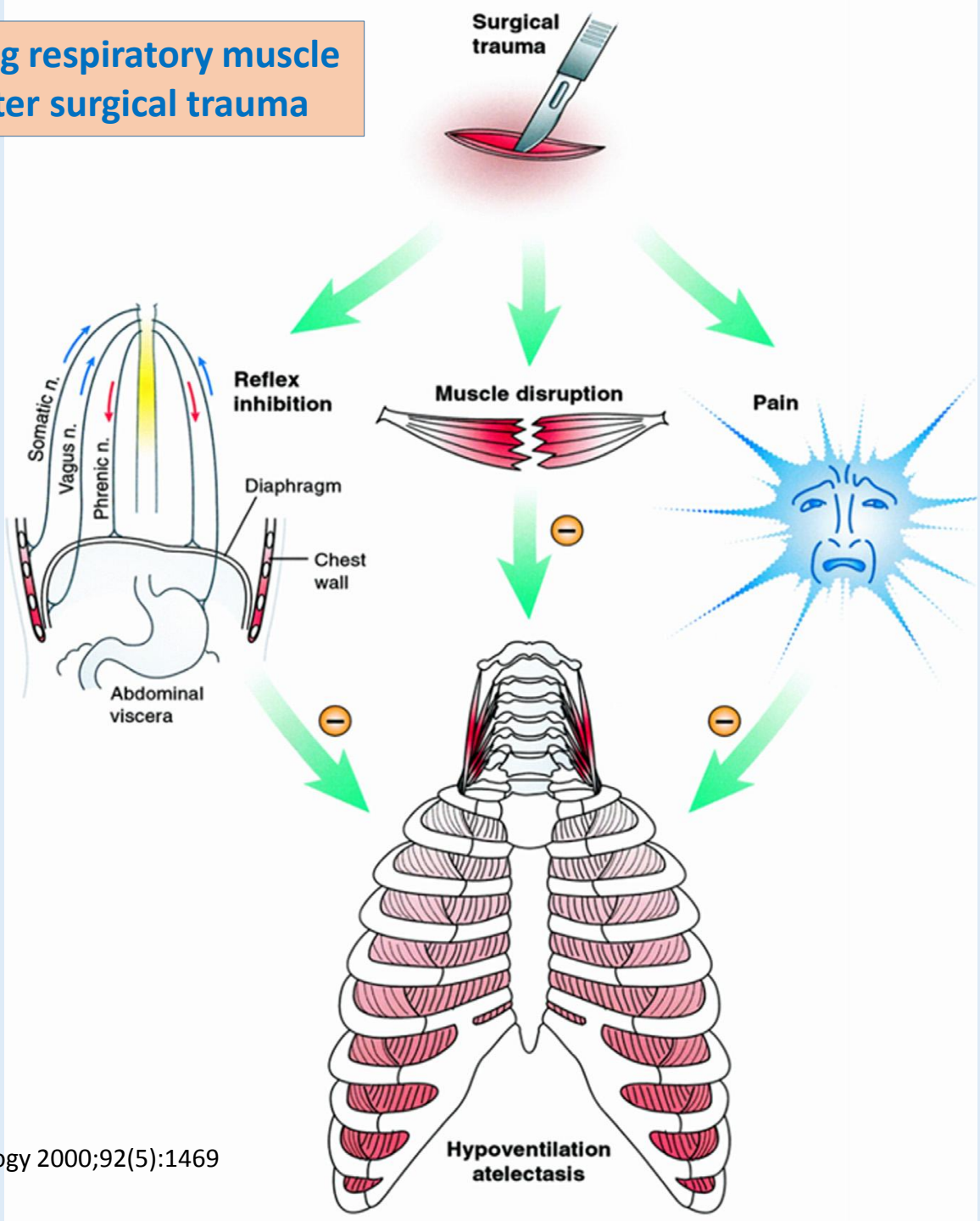
- incidence ranges from **2.0% to 5.6%** in the **general surgical population**

- **associated with**
  - **poor patient outcomes**
  - **longer durations of hospital stay**
  - **increased likelihood of rehospitalization**
  - **increased mortality**



Tusman G et al Curr Opin Anesthesiol 2012, 25:1–10

Factors producing respiratory muscle dysfunction after surgical trauma



Warner DO Anesthesiology 2000;92(5):1469

Post-operative pulmonary complications

Definition

is a **postoperative pulmonary abnormality** that
produces identifiable disease or dysfunction that is clinically significant
and **adversely affects the clinical course**

major categories of clinically significant complications

- **Atelectasis**
- **Infection**, including bronchitis and pneumonia
- **Respiratory failure** (mechanical ventilation for >48 hours after surgery or unplanned reintubation)
- **Hypoxemia**
- **Exacerbation** of underlying chronic lung condition eg COPD, asthma

PREOPERATIVE RISK ASSESSMENT

- ❑ elucidate a patient's underlying medical disease
- ❑ determine if the patient is optimized
- ❑ treat modifiable conditions
- ❑ screen for potentially unrecognized disorders
- ❑ present a clear picture of the patient's overall risk for perioperative complications

Risk factors for pulmonary complications

PATIENT-RELATED RISK FACTORS

Pulmonary	Nonpulmonary
Smoking	Age
Chronic obstructive pulmonary disease	General health status
Asthma	Obesity
Interstitial lung disease	Obstructive sleep apnea
Upper respiratory infection	Pulmonary hypertension
	Heart failure
	Nutritional status
	Dependent functional status
	Neurologic impairment

PROCEDURE-RELATED RISK FACTORS

- ❑ Surgical site
- ❑ Duration of surgery
- ❑ Type of anesthesia
- ❑ Type of neuromuscular blockade
- ❑ Emergency surgery

Preoperative Pulmonary Risk Stratification for Noncardiothoracic Surgery: Systematic Review for the American College of Physicians

Gerald W. Smetana, MD; Valerie A. Lawrence, MD; and John E. Cornell, PhD

Ann Intern Med. 2006;144:581-595

PATIENT-RELATED RISK FACTORS

173 500 patients

Factor	Strength of Recommendation†	Odds Ratio‡
Potential patient-related risk factor		
Advanced age	A	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	1.62
Impaired sensorium	B	1.39
Cigarette use	B	1.26
Alcohol use	B	1.21
Abnormal findings on chest examination	B	NA
Diabetes	C	
Obesity	D	
Asthma	D	
Obstructive sleep apnea	I	
Corticosteroid use	I	
HIV infection	I	
Arrhythmia	I	
Poor exercise capacity	I	

?

PROCEDURE-RELATED RISK FACTORS

Aortic aneurysm repair	A	6.90
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	2.10
General anesthesia	A	1.83
Perioperative transfusion	B	1.47
Hip surgery	D	
Gynecologic or urologic surgery	D	
Esophageal surgery	I	

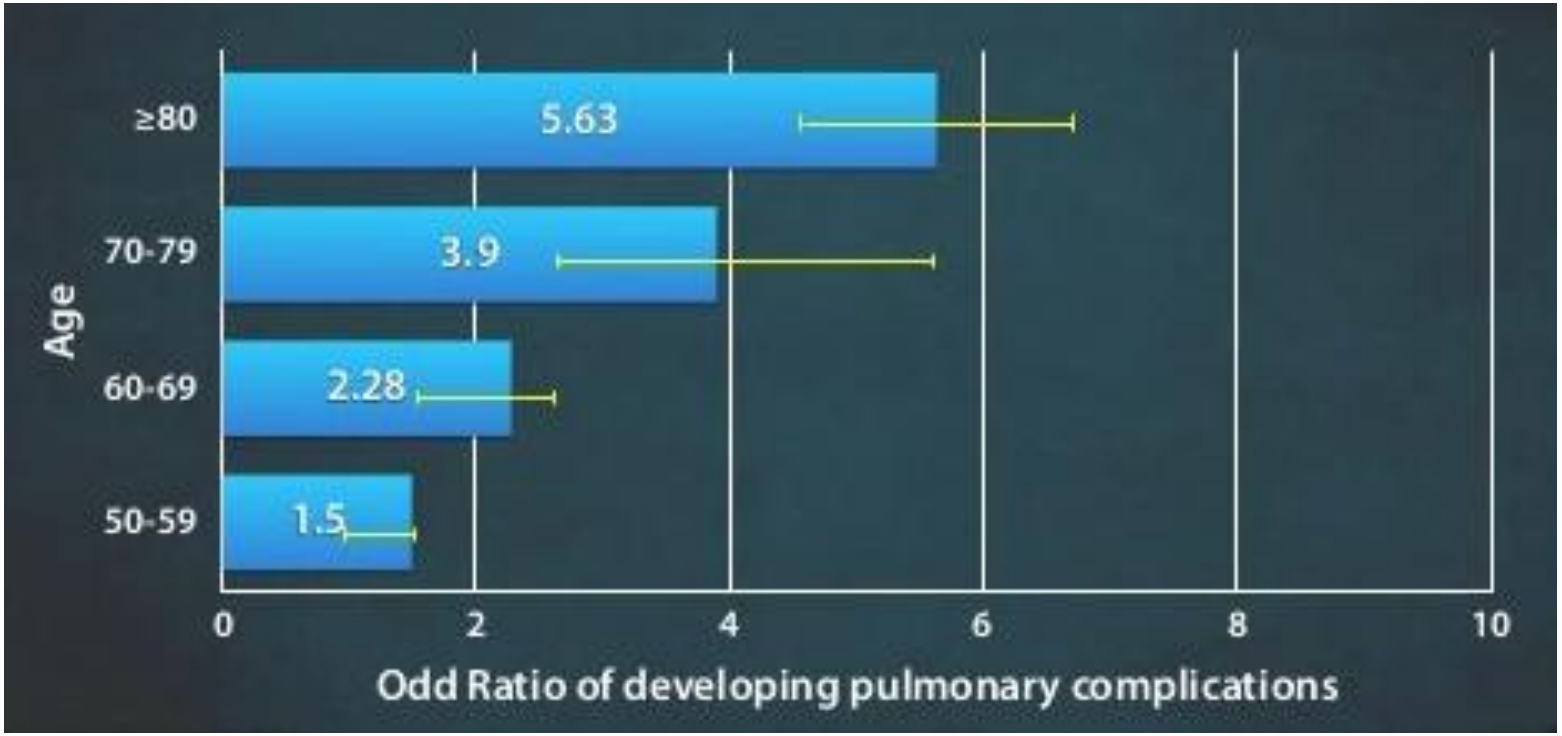
Laboratory Tests

Albumin level < 35 g/L	A	2.53
Chest radiography	B	4.81
BUN level > 7.5 mmol/L (>21 mg/dL)	B	NA
Spirometry	I	

Smentana G et al Ann Intern Med. 2006;144:581-595

AGE & post-operative pulmonary complications

Age >50 was an independent risk factor for PPCs



Smentana G et al Ann Intern Med. 2006;144:581-595

ASA Physical Status Class & PPCs

Classification	Description
ASA 1	Healthy patients
ASA 2	Mild to moderate systemic disease caused by the surgical condition or by other pathological processes, and medically well controlled
ASA 3	Severe disease process which limits activity but is not incapacitating
ASA 4	Severe incapacitating disease process that is a constant threat to life
ASA 5	Moribund patient not expected to survive 24 hours with or without an operation
ASA 6	Declared brain-dead patient whose organs are being removed for donor purposes

Pulmonary complications after major abdominal surgery:
National Surgical Quality Improvement Program analysis

Yang CK, Teng A, Lee DY, Rose K — J Surg Research 2015;198:441-9

165,196 patients
PPCs : 5.8%

Prognostic factors		PPCs adjusted OR (95% CI)	P Value
ASA class			
No disturbance	1	Referent	
Mild disturbance	2	1.3 (0.9–1.9)	0.2087
Severe disturbance	3	2.9 (1.9–4.3)	<0.0001
Life threat/moribund	4-5	4.4 (3.0–6.7)	<0.0001

OBESITY & PPCs

Obesity is not a significant predictor of PPCs

AND

should not affect patient selection for otherwise high-risk procedures

165,196 patients
Major abdominal surgery

Prognostic factors	PPCs adjusted OR (95% CI)	*P* Value
BMI (kg/m^2)		
0–20	Referent	
21–35	0.8 (0.7–0.8)	<0.0001
>35	0.9 (0.9–1.0)	0.1066

Yang CK J Surg Research 2015;198:441-9

The Obesity Paradox

Body Mass Index and Outcomes in Patients Undergoing Nonbariatric General Surgery

John T. Mullen, MD, FACS, Donald W. Moorman, MD, FACS,* and Daniel L. Davenport, PhD†*

118,707 patients
ACS NSQIP

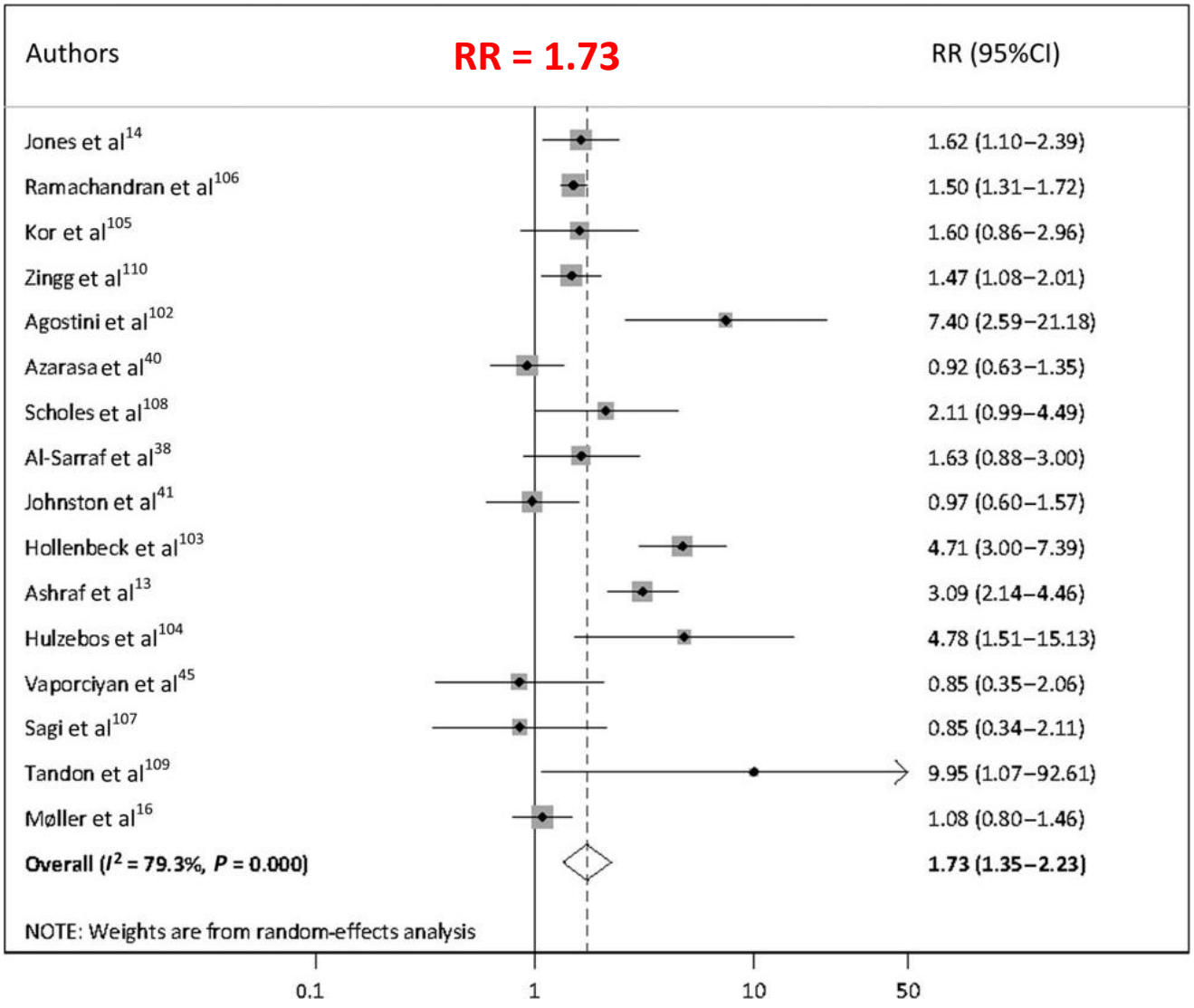
Characteristic	All Patients	Underweight	Normal (reference)	Overweight	Obese I	Obese II	Obese III
No. patients (%)	118,707 (100.0)	3056 (2.6)	36,200 (30.4)	37,979 (32.0)	21,559 (18.2)	10,552 (8.9)	9361 (7.9)
Mortality (%)	1.5	5.0*	1.8	1.3†	1.2†	1.0†	1.2†
Morbidity (%)	11.3	19.5*	10.8	10.5	10.8	11.8	13.8*
Return to O.R. (%)	5.3	8.2*	5.4	5.0†	4.8†	5.3	5.7
Length of hospital stay (days)	4.5	9.7*	4.8	4.2†	4.1†	4.2	4.7
Wound occurrence (%)	5.8	7.0*	4.9	5.6*	5.9*	6.8*	8.0*
Sepsis/septic shock (%)	4.1	8.5*	4.2	3.8	3.5†	3.9	4.6
Pulmonary occurrence (%)	3.5	7.9*	3.7	3.1†	3.2	3.4	4.2
UTI (%)	1.7	3.4*	1.7	1.5	1.5	1.7	1.9
Renal insufficiency or failure (%)	0.7	1.0	0.7	0.6	0.7	0.8	0.9
AMI or cardiac arrest (%)	0.5	1.0*	0.5	0.5	0.4	0.4	0.5
Transfusion >4u w/in 72 h (%)	0.5	0.9	0.5	0.4	0.4	0.3	0.7
CVA or coma (%)	0.3	0.6*	0.3	0.2	0.2	0.2	0.3

*†The mean rate of the characteristic for a particular BMI class is significantly higher (*) or lower (†) than the rate for normal class patients (Bonferroni comparison of means

Mullen J et al Ann Surg 2009;250: 166–172

smoking is a significant predictor of PPCs

Smoking & Pulmonary complications



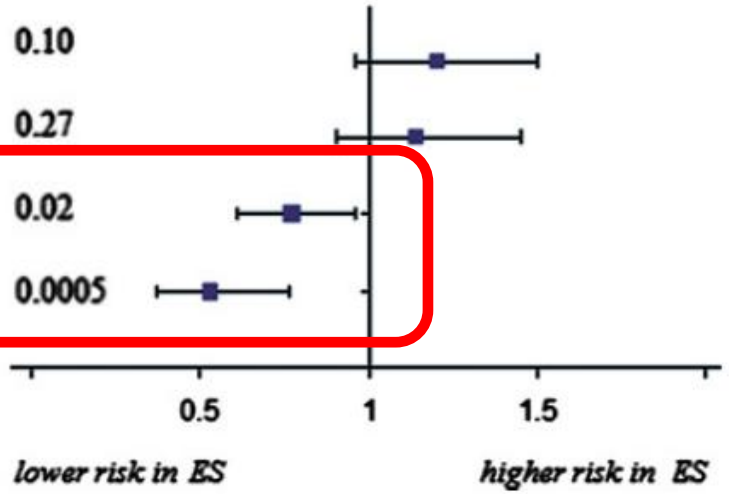
Grønkjær A et al Ann Surg 2014;259:52–71

smoking cessation reduces PPCs

Smoking cessation **for at least 4 weeks** before surgery reduces the risk of PPCs, and **longer periods of smoking cessation may be even more effective**.

Smokers vs ex-smokers

Comparisons	No. of Patients	RR [95% CI]	I^2%	P value
< 2 wk vs. CS	559	1.20 [0.96, 1.50]	0%	0.10
2 - 4 wk vs. CS	2210	1.14 [0.90, 1.45]	6%	0.27
> 4 wk vs. CS	5659	0.77 [0.61, 0.96]	64%	0.02
> 8 wk vs. CS	1426	0.53 [0.37, 0.76]	52%	0.0005



Wong J et al Can J Anesth (2012) 59:268–279

RISK MODELS

- **Risk for post-operative pulmonary complications**
  - ARISCAT INDEX
- **Risk for post-operative respiratory failure**
  - Arozullah index
  - Gupta index
- **Risk for post-operative pneumonia**
  - Arozullah index
  - Gupta index

ARISCAT Index

Assess Respiratory Risk in Surgical Patients in Catalonia

Independent Predictors of Risk for Post-operative pulmonary complications

- ❑ Age : >50 years
- ❑ Preoperative oxygen saturation : <96%
- ❑ Respiratory infection in the last month
- ❑ Preoperative anemia with hemoglobin ≤10 g/dL
- ❑ Emergency surgery
- ❑ Surgical incision
  - Upper abdominal
  - Intrathoracic
- ❑ Duration of surgery : >2h

Canet J et al Anesthesiology 2010; 113:1338 –50

ARISCAT Index

Independent Predictor of PPC Risk	Risk Score
Age, y	
≤ 50	0
51-80	3
> 80	16
Preoperative Spo_2 %	
≥ 96	0
91-95	8
≤ 90	24
Respiratory infection in the last month	17
Preoperative anemia (< 10 g/dL)	11
Surgical incision site	
Peripheral	0
Upper abdominal	15
Intrathoracic	24
Duration of surgery, h	
≤ 2	0
> 2 to 3	16
> 3	23
Emergency procedure	8

0 to 25 points: Low risk: 1.6%

26 to 44 points: Intermediate risk: 13.3%

45 to 123 points: High risk: 42.1%

Arozullah respiratory failure index

Veterans Affairs Surgical Quality Improvement Program – VASQIP

Preoperative predictor	Point value
Type of surgery	
Abdominal aortic aneurysm	27
Thoracic	21
Neurosurgery, upper abdominal, peripheral vascular	14
Neck	11
Emergency surgery	11
Albumin <3.0 g/dL	9
BUN >30 mg/dL **Ur>65mg/dl**	8
Partially or fully dependent functional status	7
History of chronic obstructive pulmonary disease	6
Age	
≥70 years	6
60 to 69 years	4

Class	Point total	% RF
1	≤10	0.5
2	11 to 19	1.8
3	20 to 27	4.2
4	28 to 40	10.1
5	>40	26.6

Arozullah A et al An Surg 2000;232(2):242-53

Arozullah Postoperative Pneumonia Risk Index

Predictor	Multivariate Analysis OR	Risk score
Age 50-59	1.5	4
Age 60-69	2.4	9
Age 70-79	3.6	13
Age >=80	5.6	17
History of COPD	1.7	5
History of stroke	1.5	4
Weight loss >10% in 6mo	1.9	7
Impaired sensorium	1.5	4
Partially dependent functional status	1.8	6
Fully dependent		
Current smoker within 1yr		
Alcohol >2/d past 2 wks		

Predictor	Multivariate Analysis OR	Risk score
Steroid for chronic condition	1.3	3
Transfusion >4 units	1.3	3
BUN <8	1.5	4
BUN 22-30	1.2	2
BUN >30 Ur>65mg/dl	1.4	3
General anesthesia	1.6	4
Vascular	1.3	3
Neck surgery	2.3	8
Neurosurgery	2.1	8
Upper abdominal	2.7	10
	3.9	14
	4.3	15
	1.3	3

Risk Category	points	PPC rate
Class 1	0-15	**0.24%**
Class 2	16-25	**1.18%**
Class 3	26-40	**4.6%**
Class 4	41-55	**10.8%**
Class 5	>55	**15.9%**

GUPTA - Risk Calculators

American College of Surgeons' National Surgical QualityImprovement Program - NSQIP

Postoperative Respiratory Failure

- **Procedure type**
- **ASA class**
- **Emergency case**
  - Yes
  - no
- **Functional status**
  - Totally dependent
  - Partially dependent
  - Totally Independent
- **Sepsis**
  - Preoperative SIRS
  - Preoperative septic shock
  - Preoperative sepsis
  - none

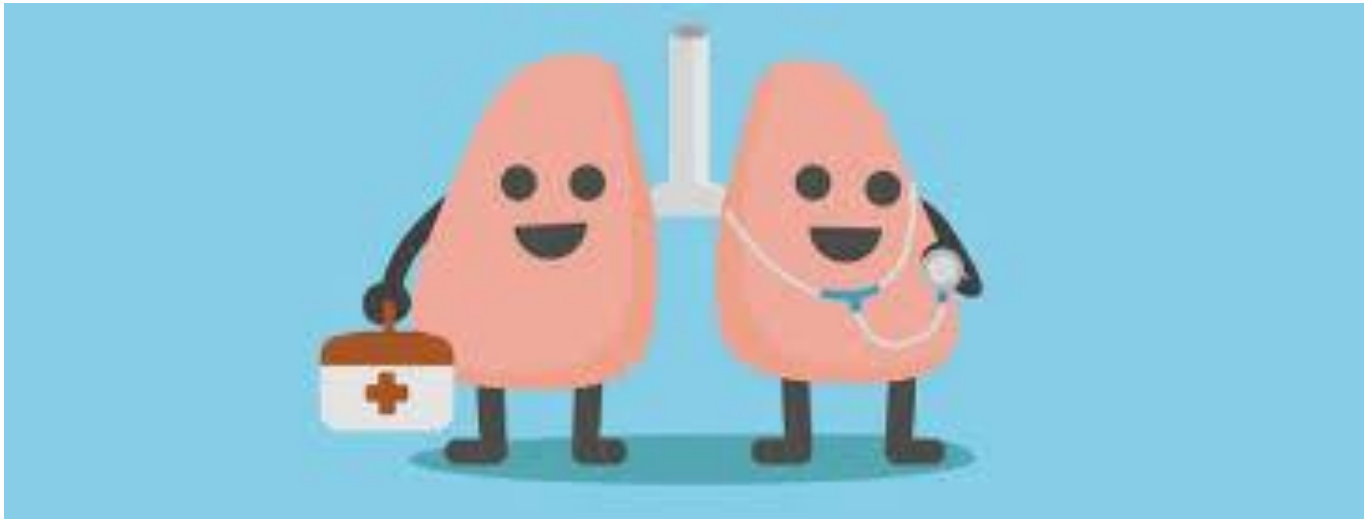
Gupta H et al CHEST 2011; 140(5):1207–1215

Postoperative Pneumonia

- **Age**
- **COPD**
  - Yes
  - No
- **Smoking within last year**
- **Procedure type**
- **ASA class**
- **Functional status**
  - Totally dependent
  - Partially dependent
  - Totally Independent
- **Sepsis**
  - Preoperative SIRS
  - Preoperative septic shock
  - Preoperative sepsis
  - None

Gupta H et al Mayo Clin Proc. 2013;88(11):1241-1249

PREOPERATIVE ASSESSMENT FOR PATIENTS WITH PULMONARY PATHOLOGY



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Functionally dependent	A	1.65–2.51
COPD	A	1.79
Weight loss	B	1.62
Impaired sensorium	B	1.39
Cigarette use	B	1.26
Alcohol use	B	1.21
Abnormal findings on chest examination	B	NA
Diabetes	C	
Obesity	D	
Asthma	D	
Obstructive sleep apnea	I	
Corticosteroid use	I	
HIV infection	I	
Arrhythmia	I	
Poor exercise capacity	I	

Obstructive Diseases & PPCs

ASTHMA

- Well-controlled asthma is NOT a risk factor for PPCs.
- Poorly controlled asthma and/or the presence of wheezing on examination, are risk factors for PPCs.

COPD

- COPD is a major risk factor for PPCs
- Patients with a recent exacerbation or poorly controlled COPD should not undergo elective surgery until further optimized

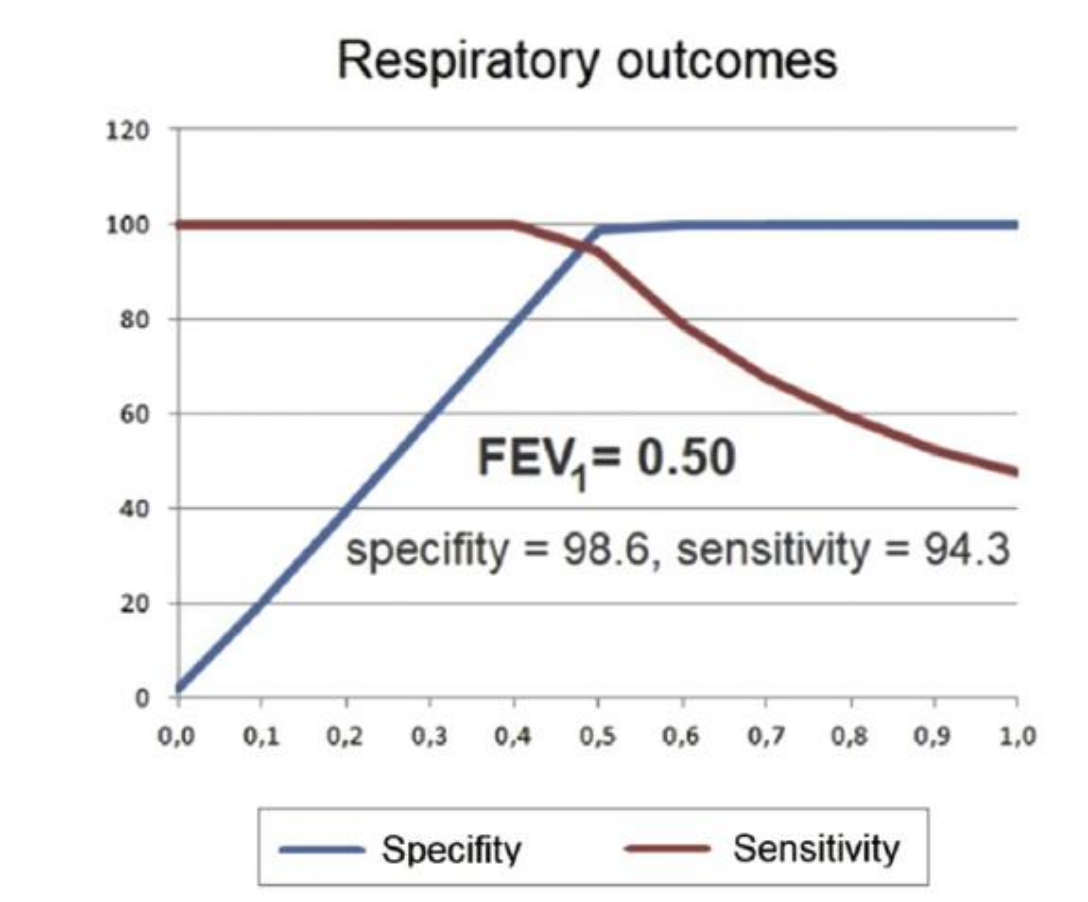
Comparison of Risk Models

ARISCAT - Overall	Arozullah – Resp failure	Arozullah - Pneumonia	Gupta - Pneumonia
Age	Age	Age	Age
Preop SpO2	History of COPD	History of COPD	History of COPD
Resp infection w/in 1 mo	Dependent functional status	Dependent functional status	Dependent functional status
Preop hemoglobin <=10	BUN >30	History of stroke	ASA class
Type of surgery	Albumin <3	Weight loss >10% in 6mo	Preoperative sepsis
Duration of surgery	Type of surgery	Impaired sensorium	Type of surgery
Emergency procedure	Emergency procedure	Current smoker within 1yr	Smoking before operation
		Alcohol >2/d past 2 wks	**Gupta – Respiratory failure**
		Steroid for chronic condition	Dependent functional status
		Transfusion >4 units	ASA class
		BUN	Preoperative sepsis
		General anesthesia	Type of surgery
		Type of surgery	Emergency surgery

3% of patients develop postop respiratory failure
25% of these patients die within 30 days

Chronic obstructive pulmonary disease severity influences outcomes after off-pump coronary artery bypass

Marcela Viceconte, MSc,[a,b] Isadora S. Rocco, MSc,[a,b] Hayanne O. Pauletti, MSc,[a,b] Milena Vidotto, PhD,[b] Ross Arena, PhD,[c] Walter J. Gomes, MD, PhD,[a] and Solange Guizilini, PhD[a,b]



confounders included in the model : age, BMI, and LV-EF

Viceconte M et al J Thorac Cardiovasc Surg 2018;156(4):1554-61

OSA & PPCs

	OSA n (%)	Non-OSA n (%)	*P* value
Patients (*n*)	240	240	
Total postoperative complications (case)[a]	104 (43)	67 (28)	<0.001
PACU	20 (8)	20 (8.3)	1.000
ICU	40 (17)	32 (13)	0.307
Ward	61 (25)	38 (16)	0.010
Total respiratory complication (case)[b]	78 (33)	53 (22)	0.010
Total desaturation	71 (30)	46 (19)	
Mild desaturation ($90\% < SaO_2 \leq 95\%$)	30 (13)	27 (11)	
Severe desaturation ($SaO_2 \leq 90\%$)	41 (17)	19 (8)	
Pulmonary edema	8 (3)	14 (6)	
Bronchospasm	5 (2)	3 (1)	
Pneumothorax	2 (0.8)	2 (0.8)	
Hypercapnea	2 (0.8)	1 (0.4)	
Laryngospasm	2 (08)	0	
Upper airway obstruction	1 (0.4)	0	
Arrive intubated in PACU	56 (23)	55 (23)	
Reintubated	1 (0.4)	1 (0.4)	

Liao P et al Can J Anesth/J Can Anesth (2009) 56:819–828

Prevalence of undiagnosed obstructive sleep apnea among adult surgical patients in an academic medical center

Kevin J. Finkel [a], Adam C. Searleman [a], Heidi Tymkew [a], Christopher Y. Tanaka [a], Leif Saager [a], Elika Safer-Zadeh [a], Michael Bottros [a], Jacqueline A. Selvidge [a], Eric Jacobsohn [b], Debra Pulley [a], Stephen Duntley [c], Colleen Becker [d], Michael S. Avidan [a,*]

- **2877 patients screened**
- **23.7%** screened **high-risk for OSA**
  - **82%** had **undiagnosed OSA**

Severity of OSA in the high-risk patients

OSA severity	Number	Percentage
No OSA (0–5)	37	18.0%
Mild OSA (6–20)	97	47.1%
Moderate OSA (21–40)	40	18.9%
Severe OSA (>40)	33	16.0%
Mild to severe OSA	170	82.0%

Sleep Medicine 10 (2009) 753–758

Screening tool for OSA: STOP-Bang

S	Does the patient **snore** loudly (louder than talking or loud enough to be heard through closed doors)?	Y/N
T	Does the patient often feel **tired**, fatigued, or sleepy during the day?	Y/N
O	Has anyone **observed** the patient stop breathing during their sleep?	Y/N
P	Does the patient have, or is the patient being treated for, high blood **pressure**?	Y/N
B	Does the patient have a **BMI** of more than 35?	Y/N
a	**Age.** Is the patient older than 50?	Y/N
n	Is the patient's **neck** circumference greater than 40cm?	Y/N
g	**Gender.** Is the patient male?	Y/N

Scoring:
Y ≥ 3 = high risk of OSA
Y < 3 = low risk of OSA

Developed by Chung F, Yegneswaran B, Liao P, Chung SA, Vairavanathan S, Islam S, Khajehdehi A, Shapiro C: *STOP Questionnaire A Tool to Screen Patients for Obstructive Sleep Apnea*, 2008.

ASA Guidelines 2014 - Identification and Assessment of OSA

If a patient **has signs or symptoms in two or more of these categories**, there is a **significant probability that he or she has OSA**

A. Clinical signs and symptoms suggesting the possibility of OSA

1. Predisposing physical characteristics

Predisposing physical characteristics

- Adult patients: BMI 35 kg/m^2
- Pediatric patients: 95th percentile for age and sex
- Neck circumference 17 inches (men) or 16 inches (women)
- Craniofacial abnormalities affecting the airway
- Anatomical nasal obstruction
- Tonsils nearly touching or touching in the midline

2. History of apparent airway obstruction during sleep

History of airway obstruction during sleep

- ❑ **The severity of OSA may be determined by sleep study**
- ❑ **<u>If a sleep study is not available</u>**, such patients should **be treated as though they have moderate sleep apnea unless one or more of the signs or symptoms above is severely abnormal**

- Intermittent vocalization during sleep
- Parental report of restless sleep, difficulty breathing, or struggling respiratory efforts during sleep
- Child with night terrors
- Child sleeps in unusual positions
- Child with new onset enuresis

3. Somnolence (one or more of the following is present)

Somnolence

- Frequent daytime somnolence or fatigue despite adequate "sleep"
- Falls asleep easily in a nonstimulating environment (*e.g.*, watching television, reading, riding in, or driving a car) despite adequate "sleep"
- Pediatric patients: parent or teacher comments that child appears sleepy during the day, is easily distracted, is overly aggressive, is irritable, or has difficulty concentrating
- Pediatric patients: child often difficult to arouse at usual awakening time

ASA Guidelines 2014 - Scoring System for Perioperative Risk from OSA

A. Severity of sleep apnea based on sleep study (or clinical indicators if sleep study is not available)
Point score: (0–3)†‡

Severity of OSA

Severity of OSA (table 1)	Points
None	0
Mild	1
Moderate	2
Severe	3

B. Invasiveness of surgery and anesthesia
Point score: (0–3)

Type of surgery & anesthesia

Type of surgery and anesthesia	Points
Superficial surgery under local or peripheral nerve block anesthesia without sedation	0
Superficial surgery with moderate sedation or general anesthesia	1
Peripheral surgery with spinal or epidural anesthesia (with no more than moderate sedation)	1
Peripheral surgery with general anesthesia	2
Airway surgery with moderate sedation	2
Major surgery, general anesthesia	3
Airway surgery, general anesthesia	3

C. Requirement for postoperative opioids
Point score: (0–3)

Requirement for postoperative opioids

Opioid requirement	Points
None	0
Low-dose oral opioids	1
High-dose oral opioids, parenteral or neuraxial opioids	3

Estimation of Perioperative risk :
The score for A + the greater of the score for either B or C: 0-6

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The score for A + the greater of the score for either B or C: 0-6

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Point score: (0–3)†‡

Severity of OSA (table 1)	Points
None	0
Mild	1
Moderate	2
Severe	3

points
+1: if PCO2 >50mmHg
-1: if CPAP or NPPV used before surgery

B. Invasiveness of surgery and anesthesia
Point score: (0–3)

Type of surgery and anesthesia	Points
Superficial surgery under local or peripheral nerve block anesthesia without sed	0
Superficial surger or general anesth	1
Peripheral surger dation)	1
Peripheral surger	2
Airway surgery w	2
Major surgery, ge	3
Airway surgery, g	3

score 4: increased perioperative risk

score of 5 or 6: significantly increased perioperative risk

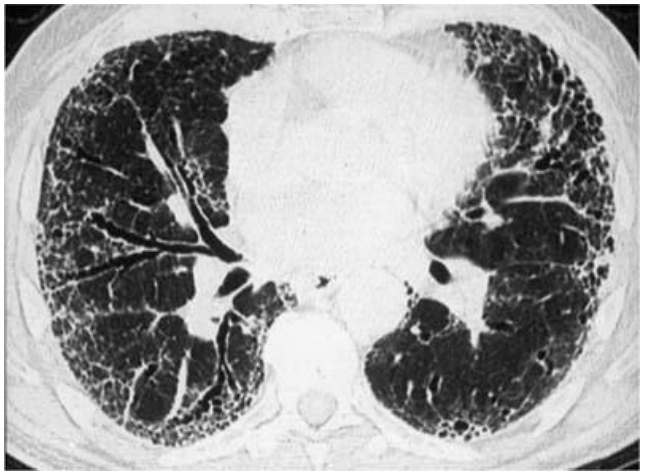
C. Requirement for po
Point score: (0–3)

Opioid requirement	Points
None	0
Low-dose oral op s	1
High-dose oral opioids, parenteral or neuraxial opioids	3

D. Estimation of perioperative risk:
Overall point score: the score for A plus the greater of the score for either B or C: (0–6)§

Preoperative Evaluation of Patients With Interstitial Lung Disease

Patel N et al CHEST 2019; 156(5):826-833



- **Patients with interstitial lung disease are at an increased risk for perioperative morbidity and mortality.**

- **Patients with ILD undergoing lung cancer resection or emergency surgery** have a **higher risk for PPCs** than patients undergoing **nonthoracic surgery or elective SLB for ILD diagnosis**

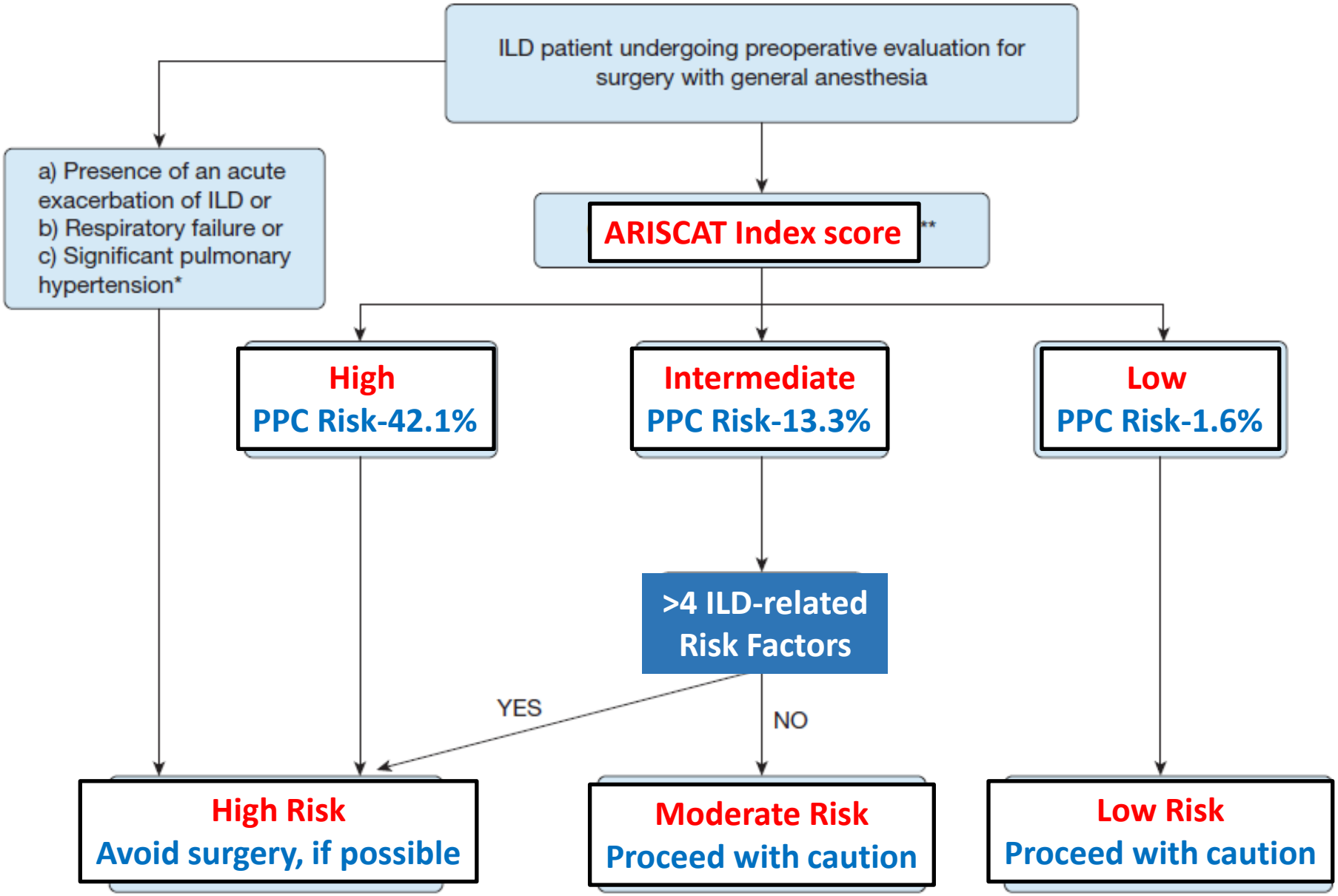
Patient- and Procedure-Related Risk Factors for ILD-Related PPCs

Factor
Patient –related factors
Male sex
D_{LCO} < 60% predicted
Preoperative home oxygen requirement
Presence of acute exacerbation of ILD
Pulmonary hypertension[a]
Charlson Comorbidity Index score ≥ 2
Immunosuppressed status
OSA[b]
Procedure –related factors
General anesthesia
Emergency surgery
Longer duration of anesthesia/ longer operative time (> 2 h)
Pulmonary/thoracic surgery
Open rather than thorascopic surgery
Pneumonectomy or lobectomy (vs wedge resection)[c]

Transthoracic echocardiogram (right ventricular systolic pressure >40 mm Hg) OR right-sided heart catheterization with mean pulmonary arterial pressure > 25 mm Hg

Patel N et al CHEST 2019; 156(5):826-833

Approach to preoperative evaluation of ILD patients undergoing surgery



Patel N et al CHEST 2019; 156(5):826-833

PULMONARY HYPERTENSION

- **Perioperative morbidity and mortality** for patients with PH is **extremely high**
- **No patient with a new diagnosis of PH should proceed with elective surgery without a thorough work-up and evaluation with a PH specialist**
- **Patients 'suspected' of having PH with an uncertain underlying cause and ungraded severity**
  - **elective surgery must be postponed**
  - **the patient referred to a specialised PH service before surgery**

	Ramakrishna et al. (2005) (n = 145)	Minai et al. (2006) (n = 21)	Lai et al. (2007) (n = 62)	Price et al. (2010) (n = 28)	Memtsoudis et al. (2010) (n = 3543)	Kaw et al. (2011) (n = 96)
Country	USA	USA	Taiwan	France	USA	USA
PH due to left heart disease	No	No	Yes	No	No	Yes
General anaesthesia	100%	79%	58%	50%	Data unavailable	100%
Major surgery	79%	86%	58%	57%	THR/TKR	100%
Mortality	7%	18%	9.7%	7%	2.4/0.9%	1%
Morbidity	42%	14%	24%	29%	_	28%
Study type/ limitations	Retrospective No control ECHO criteria to define PH	Retrospective No control Severe PH	Retrospective Contolled Doppler ECHO criteria	Retrospective No control RHC criteria Mild-to-moderate disease	NIS database Matched samples. Immediate postoperative period only	Retrospective Controlled RHC criteria

Pilkington SA et al Anaesthesia 2015, 70, 56–70

NYHA-WHO functional class

World Health Organization functional classification of pulmonary hypertension

Class	Definition
Class I	No limitation of physical activity No undue dyspnea or fatigue, chest pain, or near syncope with ordinary physical activity
Class II	Slight limitation of physical activity Comfortable at rest Undue dyspnea or fatigue, chest pain, or near syncope with ordinary physical activity
Class III	Marked limitation of physical activity Comfortable at rest Undue dyspnea or fatigue, chest pain, or near syncope with less than ordinary activity causes
Class IV	Signs of right heart failure Dyspnea and/or fatigue may be present at rest Inability to carry out any physical activity without symptoms

Patient and surgical risk factors associated with increased morbidity and mortality in patients with pulmonary hypertension

Patient factors	Surgical factors
NYHA/WHO functional class ≥ 2	Emergency surgery
6MWD < 300 m	Intermediate-/high-risk surgery
History of coronary artery disease	ASA physical status > 2
History of pulmonary embolism	Duration of anaesthesia > 3 h
History of chronic renal insufficiency	Intra-operative use of vasopressors
RVH with severe systolic dysfunction	
Higher mean pulmonary artery pressure	

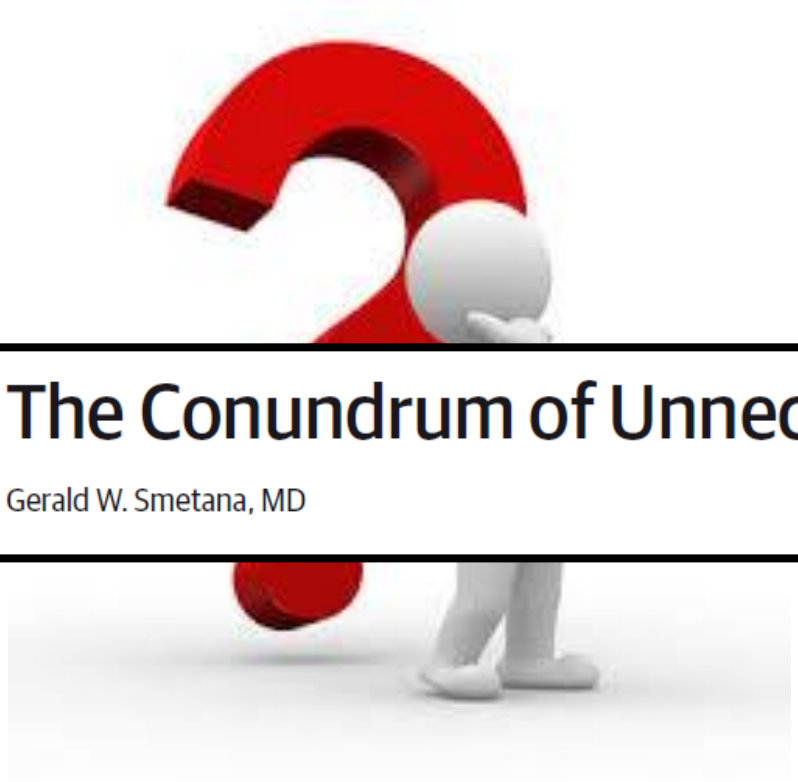
Pilkington SA et al Anaesthesia 2015, 70, 56–70

PREOPERATIVE RISK ASSESSMENT

- ❑ **detailed physical examination**
- ❑ **Medical History- Seek signs suggestive of**:
  - ➢ **asthma**
  - ➢ **COPD**
  - ➢ **OSA**
  - ➢ **right heart failure** (suggestive of cor pulmonale)
  - ➢ **pulmonary hypertension**
  - ➢ **neurologic impairment**
  - ➢ **neuromuscular weakness**
  - ➢ **spinal deformities**

  that might modify PPC risk

PREOPERATIVE PULMONARY RISK ASSESSMENT



- ❑ X-ray
- ❑ Spirometry

The Conundrum of Unnecessary Preoperative Testing

Gerald W. Smetana, MD

JAMA Internal Medicine 2015

Guidelines

American Society of Anesthesiologists - 2012

- **Preoperative tests**
  - **should not be ordered routinely**.
  - may be ordered, required, or performed **on a selective basis** for purposes of **guiding or optimizing perioperative management**

- The **indications for such testing** should be **documented and based on**
  - **information** obtained from **medical records**
  - **patient interview**
  - **physical examination**
  - **type and invasiveness of the planned procedure**

Guidelines

European Society of Anaesthesiology -2018

- Historically, testing before noncardiac surgery involved a series of standard tests applied to all patients
  - Chest x-ray
  - electrocardiography
  - laboratory testing
  - Urinalysis

- these tests often
  - do not change perioperative management
  - may lead to follow-up testing
  - may lead to surgical delay
  - for results that are often normal
  - increase the cost of care

- Consider specific testing in selected patients guided by a peri-operative risk assessment based on clinical history and examination

Which pre-operative tests should be ordered?

Chest Radiographs

American Society of Anesthesiologists - 2012

- **Clinical characteristics to consider include**
  - smoking
  - recent upper respiratory infection
  - COPD
  - cardiac disease

Which pre-operative tests should be ordered?

Chest Radiographs

AMERICAN COLLEGE OF RADIOLOGY

Appropriateness Criteria for Routine Chest Radiography

- **In the case of the preoperative chest radiograph, consider**:
  - **advanced patient age (>70 y)**
  - **certain other patient-related and procedure related risk factors**
    - **history of cardiopulmonary disease,**
    - **unreliable history and physical examination**
    - **high-risk surgery**

however, its <u>ability to forecast postoperative pulmonary complications is low</u>.

- to investigate a **clinical suspicion for acute or unstable chronic cardiopulmonary disease that could influence patient care**.
  - **<u>Selective ordering</u>** is recommended

Which pre-operative tests should be ordered?

Tests Other than Chest X-ray

American Society of Anesthesiologists - 2012

- tests other than Chest X-ray
  - noninvasive passive or provocative screening tests
    - pulmonary function tests
    - pulse oximetry
  - invasive assessment of pulmonary function
    - arterial blood gas

- Clinical characteristics to consider:
  - type and invasiveness of the surgical procedure
  - interval from previous evaluation
  - treated or symptomatic asthma
  - symptomatic COPD
  - scoliosis with restrictive function

Which pre-operative tests should be ordered?

NICE guidelines on pre-operative testing 2016

NICE
National Institute for Health and Care Excellence

- ❑ **Do NOT routinely offer chest X-rays before surgery**.
- ❑ **Lung function/arterial blood gas**
  - **ASA class 1-2: not routinely**
  - **ASA class 3-4 due to known or suspected respiratory disease: consider for intermediate or severe operations**

Timing of Preoperative Testing

American Society of Anesthesiologists - 2012

- **Test results obtained from the medical record within 6 months of surgery** generally are acceptable **if the patient's medical history has NOT changed substantially**.
- **More recent test** results may be desirable
  - **when the medical history has changed**
  - **when a test results may play a role in the selection of a specific anesthetic technique** (e.g., regional anesthesia in the setting of anticoagulation therapy).

A reasonable approach

patient selection for preoperative chest x-ray

- patients with **known cardiopulmonary disease**
- in those **over age 50 years undergoing high risk surgical procedures**, including upper abdominal, aortic, esophageal, and thoracic surgery
- in the **presence of symptoms, findings on examination**, or **prior abnormal radiograph**

patient selection for preoperative PFTs

- **Patients with respiratory disease** eg COPD or asthma **if clinical evaluation cannot determine if the patient is at their best baseline**
- **patients with dyspnea or exercise intolerance** that **remains unexplained after clinical evaluation.**
- **PFTs should NOT be used as the primary factor to deny surgery**.
- **PFTs should NOT be ordered routinely prior to abdominal surgery or other high risk surgeries**

pulmonologist preoperative consultation

pulmonologist preoperative consultation

It is reasonable to delay elective surgery in patients with an acute exacerbation, recent infection, or worsening of symptoms for 4 -6 weeks from resolution of symptoms.

- **Any patient managed for chronic disease by a pulmonologist**
  - determine the **extent, severity, and stability of the disease**
  - determine **if the patient is optimized**
  - assess **compliance with prescribed therapies**
  - evaluate **perioperative risk of PPCs**
  - gather **results of recent PFTs or chest imaging**

- may be **considered in patients with**
  - **unexplained dyspnea on exertion**
  - **hypoxemia**
  - **hemoptysis**
  - **PH**
  - **abnormal chest imaging**
  - **recent hospitalizations or emergency room visits for acute pulmonary processes**