

관상동맥질환 환자에서의 폐암 수술 전후 위험도 평가

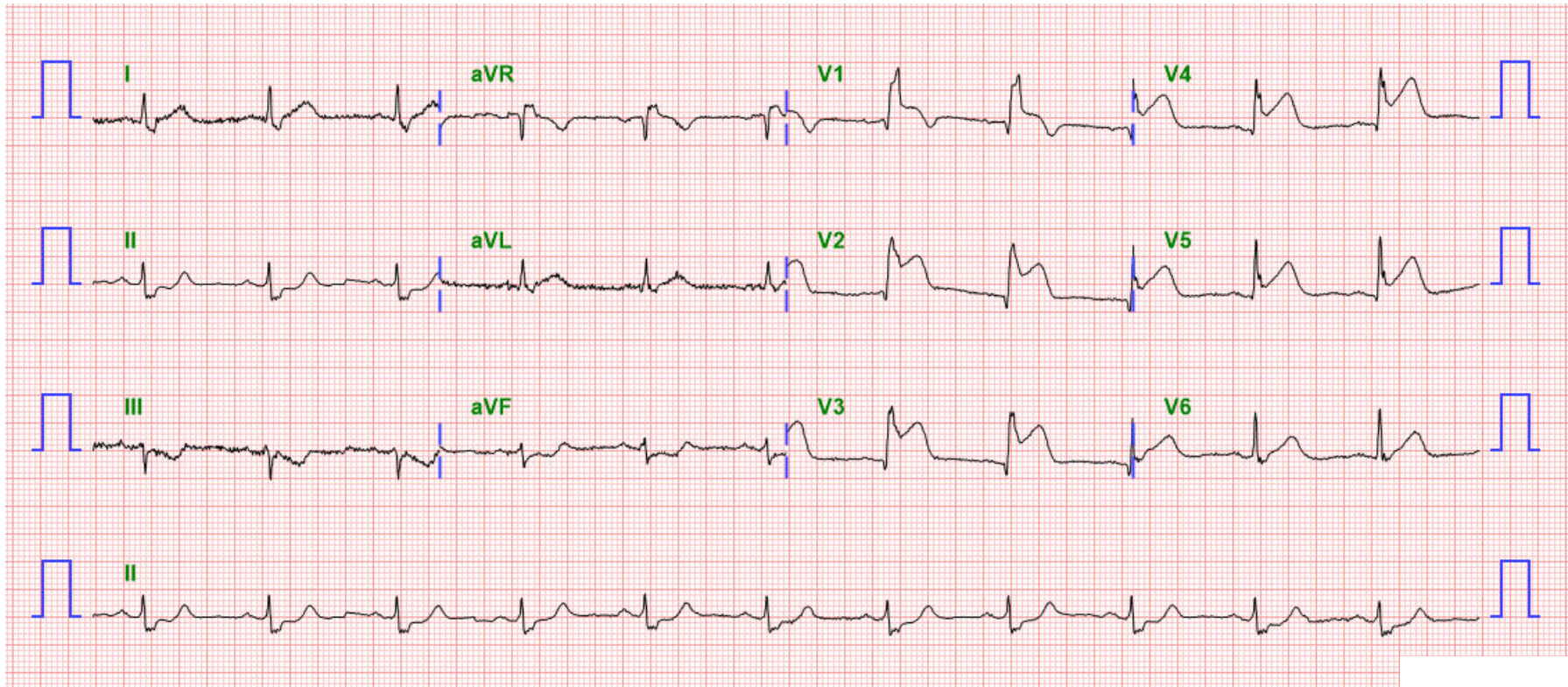
가톨릭의대 의정부성모병원

순환기내과 안 효 석

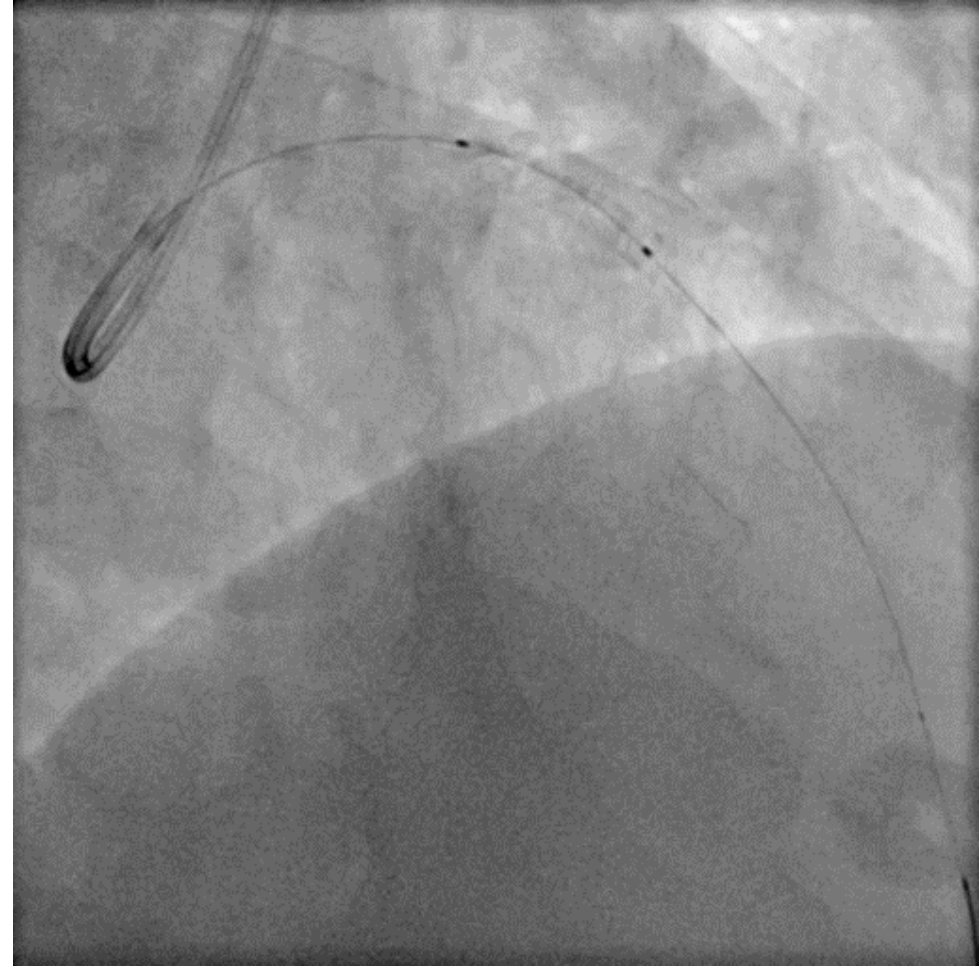
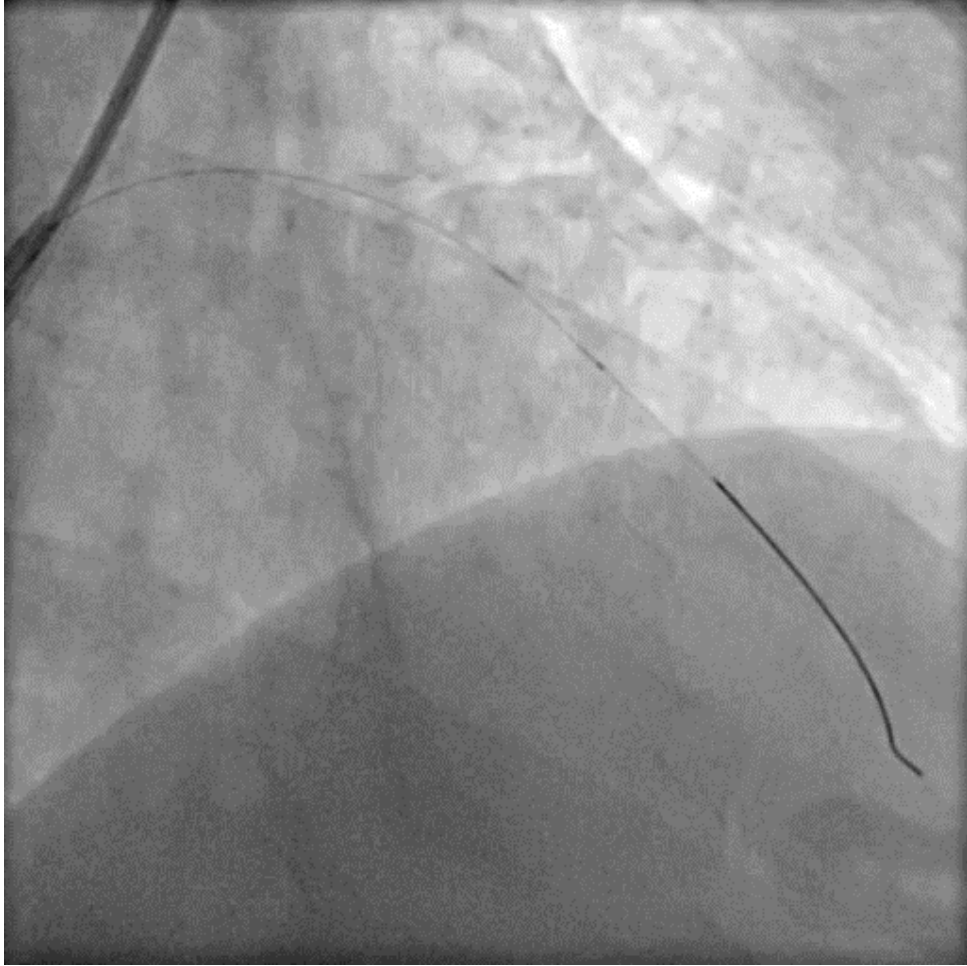
Case 1

- M/70
- C.C : chest pain

onset) 내원 2시간 전



Case 1 STEMI



Case 1 STEMI

- 응급 시술 이후 ...
- 폐암 발견
- 어떻게 해야하나 ???

Case 2 STEMI

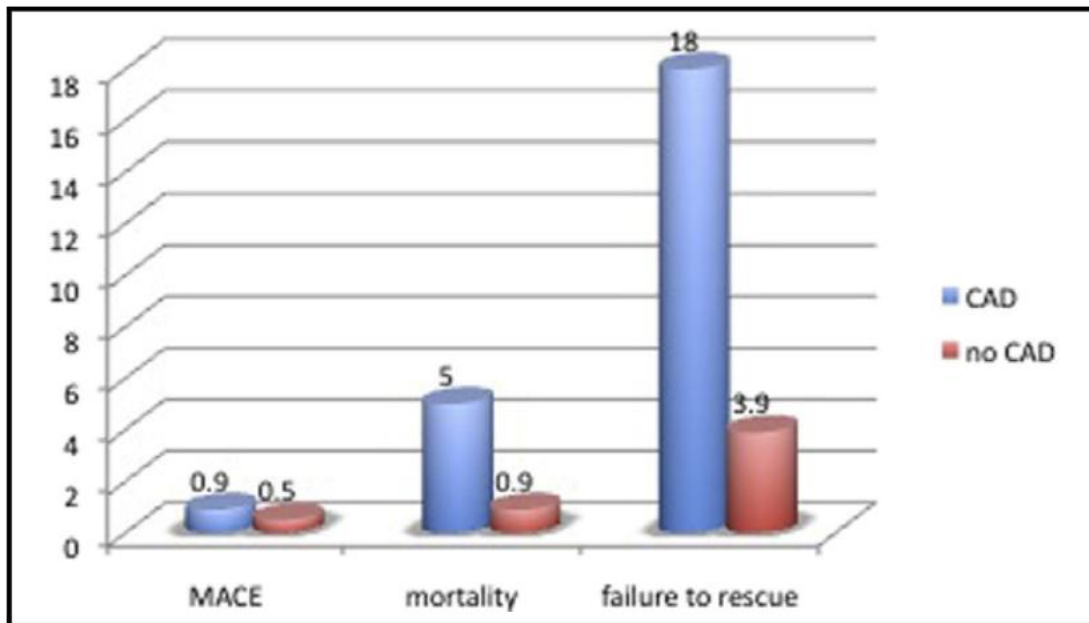
- M/71
- 3개월 전 STEMI로 PCI 시행 (DES)
- 폐암 발견
- 수술 시기 ??

Key clinical question

- Who should be delayed?
- Who can proceed?
- How should perioperative risk be managed?
- Main conflict: cancer progression vs cardiac events

Key clinical question

- Shared Risk Factors for CAD and Lung Cancer
- Prevalence of CAD in Lung Cancer Surgery Candidates
 - CAD prevalence in operable lung cancer: 7–16%
 - CAD prevalence in VATS lobectomy cohort: 13%
 - Common cardiovascular comorbidity in thoracic surgical practice
- Bidirectional Association Between CVD and Lung Cancer
- 목적은 “수술 취소”가 아니라 “위험도 조절”



Patients with CAD had higher 30-day mortality than those without CAD after VATS lobectomy.

Coronary artery disease is associated with an increased mortality rate following video-assisted thoracoscopic lobectomy

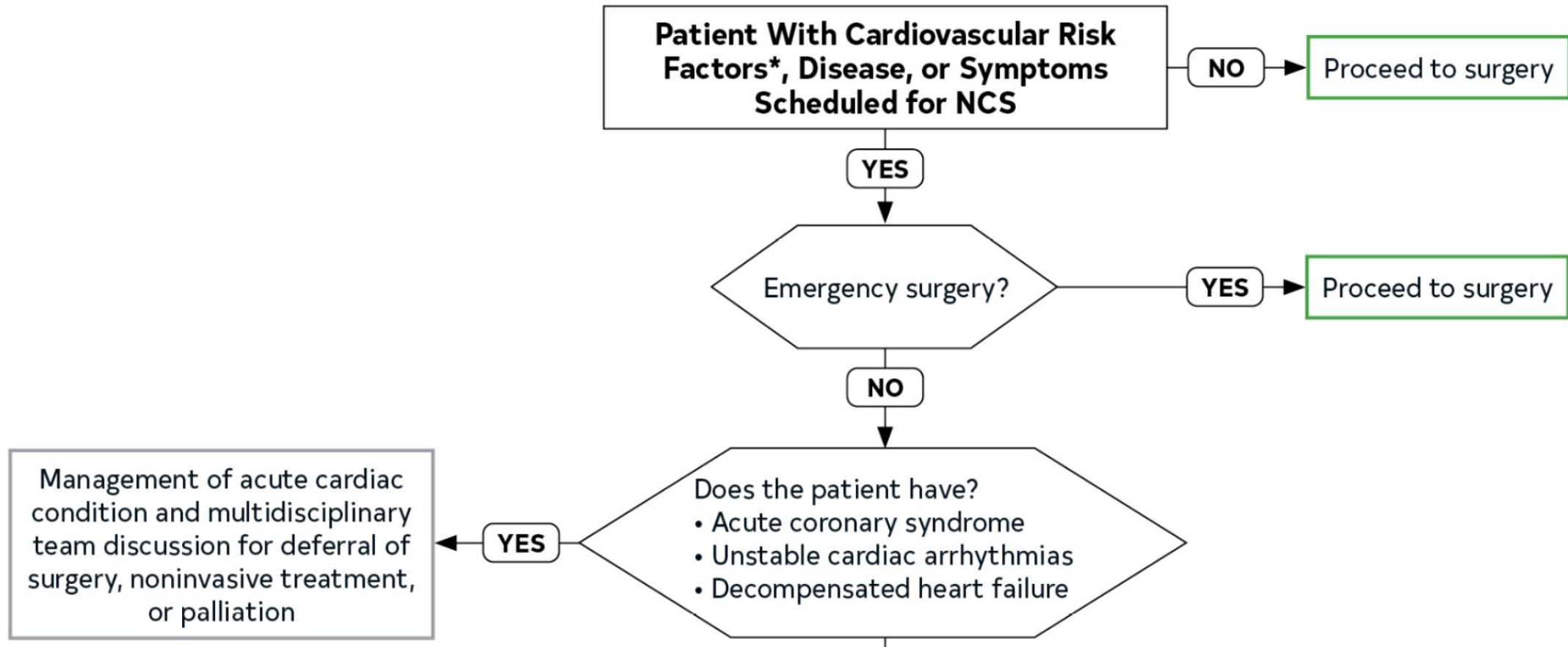
The Journal of Thoracic and Cardiovascular Surgery, 2017; 154, 352-357.

TABLE 4. Comparison of outcomes between matched groups of patients with and without CAD (218 pairs)

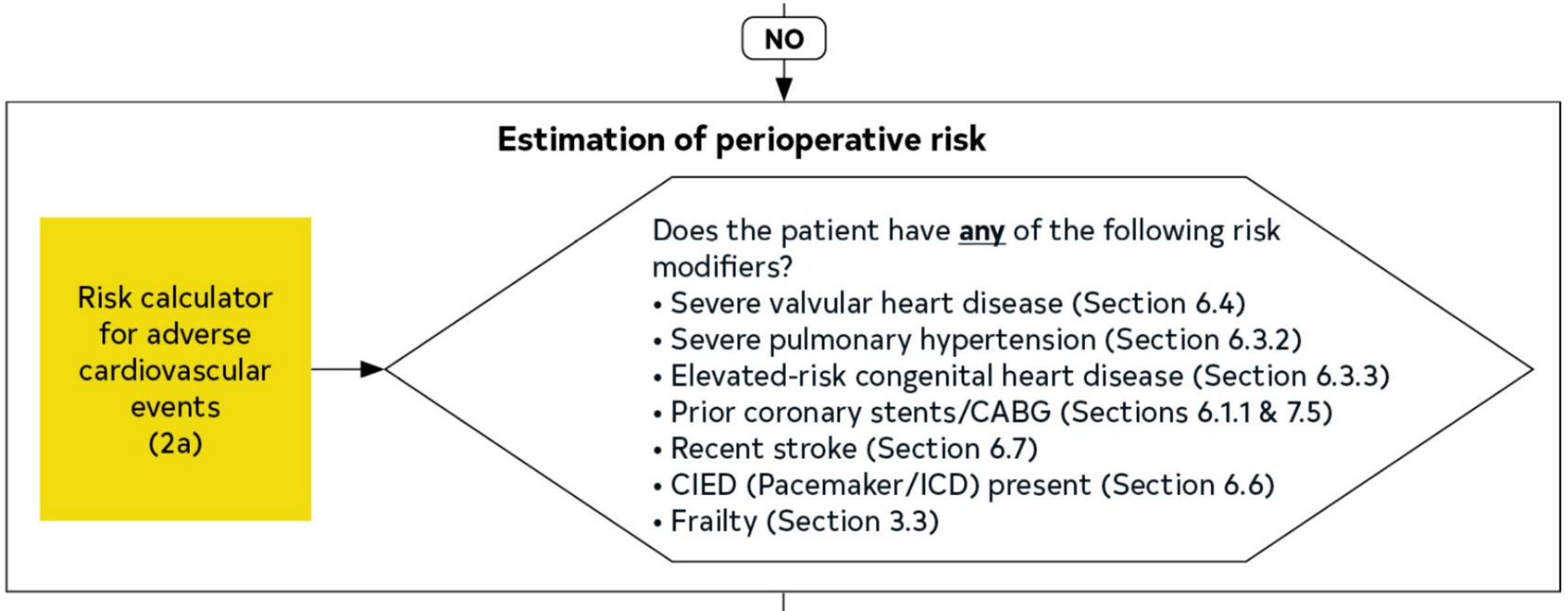
	Patients with CAD (n = 218)	Patients without CAD (n = 218)	P
MACE, n (%)	2 (0.9%, 0.1-3.2)	1 (0.5%, 0.1-2.5)	1
Cardiopulmonary complications, n (%)	61 (28, 22-34)	51 (23, 18-30)	.3
LOS, d	7.3 (6.3-8.3)	6.2 (5.5-6.9)	.3
AF, n (%)	31 (14, 9.9-19.0)	18 (8.2, 5-13)	.07
30-d mortality, n (%)	11 (5.0, 2.5-8.8)	2 (0.9, 0.1-3.2)	.02

Results are expressed as means and 95% confidence intervals (numeric variables) or numbers, percentages and 95% confidence intervals (categorical variables). CAD, Coronary artery disease; MACE, major adverse cardiac events; LOS, length of postoperative stay; AF, atrial fibrillation.

Key clinical question



Key clinical question



RCRI Score (the Revised Cardiac Risk Index)

1) High-risk surgery

Includes intraperitoneal, **intrathoracic**, or suprainguinal vascular procedures.

2) History of **ischemic heart disease**

a history of myocardial infarction, a positive exercise stress test,
current complaint of chest pain, use of nitrate therapy, or Q waves on ECG.

3) History of congestive heart failure.

4) History of cerebrovascular disease:

Includes a history of stroke or transient ischemic attack (TIA).

5) Insulin-dependent diabetes mellitus.

6) Preoperative serum creatinine > 2.0 mg/dL (177 µmol/L).

RCRI Score (the Revised Cardiac Risk Index)

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

Thomas H. Lee, MD, SM; Edward R. Marcantonio, MD, SM; Carol M. Mangione, MD, SM;
Eric J. Thomas, MD, SM; Carisi A. Polanczyk, MD; E. Francis Cook, ScD; David J. Sugarbaker, MD;
Magruder C. Donaldson, MD; Robert Poss, MD; Kalon K.L. Ho, MD, SM; Lynn E. Ludwig, MS, RN;
Alex Pedan, PhD; Lee Goldman, MD, MPH

- Prospective cohort study.
- **Study Population:** 4,315 patients (aged ≥ 50) undergoing elective major noncardiac surgery
- **Primary Outcomes:** Major cardiac complications (e.g., myocardial infarction, pulmonary edema, cardiac arrest, complete heart block).
- **Key Achievement:** Identified 6 independent clinical predictors, establishing the **Revised Cardiac Risk Index (RCRI)**.

Circulation. 1999;100:1043-1049.

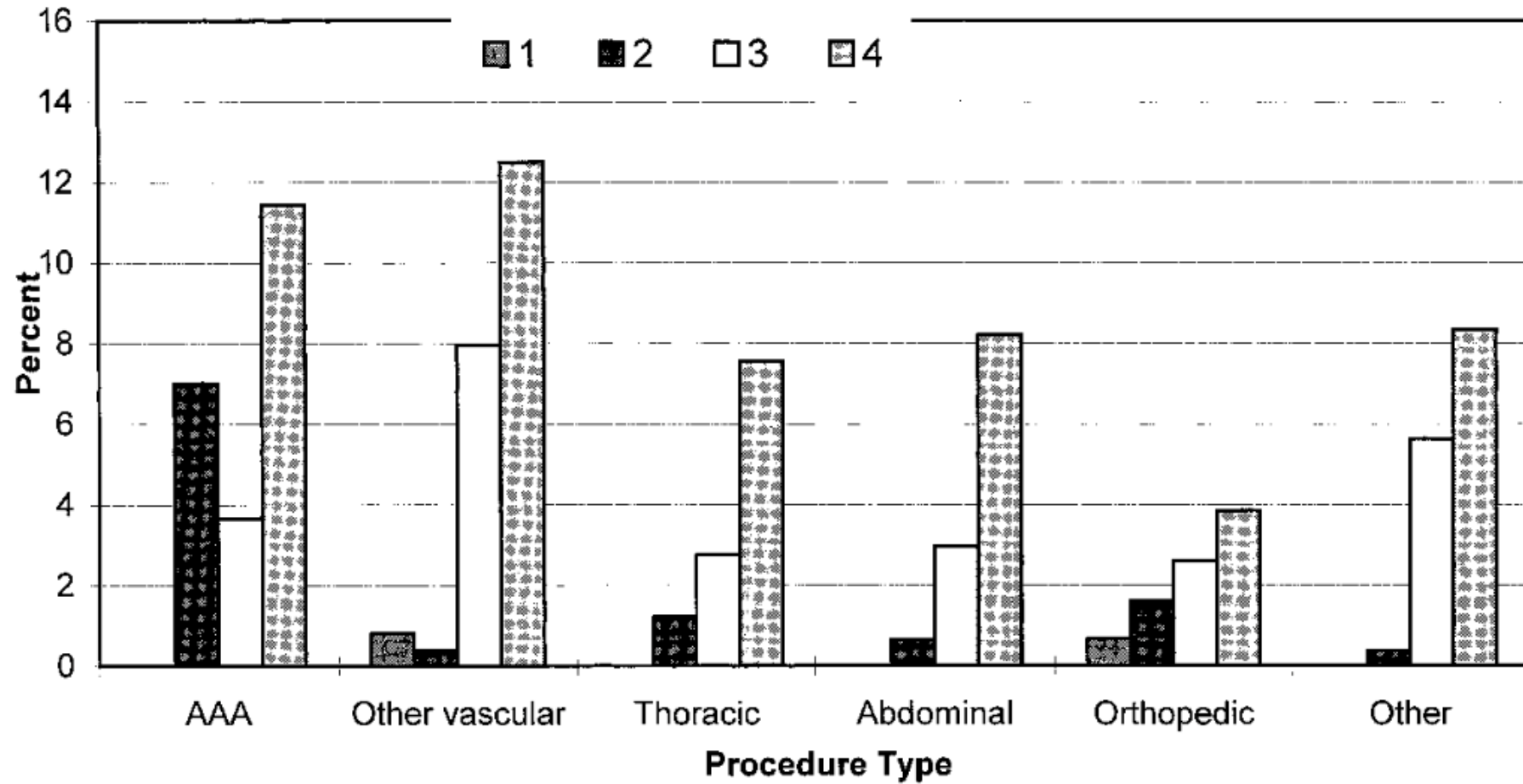
RCRI Score

TABLE 3. Major Cardiac Complication Rates and 95% CIs in Derivation and Validation Cohorts Stratified by Risk Classification System

	Derivation Cohort (n=2893)		Validation Cohort (n=1422)	
	Events/Pop	Rate (95% CI)	Events/Pop	Rate (95% CI)
Original Cardiac Risk Index				
Class I	31/2200	1.4 (1.0, 2.0)	13/1039	1.3 (0.7, 2.1)
Class II	20/561	3.6 (2.2, 5.5)	15/297	5.1 (2.9, 8.2)
Class III	5/127	3.9 (1.3, 8.9)	8/84	9.5 (4.2, 17.9)
Class IV	0/5	0	0/2	0
ROC area (SE)	0.606 (0.034)		0.701 (0.043)	
Modified Cardiac Risk Index				
Class I	49/2786	1.8 (1.3, 2.3)	29/1371	2.1 (1.4, 3.0)
Class II	6/95	6.3 (2.4, 13.2)	4/44	9.1 (2.5, 12.8)
Class III	1/12	8.3 (0.2, 38.5)	3/7	42.9 (9.9, 82)
ROC area (SE)	0.545 (0.022)		0.582 (0.034)	
ASA class				
Class I	0/140	0	0/65	0
Class II	14/1558	0.9 (0.5, 1.5)	7/729	1.0 (0.4, 2.0)
Class III	35/1078	3.3 (2.3, 4.5)	24/561	4.3 (2.8, 6.3)
Class IV	7/81	8.6 (3.5, 17)	4/43	9.3 (2.6, 22.1)
ROC area (SE)	0.697 (0.031)		0.706 (0.036)	
Revised Cardiac Risk Index				
Class I	5/1071	0.5 (0.2, 1.1)	2/488	0.4 (0.05, 1.5)
Class II	14/1106	1.3 (0.7, 2.1)	5/567	0.9 (0.3, 2.1)
Class III	18/506	3.6 (2.1, 5.6)	17/258	6.6 (3.9, 10.3)
Class IV	19/210	9.1 (5.5, 13.8)	12/109	11.0 (5.8, 18.4)
ROC area (SE)	0.759 (0.032)*		0.806 (0.034)†	

Circulation. 1999;100:1043-1049.

RCRI Score (the Revised Cardiac Risk Index)



Circulation. 1999;100:1043-1049.

RCRI Score (the Revised Cardiac Risk Index)

TABLE 4. Rates of Major Cardiac Complications and Multivariate ORs* Among Patients With Individual Risk Factors in Derivation and Validation Sets

	Derivation Set (n=2893)		Validation Set (n=1422)	
	Crude Data	Adjusted OR (95% CI)	Crude Data	Adjusted OR (95% CI)
Revised Cardiac Risk Index				
1. High-risk type of surgery	27/894 (3%)	2.8 (1.6, 4.9)	18/490 (4%)	2.6 (1.3, 5.3)
2. Ischemic heart disease	34/951 (4%)	2.4 (1.3, 4.2)	26/478 (5%)	3.8 (1.7, 8.2)
3. History of congestive heart failure	23/434 (5%)	1.9 (1.1, 3.5)	19/255 (7%)	4.3 (2.1, 8.8)
4. History of cerebrovascular disease	17/291 (6%)	3.2 (1.8, 6.0)	10/140 (7%)	3.0 (1.3, 6.8)
5. Insulin therapy for diabetes	7/112 (6%)	3.0 (1.3, 7.1)	3/59 (5%)	1.0 (0.3, 3.8)
6. Preoperative serum creatinine >2.0 mg/dL	9/103 (9%)	3.0 (1.4, 6.8)	3/55 (5%)	0.9 (0.2, 3.3)

*Based on logistic regression models including these 6 variables.

Preoperative consult

The incidence of perioperative cardiac complications

High- risk surgery (intraperitoneal, intrathoracic, or suprainguinal vascular)- 1 / 1

History of ischemic heart disease ----- 1 / 1

History of CHF ----- 0 / 1

History of cerebrovascular disease ----- 0 / 1

Insulin therapy ----- 0 / 1

Serum Cr > 2.0mg/dl ----- 0 / 1

Preoperative consult

Lee's revised cardiac risk는 (0, 1, 2, 3 이상)점 입니다.

수술중 약 (0.4, 0.9, 7, 11) %에서 심근경색, 폐색전증, 심장마비, 방실차단 등의 발생 가능성에 대해 충분히 설명 후 수술 진행하시기 바랍니다.

-----Remarks-----

- 1) Preop. risk 이외의 내용에 대한 협진은 별도로 의뢰하여 주십시오
 - 2) General anesthesia 및 stressful condition 에서의 op. 에 의한 complication 에 대해 충분한 설명 이후 귀과적인 op.가 필요할 것으로 사료됩니다.
 - 3) CAD 환자는 수술중 MI , V.tach 발생가능성에 대하여 환자, 보호자분께 충분한 설명과 informed consent 및 주의가 필요합니다.
 - 4) Fluid overloading 시 ischemic heart ds. 발생 가능성이 높아지므로, 수술 전,후 I/O control 에 주의하여 주십시오.
- 의뢰해주셔서 감사합니다.

RCRI Score (the Revised Cardiac Risk Index)

Age-Specific Performance of the Revised Cardiac Risk Index for Predicting Cardiovascular Risk in Elective Noncardiac Surgery

Charlotte Andersson, MD, PhD; Mads Wissenberg, MD; Mads Emil Jørgensen, MB; Mark A. Hlatky, MD; Charlotte Mérie, MD, PhD; Per Føge Jensen, MD, PhD, MHM; Gunnar H. Gislason, MD, PhD; Lars Køber, MD, DSc; Christian Torp-Pedersen, MD, DSc

- Nationwide observational cohort study (Denmark).
- **Study Population:** All individuals ≥ 25 years undergoing major elective noncardiac surgery
- **Main Objective:** To systematically assess and re-validate the performance of the RCRI
- **Primary Outcomes:** 30-day Major Adverse Cardiovascular Events (MACE)
- **Key Achievement:** Demonstrated that the RCRI remains a robust and reliable risk-stratification tool in modern clinical practice, regardless of the patient's age.

RCRI Score (the Revised Cardiac Risk Index)

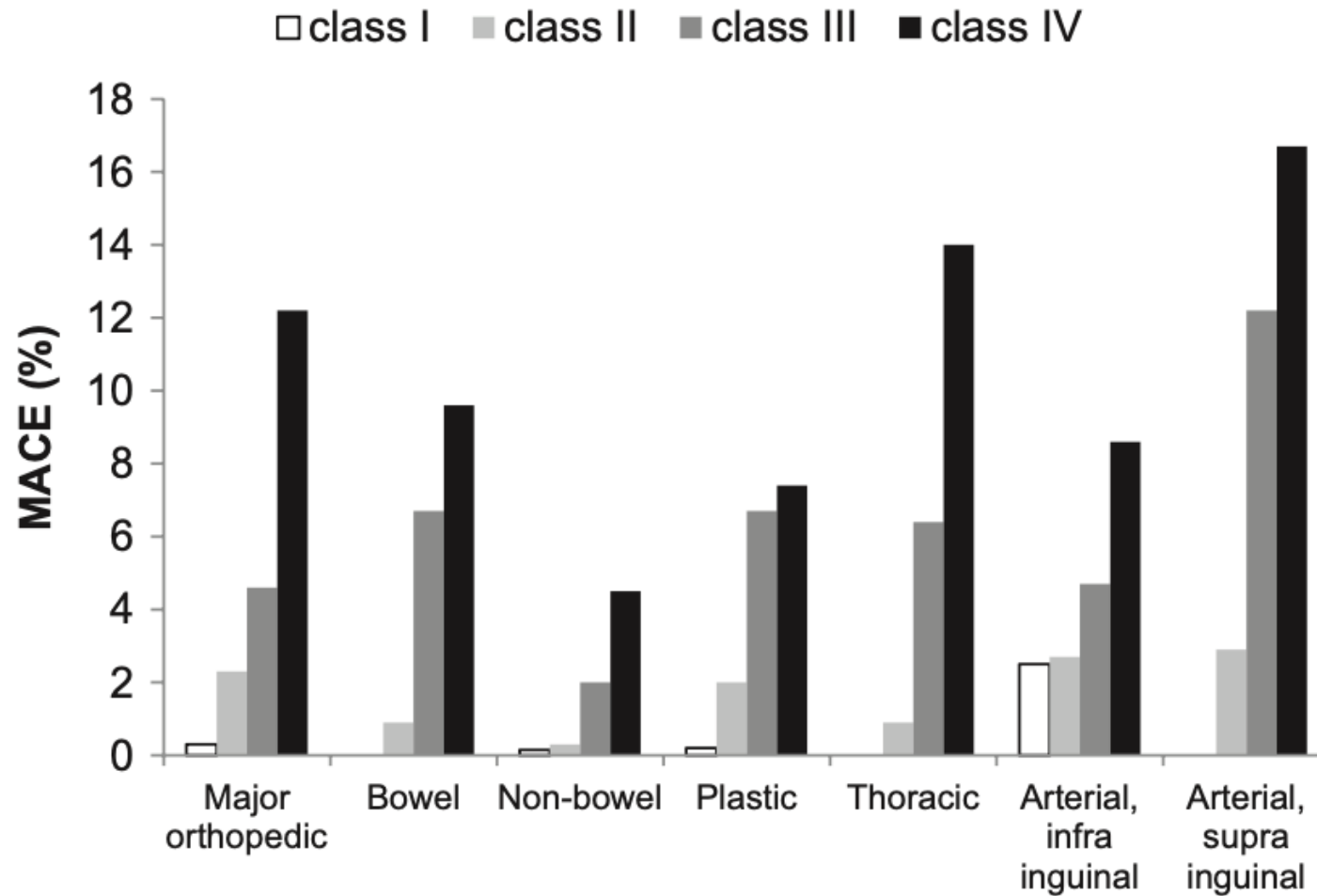


Figure. Major adverse cardiovascular events (MACE) rates by revised cardiac risk index classes for selected surgeries.

RCRI Score (the Revised Cardiac Risk Index)

Table 3. Observed Major Adverse Cardiovascular Events Rates in Different Age Groups

RCRI Class	Age Groups, y				
	≤55	56–65	66–75	76–85	>85
n total	214 776	96 793	81 936	43 491	10 356
I	70/184 890 (0.04%)	95/76 585 (0.12%)	191/60 314 (0.32%)	261/29 108 (0.90%)	125/6499 (1.92%)
II	55/27 886 (0.20%)	122/16 878 (0.72%)	209/16 954 (1.23%)	230/10 465 (2.20%)	139/2706 (5.14%)
III	34/1674 (2.03%)	77/2706 (2.85%)	145/3653 (3.97%)	178/3008 (5.92%)	87/880 (9.89%)
IV	10/326 (3.07%)	29/624 (8.98%)	80/1015 (7.88%)	100/910 (10.99%)	38/271 (9.77%)
C statistic	0.739 (0.700–0.778)	0.772 (0.745–0.779)	0.746 (0.726–0.766)	0.701 (0.681–0.720)	0.683 (0.657–0.710)

C statistic with 95% confidence intervals refers to logistic regression modeling with RCRI class as continuous variable. RCRI indicates revised cardiac risk index.

RCRI Score (the Revised Cardiac Risk Index)

Table 4. Sensitivity, Specificity, Positive and Negative Predictive Values, and Positive and Negative Likelihood Ratios of Having ≥1 Risk Factor (ie, RCRI Class>I vs RCRI Class I) for Predicting Major Adverse Cardiovascular Events

	≤55 y	56–65 y	66–75 y	76–85 y	>85 y
Sensitivity, %	58.6 (50.8–66.1)	70.6 (65.3–75.5)	64.2 (60.0–68.3)	66.1 (62.6–69.4)	66.7 (61.6–71.4)
Specificity, %	86.1 (86.0–86.3)	79.3 (79.0–79.5)	74.0 (73.7–74.3)	67.5 (67.1–68.0)	64.0 (63.0–64.9)
Positive predictive value, %	0.3 (0.3–0.4)	1.1 (1.0–1.3)	1.6 (1.4–1.8)	3.5 (3.2–3.9)	6.5 (5.8–7.3)
Negative predictive value, %	>99.9 (>99.9–>99.9)	99.9 (99.9–99.9)	99.7 (99.6–99.7)	99.1 (99.0–99.2)	98.1 (97.7–98.4)
Positive likelihood ratio, %	4.2 (3.7–4.8)	3.4 (3.2–3.7)	2.5 (2.3–2.6)	2.0 (1.9–2.1)	1.9 (1.7–2.0)
Negative likelihood ratio, %	0.5 (0.4–0.6)	0.4 (0.3–0.4)	0.5 (0.4–0.5)	0.5 (0.5–0.6)	0.5 (0.5–0.6)

Absolute numbers of true and false-positive and false-negative tests are available in Table IV in the Data Supplement. RCRI indicates revised cardiac risk index.

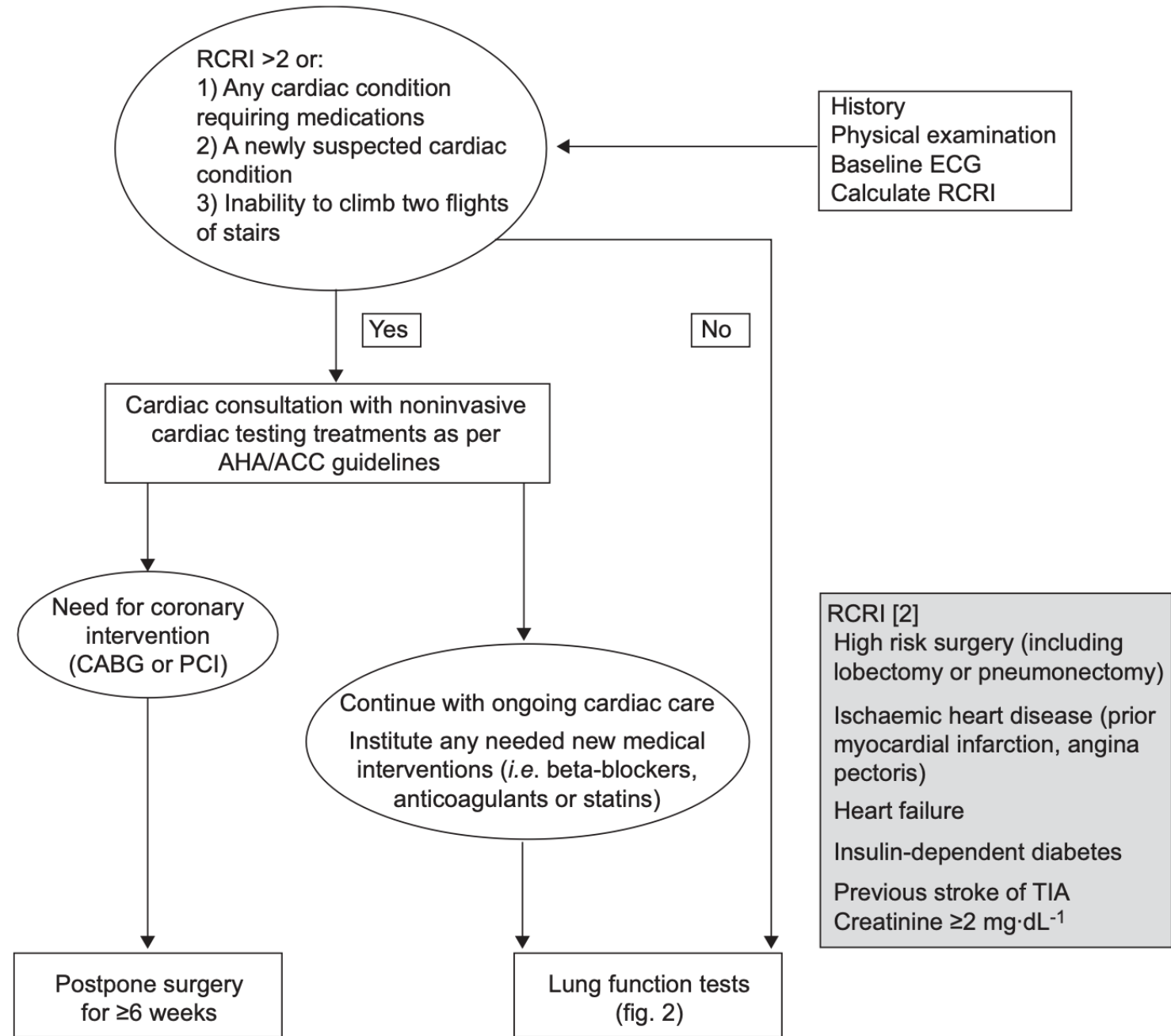
RCRI Score

ERS/ESTS TASK FORCE

ERS/ESTS clinical guidelines on fitness for radical therapy in lung cancer patients (surgery and chemo-radiotherapy)

A. Brunelli*, A. Charloux*, C.T. Bolliger, G. Rocco, J-P. Sculier, G. Varela, M. Licker, M.K. Ferguson, C. Faivre-Finn, R.M. Huber, E.M. Clini, T. Win, D. De Ruysscher and L. Goldman on behalf of the European Respiratory Society and European Society of Thoracic Surgeons joint task force on fitness for radical therapy

RCRI Score



Validating the Thoracic Revised Cardiac Risk Index Following Lung Resection



Daniel C. Thomas, MD, MPH, Justin D. Blasberg, MD, Brian N. Arnold, MD, Joshua E. Rosen, BAsC, Michelle C. Salazar, MD, Frank C. Detterbeck, MD, Daniel J. Boffa, MD, and Anthony W. Kim, MD, MS

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ThRCRI

- Ischemic heart disease: 1.5점
- Cerebrovascular disease: 1.5점
- Serum creatinine > 2.0 mg/dL: 1점
- Pneumectomy: 1.5점

: CHF, DM 제외

Risk class

- Class A: 0점
- Class B: 1.0–1.5점
- Class C: 2.0–2.5점
- Class D: >2.5점

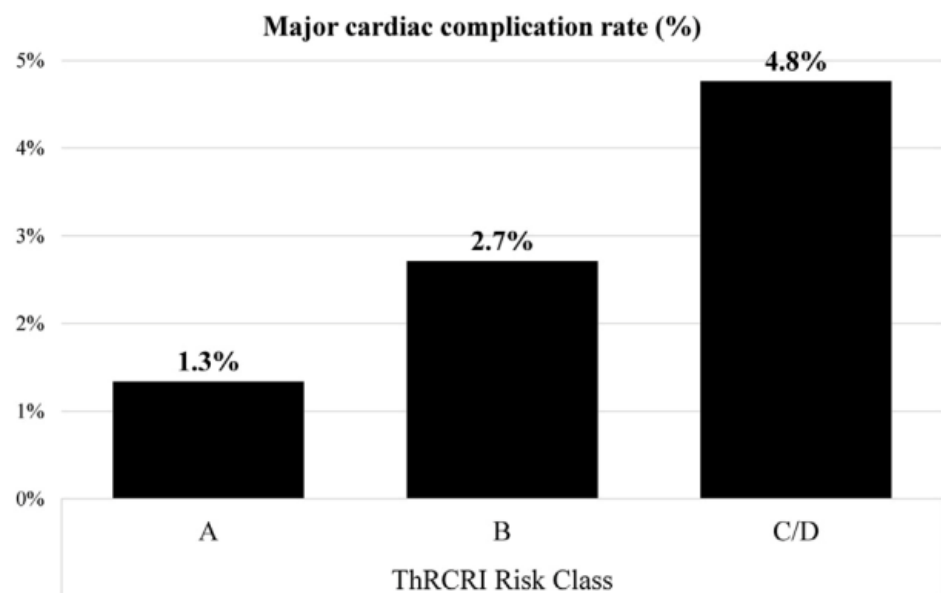


Fig 1. Incidence of major cardiac complication within the risk classes of the Thoracic Revised Cardiac Risk Index. (ThRCRI = Thoracic Revised Cardiac Risk Index.)

Table 3. Distribution of Patients Within ThRCRI Risk Classes and Rate of Major Cardiac Complications (N = 4,625)

ThRCRI Score	ThRCRI Risk Class	%	n	Cardiac Complication Rate (n) ^a
0	A	78	3,637	1.4% (49)
1.0–1.5	B	19	882	2.7% (24)
2.0–2.5	C	0.5	22	9.1% (2)
>2.5	D	1.8	84	3.6% (3)

^a $p < 0.05$.

ThRCRI = Thoracic Revised Cardiac Risk Index.

Perioperative algorithm

- 수술 자체의 위험도 평가
- 환자의 clinical risk factor 평가
- Functional capacity 평가
- ECG, biomarker, echo, stress imaging의 선택적 사용
- 결과에 따라 수술 진행, 추가 검사, 치료 최적화 결정

AHA/ACC/ACS/ASNC/HRS/SCA/SCCT/SCMR/SVM Guideline for Perioperative Cardiovascular Management of Patients Undergoing Noncardiac Surgery: A Recommendation of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines

 **ESC**
European Society of Cardiology
<https://doi.org/10.1093/eurheartj/ehab395>

2022 ESC Guidelines

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[SHOW ALL ...](#), and Kim Allan Williams Sr, MD, MACC, FAHA, MASNC | [AUTHOR INFO](#)

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ESC

European Society
of Cardiology

European Heart Journal (2022) **43**, 3826–3924
<https://doi.org/10.1093/eurheartj/ehac270>

ESC GUIDELINES

2022 ESC Guidelines on cardiovascular assessment and management of patients undergoing non-cardiac surgery

Developed by the task force for cardiovascular assessment and management of patients undergoing non-cardiac surgery of the European Society of Cardiology (ESC)

Endorsed by the European Society of Anaesthesiology and Intensive Care (ESAIC)

- Re-emphasis on Active Cardiac Conditions**

- Patients with active conditions

(e.g., Acute Coronary Syndrome, unstable angina, decompensated heart failure)
require postponement of non-emergent surgeries for treatment and stabilization.

- Shift Toward Flexible Risk Assessment**

- Moving beyond reliance on rigid calculators (e.g., RCRI, MICA)

toward comprehensive clinical judgment.

- Active management and further evaluation are recommended for patients with an estimated MACE (Major Adverse Cardiac Events) risk of $\geq 1\%$.

- **Elevated Role of Biomarkers**

- Strong clinical recommendations (Class 1/2a) for preoperative screening with high-sensitivity troponin (hs-cTn) and NT-proBNP in high-risk surgical patients.
- These biomarkers serve as more quantitative and sensitive tools for screening compared to traditional imaging like echocardiography

Frailty and Functional capacity

Recommendations	Class ^a	Level ^b
In patients aged ≥ 70 years and scheduled to undergo intermediate- or high-risk NCS, frailty screening should be considered using a validated screening tool. ^{84–87,90,91}	Ila	B
Adjusting risk assessments according to <u>self-reported ability to climb two flights of stairs</u> should be considered in patients referred for intermediate- or high-risk NCS. ⁹⁴	Ila	B

Echocardiography

Recommendations	Class ^a	Level ^b
TTE is recommended in patients with poor functional capacity ^c and/or high NT-proBNP/BNP, ^d or if murmurs are detected before high-risk NCS, in order to undertake risk-reduction strategies. ^{121,124,127,141–143}	I	B
TTE should be considered in patients with suspected new CVD or unexplained signs or symptoms before high-risk NCS. ^{59,124,125}	Ila	B

Pharmacology

Initiation

In patients with an indication for statins, it should be considered to initiate statins peri-operatively.

IIa

C

Pre-operative initiation of beta-blockers in advance^c of high-risk NCS may be considered in patients who have two or more clinical risk factors,^d in order to reduce the incidence of peri-operative myocardial infarction. [188,190–192](#)

IIb

A

Antiplatelets

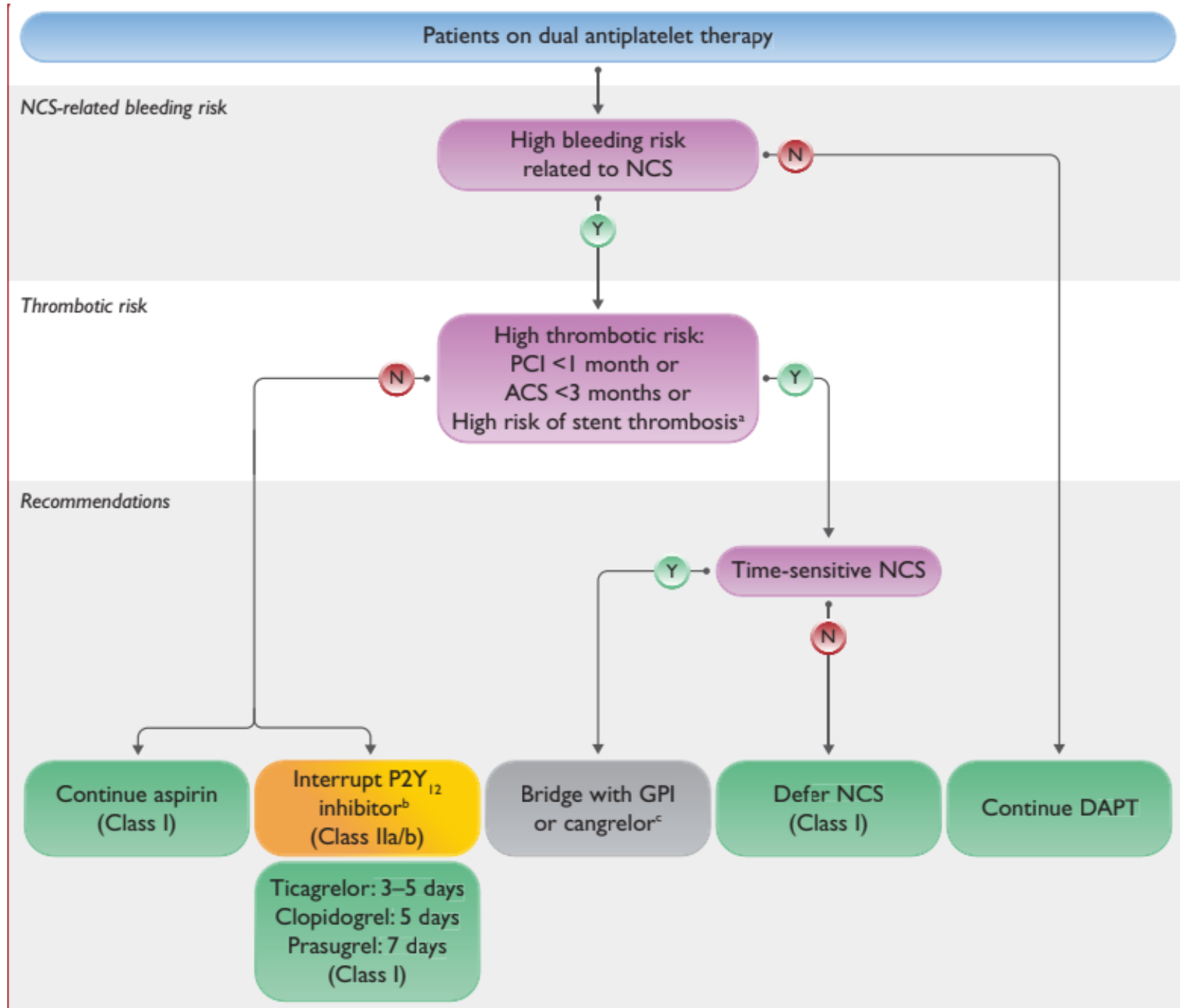
	ASA	Clopidogrel	Prasugrel	Ticagrelor	Cangrelor	Eptifibatide	Tirofiban
Target (type of blockade)	COX-1 (irreversible)	P2Y ₁₂ (irreversible)	P2Y ₁₂ (irreversible)	P2Y ₁₂ (reversible)	P2Y ₁₂ (reversible)	GPIIb/IIIa (reversible)	GPIIb/IIIa (reversible)
Application	Oral	Oral	Oral	Oral	i.v.	i.v.	i.v.
Time to C_{max}	0.5–1.0 h	2 h (after 600 mg LD) ^a	0.5 h (after 60 mg LD) ^a	0.5 h (after 180 mg LD) ^a	2 min	5 min	5 min
Prodrug	No	Yes	Yes	No	No	No	No
Bioavailability (%)	~50	~50	80	36	100	100	100
Drug interactions	NSAIDs (in particular ibuprofen + naproxen)	CYP3A4, CYP3A5, or CYP2C19 inhibitors or inducers	CYP3A4/A5 and CYP2B6 inhibitor	CYP3A4 inducers or inhibitors	None	None	None
Plasma half-life	20 min	0.5–1 h (active metabolite)	0.5–1 h (active metabolite)	6–12 h	3–6 min	2.5–2.8 h	1.2–2 h
Duration of action after last dose	7–10 days	3–10 days ^b	7–10 days ^b	3–5 days	1–2 h	4 h	8 h
Renal clearance of the active metabolite (%)	NR	NR	NR	NR	58	~50	65
Dose regimen	<i>o.d.</i>	<i>o.d.</i>	<i>o.d.</i>	<i>b.i.d.</i>	Bolus, infusion	Bolus, infusion	Bolus, infusion

Antiplatelets

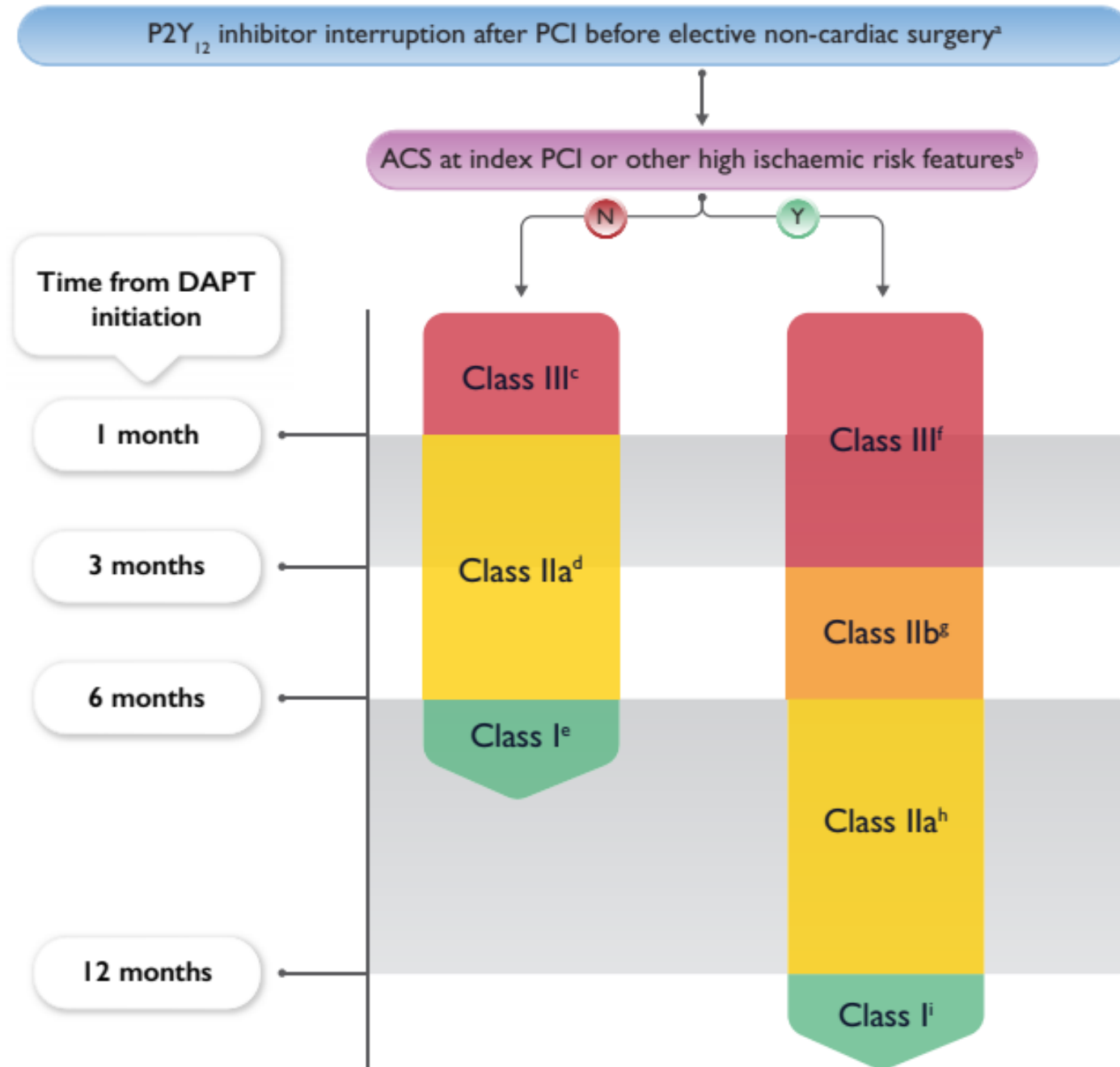
Surgery with high bleeding risk (frequent or with significant clinical impact)

- Abdominal surgery with liver biopsy, extracorporeal shockwave lithotripsy
- Extensive cancer surgery (e.g. pancreas, liver)
- Neuraxial (spinal or epidural) anaesthesia
- Neurosurgery (intracranial, spinal)
- Major orthopaedic surgery
- Procedures with vascular organ biopsy (kidney or prostate)
- Reconstructive plastic surgery
- Specific interventions (colon polypectomy, lumbar puncture, endovascular aneurysm repair)
- Thoracic surgery, lung resection surgery
- Urological surgery (prostatectomy, bladder tumour resection)
- Vascular surgery (e.g. AAA repair, vascular bypass)

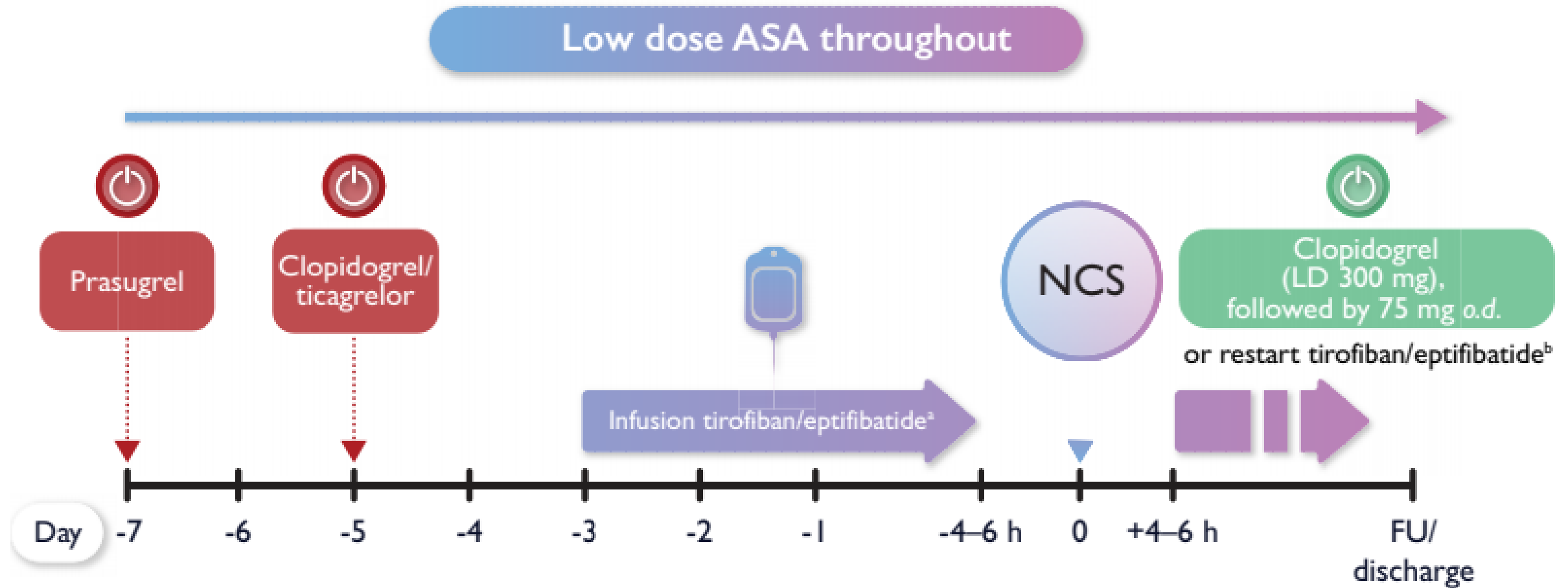
Antiplatelets



Antiplatelets



Antiplatelets



관상동맥질환 환자에서 고려할 사항

1. 수술 전 coronary revascularization은 증상 또는 예후 개선 적응증이 있을 때만 시행
2. 단순히 비심장수술 위험을 낮추기 위한 예방적 PCI는 일반적으로 권고되지 않음
3. 고위험 환자에서는 수술 후 troponin surveillance를 고려
4. CAD, frailty, renal dysfunction, HF 동반 시 BNP/NT-proBNP와 hs-troponin 기반 risk stratification이 유용

관상동맥질환 환자에서 핵심 질문

1. 최근 ACS인가?
2. 불안정 협심증 또는 decompensated HF가 있는가?
3. 최근 PCI 또는 CABG 병력이 있는가?
4. DAPT 중단이 가능한 시점인가?
5. 폐암 수술을 지연해도 종양학적으로 안전한가?

PCI 후 폐암 수술 시점

- Balloon angioplasty 후: 가능하면 최소 4주 지연
- BMS 후: 최소 1개월
- DES 후: elective surgery는 가능하면 6개월 이후
- time-sensitive cancer surgery에서는 1–3개월 이후도 multidisciplinary decision 가능
- P2Y12 inhibitor 중단 필요 시 clopidogrel 5일, ticagrelor 3–5일, prasugrel 7일 전 중단을 고려

감사합니다