Perioperative Medicine
Cardiology Consultation; Hypertension

CARDIOVASCULAR CENTER

Wook Bum Pyun M.D., Ph.D.
pwb423@ewha.ac.kr
심장혈관센타

Ewha Womans University, school of Medicine
Cardiology department

Cardiac events such as
myocardial infarction,
Cardiac death
occurred **1-5 %** of
Unselected patients
Undergoing non-cardiac surgery

Hypertension; common, avoidable

Surprisingly dark corner

58 year-old man

Stomach cancer, curable stage with surgery
Cardiologic consultations for pre-operative cardiovascular risk assessment and poor blood pressure control

148/92 mmHg

228/120 mmHg

168/104 mmHg
184/98 mmHg

Shall I go ahead and anaesthetize this patient with uncontrolled hypertension, or should I postpone surgery?

Does t sure contro consec

Are pa t an increas

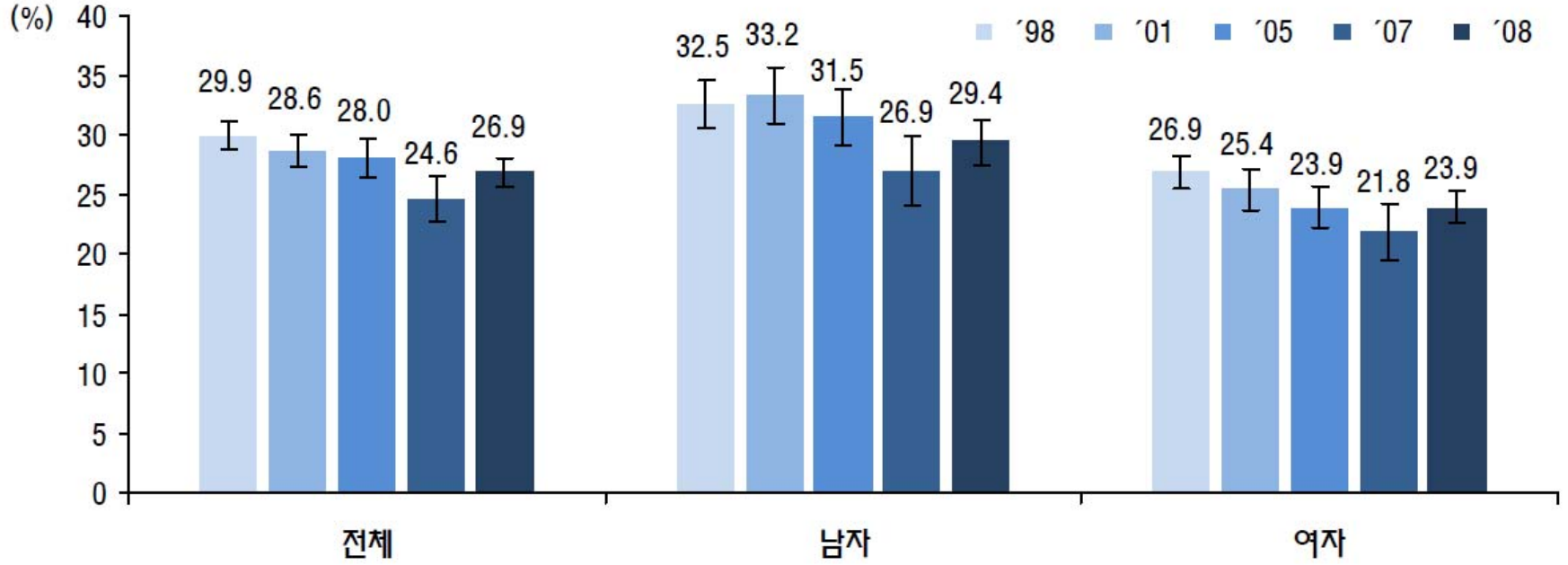
Are there any data on which I can base my decision?

2008 국민건강통계

국민건강영양조사 제4기 2차년도(2008)

그림 35. 고혈압 유병률 추이

수술 환자의 27%에서 고혈압이 있다



※고혈압 유병률 : 수축기혈압이 140mmHg 이상이거나 이완기혈압이 90mmHg 이상 또는 혈압강하제를 복용한 분율, 만30세이상
※2005년 추계인구로 연령표준화

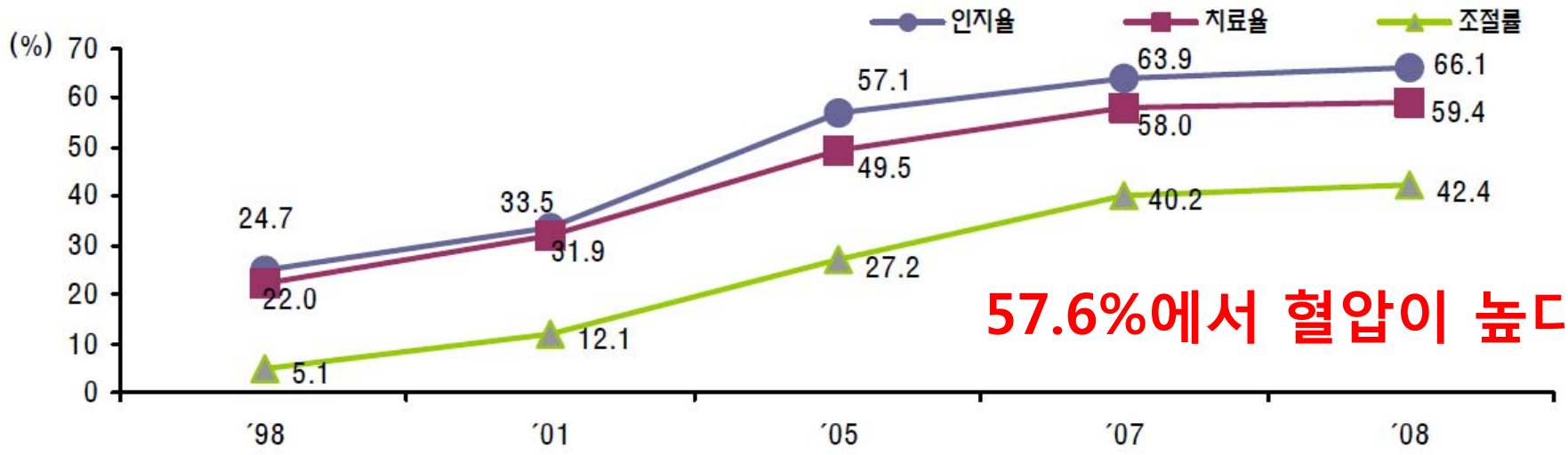
보건복지부 Ministry of Health & Welfare

질병관리본부 Korea Centers for D sease Control & Prevention

2008 국민건강통계

국민건강영양조사 제4기 2차년도(2008)

그림 37. 고혈압 관리현황



57.6%에서 혈압이 높다

※인지율 : 고혈압 유병자중 의사로부터 고혈압 진단을 받은 분율, 만30세이상
치료율 : 고혈압 유병자중 혈압강하제를 한달에 20일 이상 복용한 분율, 만30세이상
조절률(유병자기준) : 고혈압 유병자중 수축기혈압 140mmHg 미만이면서 이완기혈압 90mmHg 미만인 분율, 만30세이상
※2005년 고혈압추정인구(2005년 추계인구×2005년 고혈압 유병률)로 연령표준화

이화여자대학교의료원 EWHA MEDICAL CENTER
보건복지부 Ministry of Health & Welfare
질병관리본부 Korea Centers for D sease Control & Prevention

HYPERTENSION

Perioperative
Cardiovascular Risk Factor?

Issues in anesthesia of patients with hypertension

50% prevalence in older than 65 years

two thirds of elderly surgical patients

80% prevalence those who receive cardiac surgery

High unawareness, poor control rate

Significant contributor to postoperative risk

End-organ damage; heart, brain, kidney

Hypertension & perioperative outcomes

Hypertension

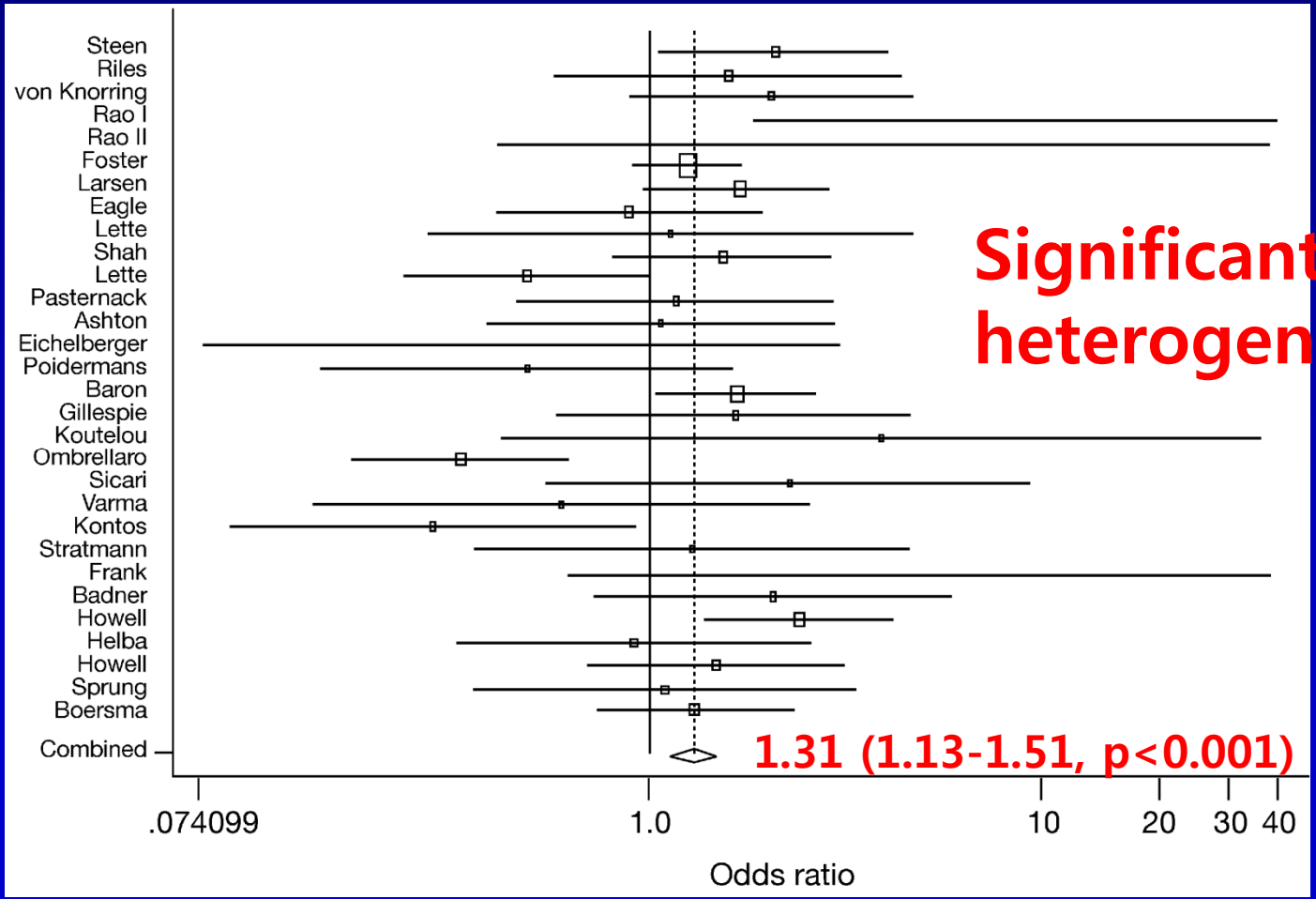
↓

Hypotension, BP Lability,
myocardial ischemia on ECG

↓

Perioperative cardiac
MI, mortality

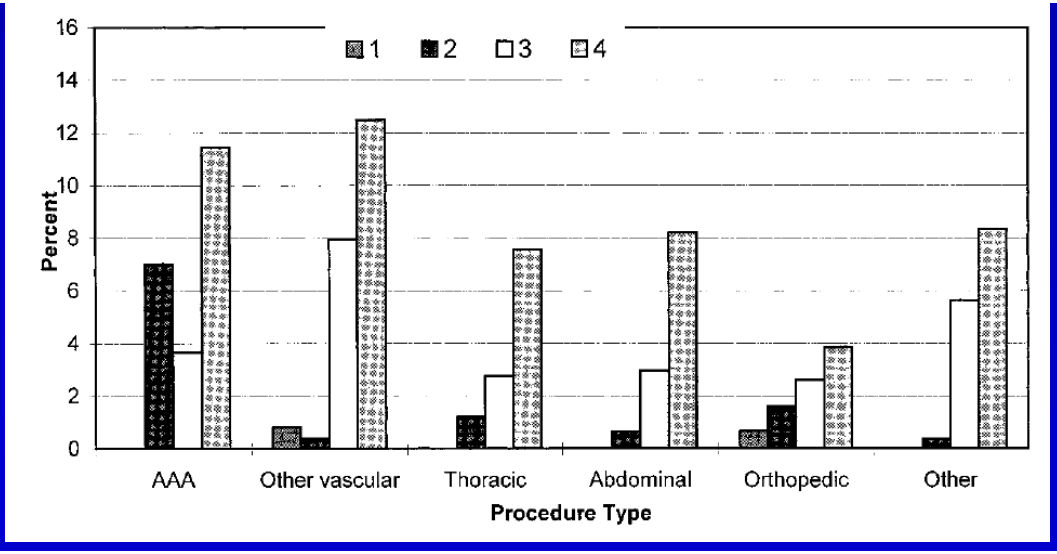
Is having a diagnosis of hypertension of itself associated with increased perioperative risk, regardless of the arterial pressure at the time of admission to hospital for surgery?



Revised Cardiac Risk Index

	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.



Circulation
JOURNAL OF THE AMERICAN HEART ASSOCIATION
American Heart Association
Learn and Live

1999년

Is elevated arterial pressure at the time of admission for surgery associated with increased perioperative cardiac risk?

676 consecutive operations in patients >40 years old
With mild to moderate hypertension

Preoperattive SBP Status	Incidence of Perioperative Hypertensive Episode (%)	Postoperative Cardiac Complications(%)
Normotensiv		
Treated and		
Treated but H[illegible]	25	7
Untreated and hypertensive	20	12

DBP<110 mmHg

Perioperative lability and development cardiac arrhythmia, ischemia, failure and renal failure

More important of intraoperative BP management than preoperative hypertension control

Goldman L, 1979

Several Issues interpreting these results

- Absence of DBP>110 mmHg (5 patients)
- Limiting generalizability to the patients with poorly controlled hypertension
- Isolated Hypertension OR combined CAD

The New England
Journal of Medicine

Volume 323 DECEMBER 27, 1990 Number 26

ASSOCIATION OF PERIOPERATIVE MYOCARDIAL ISCHEMIA WITH CARDIAC MORBIDITY AND MORTALITY IN MEN UNDERGOING NONCARDIAC SURGERY

DENNIS T. MANGANO, PH.D., M.D., WARREN S. BROWNER, M.D., M.P.H., MILTON HOLLENBERG, M.D., MARTIN J. LONDON, M.D., JULIO F. TUBAU, M.D., IDA M. TATEO, M.S., AND THE STUDY OF PERIOPERATIVE ISCHEMIA RESEARCH GROUP*

Table 3. Variables Associated with 83 Cardiac Outcomes among 474 Patients Undergoing Noncardiac Surgery.

Variable*	Odds Ratio†	P Value	No. with Outcome and Variable/No. with Variable
Univariate models			
Previous myocardial infarction	1.7 (1.1–2.8)	0.03	38/167
Definite c			
History			
History			
History			
Diabet			
w			
Preope			
Preope			
co			
Serum			
lit			
ASA s			
Cardiac			
Vascular			
Narcotic anesthesia	2.2 (1.2–4.2)	0.01	16/54
Ischemia on Holter monitoring			
Before surgery‡	3.1 (1.8–5.3)	0.0001	28/84
During surgery§	2.1 (1.2–3.7)	0.005	27/104
After surgery¶	3.3 (1.9–5.6)	0.0001	46/167
Multivariate model			
History of dysrhythmia	2.2 (1.3–3.9)	0.006	—
Preoperative use of digoxin for congestive heart failure	3.3 (1.1–11.0)	0.04	—
Vascular surgery	1.8 (1.1–3.2)	0.03	—
Ischemia on Holter monitoring after surgery	2.8 (1.6–4.9)	0.0002	—

Table 4. Variables Associated with 15 Ischemic Events among 474 Patients Undergoing Noncardiac Surgery.

Variable*	Odds Ratio†	P Value	No. with Outcome and Variable/No. with Variable
Univariate models			
History of claudication	3.4 (1.2–9.7)	0.02	9/150
Activity level ≥5‡	4.3 (1.2–16.0)	0.02	3/28
Preoperative use of nitrates	2.3 (0.83–6.6)	0.1	7/132
Serum creatinine ≥177 μmol/	5.0 (1.5–17.0)	0.004	4/35
			12/167
			—
Associated with congestive heart failure			
History of dysrhythmia‡	3.0 (1.4–6.7)		0.006
Diabetes mellitus (treated with medication)‡	2.4 (1.0–5.7)		0.04
Duration of anesthesia and surgery (per hour)§ or	1.2 (1.1–1.4)		0.002
Vascular surgery‡	3.5 (1.6–7.9)		0.002
Narcotic anesthesia§ or	2.5 (1.0–6.5)		0.05
Isoflurane and narcotic anesthesia‡	0.35 (0.16–0.76)		0.008
Associated with ventricular tachycardia			
Preoperative ischemia on Holter monitoring	7.8 (2.9–21)		0.0001
Preoperative use of digoxin for congestive heart failure	12.0 (2.8–50.0)		0.0009

Preoperative hypertension dose not seem to be an important risk factor of periopertive myocardial infarction

Common Practice to postpone surgery

DBP>110 mmHg, SBP>180 mmHg

Increased risk of
- perioperative dysrhythmia
- myocardial ischemia, MI
- stroke

Prys-Roberts in 1971
Goldman and Caldera in 1979

Pre-Operarive Blood Pressure

Perioperative
Cardiovascular Risk Factor?

ACC/AHA Perioperative Cardiovascular Evaluation For Non-cardiac Surgery

Table 2. Clinical Predictors of Increased Perioperative Cardiovascular Risk (Myocardial Infarction, Heart Failure, Death)

- Major
  - Unstable coronary syndromes
    - Acute or recent MI[a] with evidence of important ischemic risk by clinical symptoms or noninvasive study
    - Unstable or severe[b] angina (Canadian Class III or IV)[c]
  - Decompensated heart failure
  - Significant arrhythmias
    - High-grade atrioventricular block
    - Symptomatic ventricular arrhythmias in the presence of underlying heart disease
    - Supraventricular arrhythmias with uncontrolled ventricular rate
  - Severe valvular disease
- Intermediate
  - Mild angina pectoris (Canadian Class I or II)
  - Previous MI by history or pathological Q waves
  - Compensated or prior heart failure
  - Diabetes mellitus (particularly insulin-dependent)
  - Renal insufficiency
- Minor
  - Advanced age
  - Abnormal ECG (left ventricular hypertrophy, left bundle-branch block, ST-T abnormalities)
  - Rhythm other than sinus (e.g., atrial fibrillation)
  - Low functional capacity (e.g., inability to climb one flight of stairs with a bag of groceries)
  - History of stroke
  - Uncontrolled systemic hypertension

Journal of the American College of Cardiology
© 2009 by the American College of Cardiology Foundation and the American Heart Association, Inc.
Published by Elsevier Inc.

Vol. 54, No. 22, 2009
ISSN 0735-1097/09/$36.00
doi:10.1016/j.jacc.2009.07.010

PRACTICE GUIDELINES: FULL TEXT

2009 ACCF/AHA Focused Update on Perioperative Beta Blockade Incorporated Into the ACC/AHA 2007 Guidelines on Perioperative Cardiovascular Evaluation and Care for Noncardiac Surgery

A Report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines

Developed in Collaboration With the American Society of Echocardiography, American Society of Nuclear Cardiology, Heart Rhythm Society, Society of Cardiovascular Anesthesiologists, Society for Cardiovascular Angiography and Interventions, Society for Vascular Medicine, and Society for Vascular Surgery

Numerous studies have shown that stage 1 or stage 2 hypertension (systolic blood pressure below 180 mm Hg and diastolic blood pressure below 110 mm Hg) is not an independent risk factor for perioperative cardiovascular complications.

The Dilemma of Immediate Preoperative Hypertension: To Treat and Operate, or to Postpone Surgery?

Patients with DBP 110 - 130 mmHg
400 patients; control group 589 patients the study group. The control group had their surgery postponed and they remained in hospital for BP control, and the study patients received 10 mg of nifedipine intranasally

Immediate preoperative reduction of DBP with intranasal nifedipine is safe in patients with well-controlled arterial hypertension but they presented with severe to very severe hypertension for patients in the OR. We were able to avoid unnecessary surgery postponement and attendant costs.

In stage 3 hypertension >180/110 mmHg

Stage 3 hypertension should be controlled before surgery. (2002) without reference

↓

the potential benefits of delaying surgery to optimize the effects of antihypertensive medications should be weighed against the risk of delaying the surgical procedure. (2009)

Intraoperative Systolic BP Variability

Excessive release of catecholamine
Rapid intravascular volume shift
Peripheral vasoconstriction
Reduced baroreceptor sensitivity
Renin-angiotensin activation
Altered cardiac reflexes
Inadequate anesthesia
Reperfusion injury
Aortic occlusive clamps
Neural, humoral, cellular response

Intraoperative Systolic BP Variability

Hyperinflammatory and procoagulation

Platelet activation --- compromise microvascular flow

Perioperative hypertension

increase myocardial O2 consumption

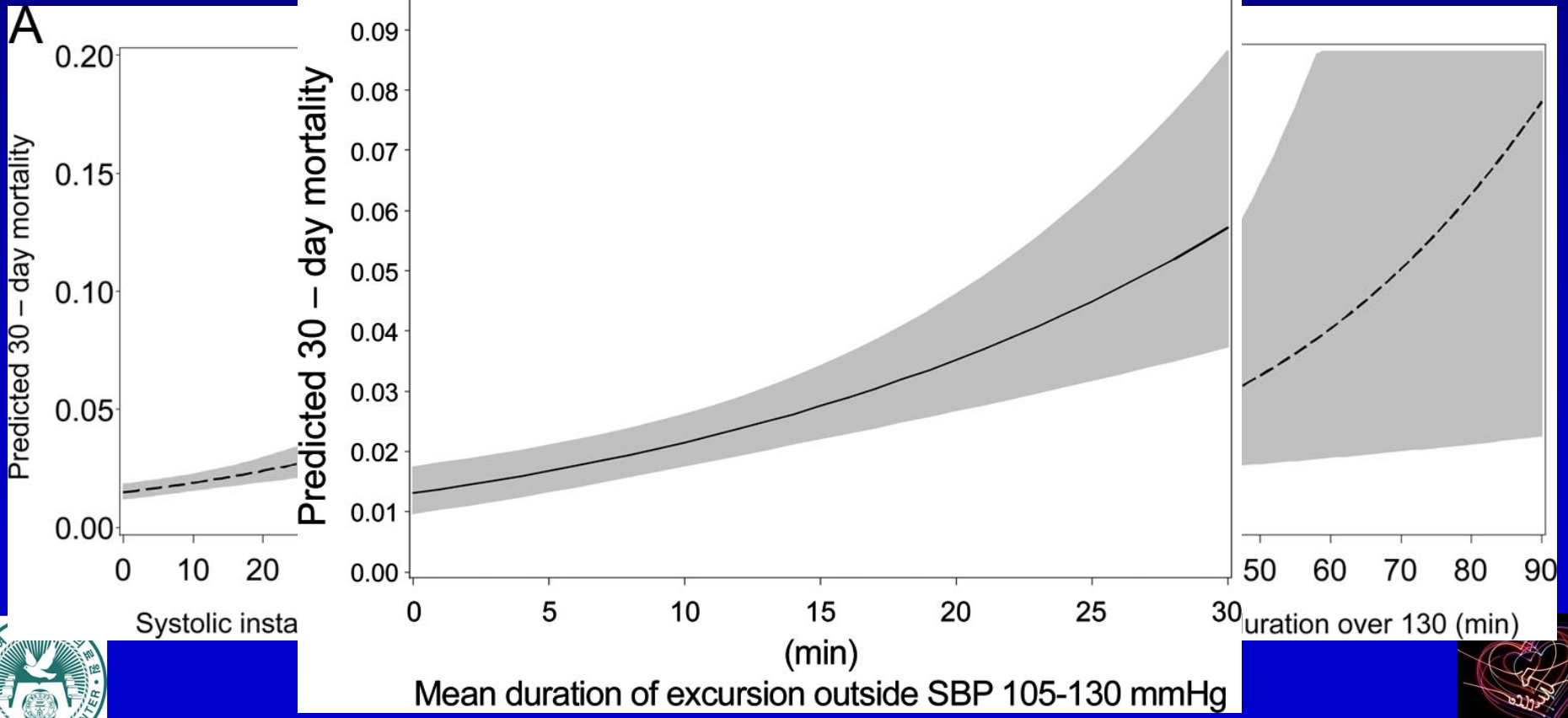
LVEDP

surgical bleeding

Perioperative hypotension

subendocardial hypoperfusion--- myocardial ischemia

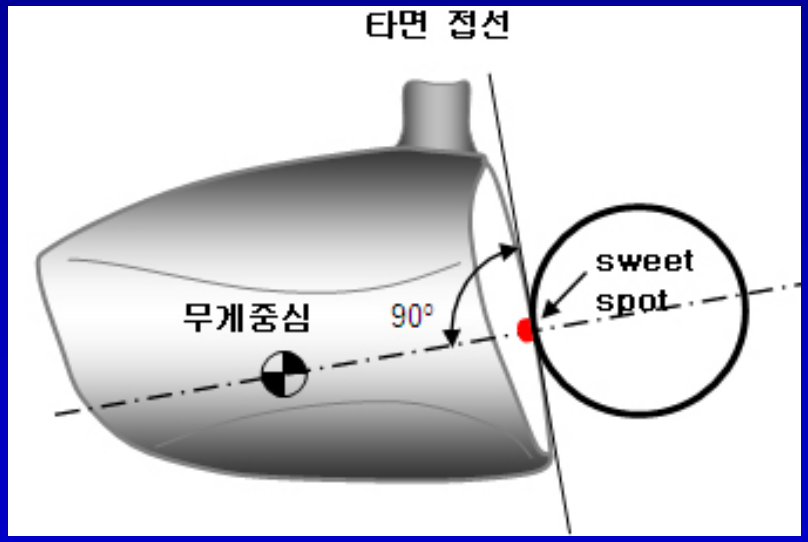
Systolic blood pressure variability episodes outside a blood pressure range (*e.g.*, higher than 135 or lower than 95 mmHg) were characterized by number of episodes, magnitude of episode, duration of episode, and magnitudeduration of excursion (*i.e.*, area under the curve).



SWEET SPOT
Target systolic blood pressure width

95 - 135 mmHg

75-135 AND 85-145 mmHg



Still difficult to hit or determine

Anti-Hypertensive Drugs

Perioperative
Cardiovascular Risk Factor?

Preoperative BP elevation

↓

Exaggerated intraoperative BP fluctuation
(blood pressure lability under anesthesia)
ECG evidence of myocardial ischemia

↓

Postoperative cardiac morbidity

Beta-blocker for preoperative high BP

↓ HR<50-60/min
<80/min intraOP

Modulate BP fluctuation
Decrease perioperative myocardial ischemia
Decrease postoperative atrial fibrillation

↓

Decrease cardiovascular complication
Reduce mortality

Beta-blockers appear to be particularly attractive agents for the treatment of preoperative high blood pressure.

Table 1. Recommendations for Perioperative β-Blocker Therapy Based on Published Randomized Clinical Trials

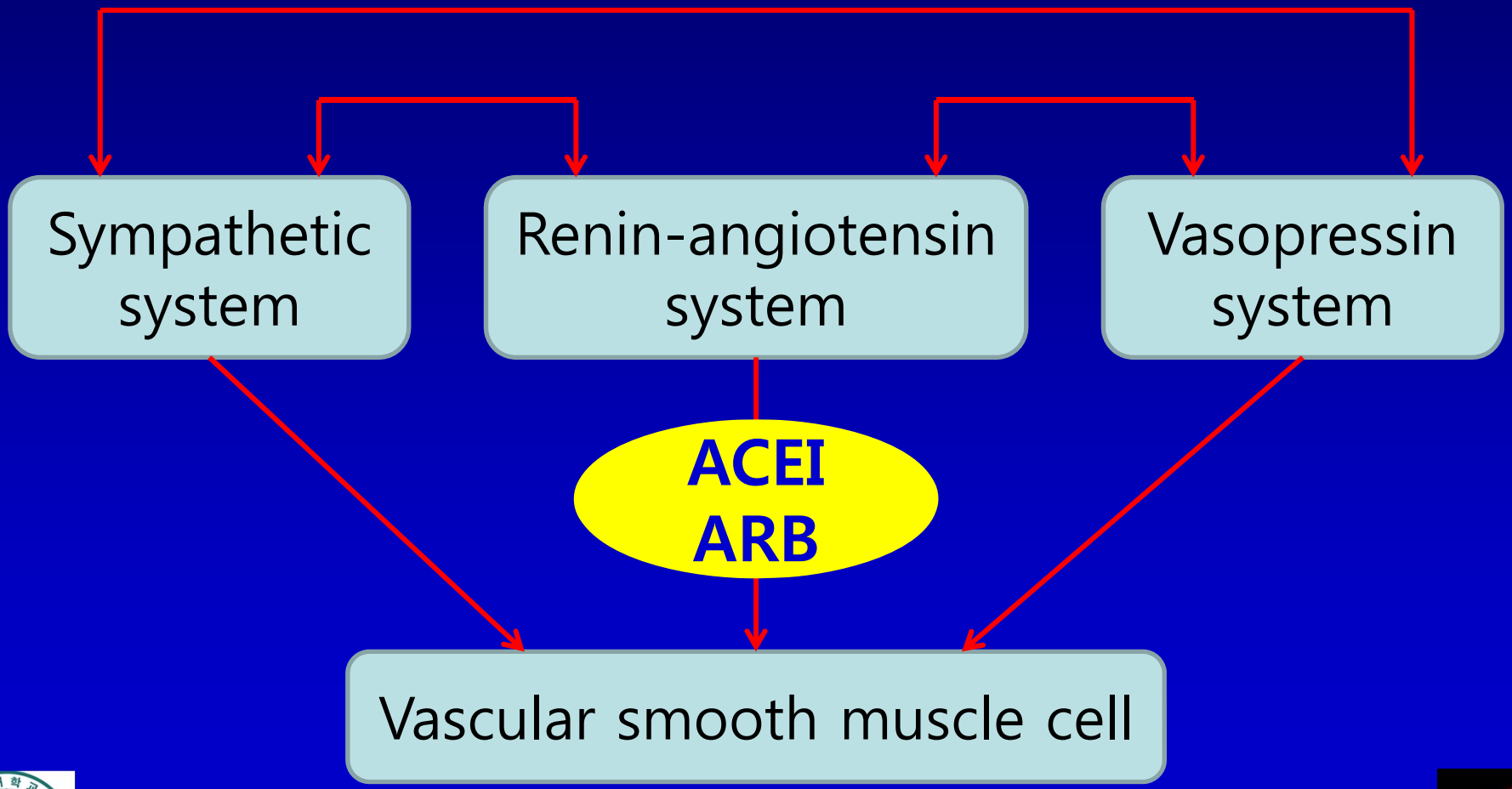
	Low cardiac patient risk	Intermediate cardiac patient risk	CHD or high cardiac patient risk[a]
Vascular surgery	Class Iib Level of Evidence: C	Class IIb Level of Evidence: C	Class I[b] Level of Evidence: B Class IIa[c] Level of Evidence: B
High-/intermediate-risk surgery	–[d]	Class IIb Level of Evidence: C	Class IIa Level of Evidence: B
Low-risk surgery	–[d]	–[d]	–[d]

preoperative testing. *(Level of Evidence: B)*

2. Beta blockers titrated to heart rate and blood pressure are reasonable for patients in whom preoperative assessment for vascular surgery identifies high cardiac risk, as defined by the presence of more than 1 clinical risk factor.‡‡ *(Level of Evidence: C)*

3. Beta blockers titrated to heart rate and blood pressure are reasonable for patients in whom preoperative assessment identifies coronary artery disease or high cardiac risk, as defined by the presence of more than 1 clinical risk factor,‡‡ who are undergoing intermediate-risk surgery (369). *(Level of Evidence: B)*

Vasopressor system in BP regulation



Preoperative hypertension appear more likely to develop intraoperative hypotension than non-hypertensive persons

ACE inhibitors and ARBs

suggested withholding ACE inhibitors and angiotensin receptor antagonists the morning of surgery

Management of Hypertension during anesthesia

Antihypertensive medications be discontinued preoperatively

Paradigm shift

Most drugs that effectively BP control should be continued throughout the perioperative periods

Why anesthetist remained wary of Hypertension?

Hypertension; hemodynamic unstability
myocardial ischemia
Major risk factors of CAD, CHF, CVA, renal disease

Combined medical conditions and drugs

Preoperative Evaluation

1. Adequacy of blood pressure control

seems reasonable…

Make normotensive in hypertensive patients

For decreasing incidence of
hypotension and myocardial ischemia

Box. Hypertensive Comorbidities Associated With Adverse Perioperative Outcomes

Occult coronary artery disease (Q waves on the electrocardiogram)

Congestive heart failure

Left ventricular hypertrophy (voltage criteria)

Renal insufficiency (serum creatinine level >2.0 mg/dL [>176.8 µmol/L])

Cerebrovascular disease (history of cerebrovascular accident or transient ischemic attack)

3. Drugs and potential side effects

ANS blocking drugs (alpha blocker)

Exaggerate BP decrease due to blood loss

positive pressure ventilation

sudden position change

Rebound hypertension in beta-blocker

Induction of Anesthesia

1. Rapidly acting IV drugs
2. Direct laryngoscopy and tracheal intubation

Maintenance of Anesthesia

To minimize wide fluctuation
in blood pressure
= control intra-op BP lability

Intraoperative hypertension
painful stimulation in light anesthesia
frequent in hypertension regardless of control
volatile anesthesia is useful for BP control

Intraoperative hypotension
control with depth of anesthesia and IV fluid

Postoperative

Require
Prompt assessment and treatment
To decrease myocardial ischemia, arrhythmia
CHF, stroke, bleeding

PAIN control
LABETALOL to oral agents

Conclusions

Mild to moderate hypertension;
- no cardiovascular risk
- need not postpone surgery

In high risk, **NOT CLEAR**
- consider risk of delay and operative risk

Consider discontinue ACEI or ARB ???

Preferred results with beta-blockers in high risk

Achieving hemodynamic stability (BP, HR)

경청해 주셔서 감사합니다.

Anesthesiology
50:285–292, 1979

Risks of General Anesthesia and Elective Operation in the Hypertensive Patient

tively) were not significantly different. Multivariate analysis of data for the patients with histories of hypertension showed that neither the preoperative in-hospital diastolic nor preoperative in-hospital systolic blood pressure values independently correlated with any of these three indices of perioperative blood pressure lability, with the development of cardiac arrhythmias, ischemia, or failure, or with postoperative renal failure. Effective intraoperative management may be more important than preoperative hypertensive control in terms of decreasing clinically significant blood pressure lability and cardiovascular complications in patients who have mild to moderate hypertension. (Key words: Blood pressure: hypertension; hypotension. Heart: arrhythmias; failure; infarction.)

Group I (
Group II
Group II
Group IV
Group V

h Cardiac
h

Per Cent

0.2
6
1
—
1

G I; r
G III;

d HT

DBP<110 mmHg

Is elevated arterial pressure at the time of admission for surgery associated with increased perioperative cardiac risk?

TABLE 1. Relationship of Preoperative Hypertension and Treatment to Perioperative Changes in Blood Pressure

No significant difference in perioperative cardiac risk

	Mean Preoperative Systolic Pressure* (torr ± SEM)	Mean Intraoperative Systolic Pressure Nadir† (torr ± SEM)	Patients with Perioperative Hypertensive Episodes‡		Patients Receiving Intraoperative Fluid Challenge or Adrenergic Agents to Maintain Blood Pressure§	
			Number	Per Cent	Number	Per Cent
Group I (normotensive, no therapy) (n = 431)	126 ± 1	94 ± 1	33	8	82	19
Group II (diuretics, no history of hypertension) (n = 49)	129 ± 3	95 ± 3	3	6	9	18
Group III (now normotensive receiving therapy) (n = 79)	136 ± 2	100 ± 2	21	27	16	20
Group IV (hypertensive despite therapy) (n = 40)	154 ± 2	97 ± 3	10	25	13	33
Group V (untreated hypertension) (n = 77)	161 ± 2	98 ± 2	15	20	21	27

A linear trend was found for risk associated with increasing admission systolic blood pressure (odds ratio: 1.20 for each 10-mmHg increase in systolic pressure, 95% confidence intervals: **1.01-1.42**).