Perioperative Medicine
Cardiology Consultation; Hypertension

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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 until the arterial pressure is controlled?

Does the benefit of preoperative arterial pressure control justify the inconvenience and financial consequences of postponing surgery?

Are patients with uncontrolled hypertension at an increased perioperative risk?

Are there any data on which I can base my decision?
수술 환자의 27%에서 고혈압이 있다

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

1.31 (1.13-1.51, p<0.001)

Significant heterogeneity
### Revised Cardiac Risk Index

<table>
<thead>
<tr>
<th>Revised Cardiac Risk Index</th>
<th>Derivation Set (n=2893)</th>
<th>Validation Set (n=1422)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Crude Data</td>
<td>Adjusted OR (95% CI)</td>
</tr>
<tr>
<td>1. High-risk type of surgery</td>
<td>27/894 (3%)</td>
<td>2.8 (1.6, 4.9)</td>
</tr>
<tr>
<td>2. Ischemic heart disease</td>
<td>34/951 (4%)</td>
<td>2.4 (1.3, 4.2)</td>
</tr>
<tr>
<td>3. History of congestive heart failure</td>
<td>23/434 (5%)</td>
<td>1.9 (1.1, 3.5)</td>
</tr>
<tr>
<td>4. History of cerebrovascular disease</td>
<td>17/291 (6%)</td>
<td>3.2 (1.8, 6.0)</td>
</tr>
<tr>
<td>5. Insulin therapy for diabetes</td>
<td>7/112 (6%)</td>
<td>3.0 (1.3, 7.1)</td>
</tr>
<tr>
<td>6. Preoperative serum creatinine &gt;2.0 mg/dL</td>
<td>9/103 (9%)</td>
<td>3.0 (1.4, 6.8)</td>
</tr>
</tbody>
</table>

*Based on logistic regression models including these 6 variables.*
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

<table>
<thead>
<tr>
<th>Preoperative SBP Status</th>
<th>Incidence of Perioperative Hypertensive Episode (%)</th>
<th>Postoperative Cardiac Complications(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normotensive</td>
<td>8</td>
<td>11</td>
</tr>
<tr>
<td>Treated and normotensive</td>
<td>27</td>
<td>24</td>
</tr>
<tr>
<td>Treated but hypertensive</td>
<td>25</td>
<td>7</td>
</tr>
<tr>
<td>Untreated and hypertensive</td>
<td>20</td>
<td>12</td>
</tr>
</tbody>
</table>

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

More important of intraoperative BP management than preoperative hypertension control

*DBP < 110 mmHg*

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

Preoperative hypertension dose not seem to be an important risk factor of perioperative 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-Operative Blood Pressure

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

<table>
<thead>
<tr>
<th>Major</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unstable coronary syndromes</td>
</tr>
<tr>
<td>Acute or recent MI* with evidence of important ischemic risk by clinical symptoms or noninvasive study</td>
</tr>
<tr>
<td>Unstable or severe\textsuperscript{b} angina (Canadian Class III or IV)\textsuperscript{c}</td>
</tr>
<tr>
<td>Decompensated heart failure</td>
</tr>
<tr>
<td>Significant arrhythmias</td>
</tr>
<tr>
<td>High-grade atrioventricular block</td>
</tr>
<tr>
<td>Symptomatic ventricular arrhythmias in the presence of underlying heart disease</td>
</tr>
<tr>
<td>Supraventricular arrhythmias with uncontrolled ventricular rate</td>
</tr>
<tr>
<td>Severe valvular disease</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Intermediate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild angina pectoris (Canadian Class I or II)</td>
</tr>
<tr>
<td>Previous MI by history or pathological Q waves</td>
</tr>
<tr>
<td>Compensated or prior heart failure</td>
</tr>
<tr>
<td>Diabetes mellitus (particularly insulin-dependent)</td>
</tr>
<tr>
<td>Renal insufficiency</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Minor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced age</td>
</tr>
<tr>
<td>Abnormal ECG (left ventricular hypertrophy, left bundle-branch block, ST-T abnormalities)</td>
</tr>
<tr>
<td>Rhythm other than sinus (e.g., atrial fibrillation)</td>
</tr>
<tr>
<td>Low functional capacity (e.g., inability to climb one flight of stairs with a bag of groceries)</td>
</tr>
<tr>
<td>History of stroke</td>
</tr>
<tr>
<td>Uncontrolled systemic hypertension</td>
</tr>
</tbody>
</table>
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 magnitude-duration 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>
<thead>
<tr>
<th>Class I1</th>
<th>Class IIa</th>
<th>Class I$^b$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beta blockers should be continued in patients undergoing surgery who are receiving beta blockers for treatment of conditions with ACCF/AHA Class I guideline indications for the drugs. (Level of Evidence: C)</td>
<td>Beta blockers titrated to heart rate and blood pressure are probably recommended for patients undergoing vascular surgery who are at high cardiac risk owing to coronary artery disease or the finding of cardiac ischemia on preoperative testing. (Level of Evidence: B)</td>
<td>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)</td>
</tr>
<tr>
<td>Vascular surgery</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class IIb</td>
<td>Class IIb</td>
<td>Class IIa$^c$</td>
</tr>
<tr>
<td>Level of Evidence: C</td>
<td>Level of Evidence: C</td>
<td>Level of Evidence: B</td>
</tr>
<tr>
<td>Low cardiac patient risk</td>
<td>Intermediate cardiac patient risk</td>
<td>CHD or high cardiac patient risk$^a$</td>
</tr>
<tr>
<td>High-/intermediate-risk surgery</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Class IIb</td>
<td>Class IIa</td>
</tr>
<tr>
<td></td>
<td>Level of Evidence: C</td>
<td>Level of Evidence: B</td>
</tr>
<tr>
<td>Low-risk surgery</td>
<td></td>
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<td></td>
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</tbody>
</table>

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

- Sympathetic system
- Renin-angiotensin system
- Vasopressin system

ACEI
ARB

Vascular smooth muscle cell
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 should be discontinued preoperatively

Paradigm shift

Most drugs that effectively control blood pressure 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
2. Evaluation of end-organ-damage
   - angina pectoris
   - LV hypertrophy
   - CHF
   - cerebrovascular disease
   - stroke
   - peripheral vascular disease
   - renal insufficiency

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

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**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)
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.
Risks of General Anesthesia and Elective Operation in the Hypertensive Patient

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.)

DBP < 110 mmHg
Is elevated arterial pressure at the time of admission for surgery associated with increased perioperative cardiac risk?

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**).