Perioperative management of hypertension

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CV risk at the peri-operative period

The magnitude of the problem in the Europe

- 7 million major surgical procedures annually
- By the year 2020, the annually conducted procedures will be increased by >50% and the elderly population by 25%

- 12% of the women and 18% of men have some degree of CVD in the age group 75+,

- Hypertension is the most frequent preoperative abnormality in surgical patients, with an overall prevalence of 20–25%.
- Preexisting hypertension is the most common medical reason for postponing surgery
CV risk during a non cardiac-surgery: Pathophysiology

- Tissue Injury
  - Fluid Shifts
    - Tachycardia
    - Hypertension or Hypotension
    - Atherosclerotic Plaque Rapture
    - Alteration in Balance Between Prothrombotic and Fibrinolytic Factors
- Hypercoagulability

Increased Myocardial Oxygen Demand

ACS
Changes in BP in the peri-operative period
BP RESPONSE DURING ANESTHESIA

- During the induction of anesthesia, sympathetic activation can cause the BP to rise by 20 - 30 mmHg and the HR to increase by 15 - 20 bpm in normotensive individuals. **These responses may be more pronounced in patients with untreated hypertension**

- As the period of anesthesia progresses, patients with preexisting hypertension are more likely to experience **intraoperative BP lability** (either hypotension or hypertension), which may lead to myocardial ischemia

- There is no evidence of superiority of any specific anaesthetic agent in non-cardiac surgery

Causes of postoperative hypertension

- Pain
- Excitement on emergence from anesthesia
- Hypercapnia
- Agitation
- Hypoxemia
- Hypervolemia
Male, 64 years old, smoker, dislipidemic and hypertensive with a history of paroxysmal atrial fibrillation admitted for elective prostatectomy. In the preoperative evaluation:

- HR: 85bpm, clinic BP: 160/85mmHg
- No cardiac murmurs, no peripheral edema
- Asymptomatic for cardiac symptoms (no angina)

Basic lab tests: within normal values

Recent echo: no LVH, EF=60%, Mild dilatation of LA

Under daily treatment with atorvostatin 20mg, metoprolol 50 mg, aspirin 100 mg and a fixed combination of irbesartan/HCT 300/12.5mg
Pre-operative evaluation of hypertensive patient
Questions to be answered

✓ Which are the determinants of cardiac risk in a non cardiac surgery? Is HTN a risk factor for CV events in a non cardiac surgery?

✓ Should we postpone the operation in order to control the BP?

✓ What additional test may be needed?

✓ Which is the appropriate pharmacotherapy before, during and after operation?
Risk for cardiac events in non cardiac surgery

1. Type of Surgery
   - Low Risk
   - Intermediate Risk
   - High Risk

2. Setting of surgery
   - Emergent
   - Urgent
   - Elective

3. Co-Morbidities
Type of surgery and estimated 30-day cardiac events rates (cardiac death and MI)

<table>
<thead>
<tr>
<th>Low-risk &lt;1%</th>
<th>Intermediate-risk 1-5%</th>
<th>High-risk &gt;5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breast</td>
<td>Abdominal</td>
<td>Aortic and major vascular surgery</td>
</tr>
<tr>
<td>Dental</td>
<td>Carotid</td>
<td>Peripheral vascular surgery</td>
</tr>
<tr>
<td>Endocrine</td>
<td>Peripheral arterial angioplasty</td>
<td></td>
</tr>
<tr>
<td>Eye</td>
<td>Endovascular aneurysm repair</td>
<td></td>
</tr>
<tr>
<td>Gynaecology</td>
<td>Head and neck surgery</td>
<td></td>
</tr>
<tr>
<td>Reconstructive</td>
<td>Neurological / orthopaedic – major (hip and spine surgery)</td>
<td></td>
</tr>
<tr>
<td>Orthopaedic-minor (knee surgery)</td>
<td>Pulmonary renal/liver transplant</td>
<td></td>
</tr>
<tr>
<td>Urologic – minor</td>
<td>Urologic - major</td>
<td></td>
</tr>
</tbody>
</table>

Surgical risk estimate (modified from Boersma et al.)
Cardiac events in Laparoscopic procedures

- Laparoscopic procedures demonstrated a cardiac stress similar to open procedures and it is recommended that patients be screened prior to intervention accordingly.

Class I/ Level:A

- The pneumoperitoneum used in these procedures results in elevated intra-abdominal pressure – reduction in venous return – decrease in cardiac output. Cardiac risk in pts with heart failure or morbid obesity is not diminished when undergoing laparoscopy compared with open surgery.
How does the urgency of surgery change the pre-operative cardiac evaluation

- In emergency procedures (major trauma, raptured abdominal aortic aneurysm), cardiac evaluation will not influence the course of the intervention but may influence the management in the immediate post operative period.

- In non-emergent but urgent untreated surgical conditions (bowel obstruction), cardiac evaluation may influence the peri-operative measures taken to reduce the cardiac risk and the type of operation guiding to less invasive interventions but will not influence the decision to perform the intervention.
Comorbidities and cardiac risk

Lee’s Revised Cardiac Risk Index (RCRI)

Hypertension is not included
AHA/ACC: Clinical Predictors of Increased Perioperative CV Risk (MI, HF, Death) (II)

- **Intermediate**
  Mild angina pectoris (Canadian Class I or III)
  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 or stairs with a bag of groceries)
  History of stroke
  Uncontrolled systemic hypertension
Which are the determinants of cardiac risk in a non cardiac surgery? Is HTN a risk factor for CV events in a non cardiac surgery?

Should we postpone the operation in order to control the BP?

What additional test may be needed?

Which is the appropriate pharmacotherapy before, during and after operation?
Level of BP and Pre-operative evaluation

Common practice

- Pts with well-controlled EH are less likely to experience intraoperative BP lability and postoperative complications than pts with poorly controlled EH.

- The ideal circumstance is to normalize BP for several months prior to elective surgery.

- In pts with grade I-II EH, there is no evidence that delay in surgery in order to optimize therapy is beneficial.
Level of BP and Pre-operative evaluation common practice

- In pts with grade III EH (BP > 180/110 mmHg) the potential benefits of delay surgery to optimize the pharmacological treatment should be weighted against the risk of delaying the surgical procedure.

In case of urgent surgery the patient should be treated with a parenteral drug acutely
## Parenteral drugs for treatment of hypertension

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dose</th>
<th>Onset of Action</th>
<th>Duration</th>
<th>Use with caution in</th>
<th>Adverse reactions</th>
<th>Pregnancy class*</th>
<th>Daily cost†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydralazine hydrochloride</td>
<td>10-20mg IV q4-6h</td>
<td>10-20 mins</td>
<td>1-4 h</td>
<td>Increased ICP; aortic dissection; myocardial ischemia</td>
<td>Reflex tachycardia; headache, flushing, vomiting</td>
<td>C</td>
<td>20mg q4h, $90</td>
</tr>
<tr>
<td>Metoprolol</td>
<td>1.25-50.0 mg IV q6h</td>
<td>20 mins</td>
<td>5-8 h</td>
<td>Heart block; brachycardia; acute heart failure</td>
<td>Bronchospasm</td>
<td>C (first trimester); D (second-third trimesters)</td>
<td>5mg q6h, $10</td>
</tr>
<tr>
<td>Enalaprilat</td>
<td>1.25-5.0 mg IV q6h</td>
<td>15-30 mins</td>
<td>6-12 h</td>
<td>Hyperkalemia; acute renal failure; hypovolemia</td>
<td>Hypotension; angioedema</td>
<td>C (first trimester); D (second-third trimesters)</td>
<td>5mg q 6h, $60</td>
</tr>
<tr>
<td>Labetalol hydrochloride</td>
<td>20-80mg IV q10min (max 300 mg daily)</td>
<td>5-10 mins</td>
<td>3-6 h</td>
<td>See metoprolol</td>
<td>Bronchospasm; nausea, vomiting; scalp tingling</td>
<td>C (first trimester); D (second-third trimesters)</td>
<td>300mg, $15</td>
</tr>
<tr>
<td>Transdermal clonidine</td>
<td>0.1-0.3mg once weekly</td>
<td>2-3 days</td>
<td>7 days</td>
<td>Abrupt withdrawal†; elderly</td>
<td>Drowsiness, dizziness; local skin erythema; dry mouth</td>
<td>C</td>
<td>0.3mg/24-hour patch, $10</td>
</tr>
</tbody>
</table>

Abbreviations: IV, intravenously, q, every; ICP, intracranial pressure

*Pregnancy class: A, controlled studies show no risk; B, no evidence of risk in humans; C, risk can not be ruled out; D, positive evidence of risk; X, contraindicated in pregnancy.

†Cost based on maximum recommended dose for 24 hours at average wholesale price (AWP) as listed in Red Book: Pharmacy’s Fundamental Reference.

If taking oral clonidine preoperatively, it is necessary to switch to transdermal preparation at least 3 days prior to avoid rebound hypertension.
Pre-operative evaluation of hypertensive patient
Questions to be answered

✓ Which are the determinants of cardiac risk in a non cardiac surgery? Is HTN a risk factor for CV events in a non cardiac surgery?

✓ Should we postpone the operation in order to control the BP?

✓ What additional test may be needed?

✓ Which is the appropriate pharmacotherapy before, during and after operation?
Specific issues to be addressed in hypertensives

- History
- Physical examination
- Laboratory evaluation
- ECG
History

- Family history for atherosclerotic CV disease

- Clinical history
  - other risk factors (hyperlipidemia, smoking, obesity, DM, exercise)
  - dietary habits/ Sleep disorders
  - previous and current treatment
  - symptoms related to secondary hypertension (PHEOCHROMOCYTOMA), CAD, CHF, AVS, stroke, PAD
Physical examination

- BP measurement in both arms and in sitting and standing position
- Signs of secondary hypertension
- Auscultation for arrhythmias, heart sounds, and murmurs
- Abdominal palpation
- Examination of carotid and peripheral arteries
- Examinations of the extremities for edema
Assessment of Functional Capacity

Can you...
- Take care of yourself? Eat, dress, or use the toilet?
- Walk indoors around the house?
- Walk a block or 2 on level ground at 2 mph (3.2 to 4.8 kph)
- Do light work around the house like dusting or washing dishes?

1 MET

Can you...
- Climb a flight of stairs or walk up a hill?
- Walk on level ground at 4 mph (6.4 kph)?
- Run a short distance?
- Do heavy work around the house like scrubbing floors or lifting or moving heavy furniture?
- Participate in moderate recreational activities like golf, bowling, dancing, doubles tennis, or throwing a baseball or football?

4 METs

Can you...
- Participate in strenuous sports like swimming, singles tennis, football, basketball, or skiing?

Greater than 10 METs
■ **Electrocardiogram**

Should be part of all routine assessment of subjects with **high BP** in order to detect LVH, patterns of “strain”, ischaemia and arrhythmias.

*ESH GDLs2007*

■ Presence of Q waves or significant ST segment elevation or depression have been associated with increased incidence of perioperative cardiac complications
**Echocardiography** is recommended when a more sensitive method of detection of LVH is considered useful as well as assessment of LV systolic function. *ESH GDLs 2007*
Stress test peri-operatively
What information do we get?

- Stress test: very high negative predictive value (90-100%) but low positive predictive value (30-67%).

So stress test is more useful for reducing estimated risk if negative than for identifying patients at very high risk when positive.

Stress test is unable to identify vulnerable plaque.
Pre-operative evaluation of a hypertensive patient

Identify undiagnosed or uncontrolled hypertensives

Estimate the true high level of BP

In order to reduce

- the operative risk in the short term period and
- the adverse long term effects

Safety of the patient peri-operatively

Deferments/cancellations of surgery
Pre-operative evaluation of hypertensive patient
Questions to be answered

✓ Which are the determinants of cardiac risk in a non cardiac surgery? Is hypertension a risk factor for CV events in a non cardiac surgery?

✓ Can I postpone the operation in order to control the blood pressure?

✓ What additional test may I need?

✓ Which is the appropriate pharmacotherapy before, during and after operation?
Pts who are taking chronic antihypertensive treatment should continue taking their medications until the time of surgery

ESC guidelines 2009
Male, 64 years old, smoker, dislipidemic and hypertensive with a history of paroxysmal atrial fibrillation admitted for elective prostatectomy. In the preoperative evaluation:

- HR: 85 bpm, clinic BP: 160/85 mmHg
- No cardiac murmurs, no peripheral edema
- Asymptomatic for cardiac symptoms (no angina)
- Basic lab tests: within normal values
- Recent echo: no LVH, EF=60%, Mild dilatation of LA

Under daily treatment with *atorvostatin* 20 mg, *metoprolol* 50 mg, *aspirin* 100 mg and a fixed combination of *irbesartan/HCT* 300/12.5 mg
B-blockers in the peri-operative period
POISE trial
The level of baseline cardiac risk

- Lee index > 3 → Significant decrease in mortality
- Lee index = 1 or 2 → No significant difference
- Lee index = 0 → Increase in mortality

Preoperative b-blocker withdrawal → Increase in mortality
# Pre-operative evaluation of a hypertensive patient

## Recommendations on β-blockers

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Class</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>β-blockers are recommended in patients who have known IHD or myocardial ischaemia according to pre-operative stress testing</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>β-blockers are recommended in patients scheduled for high risk surgery</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td><strong>Continuation of β-blockers is recommended in patients previously treated with β-blockers because of IHD, arrhythmias, or hypertension</strong></td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>β-blockers should be considered for patients scheduled for intermediate-risk surgery</td>
<td>IIa</td>
<td>B</td>
</tr>
<tr>
<td>Continuation in patients previously treated with β-blockers because of chronic heart failure with systolic dysfunction should be considered</td>
<td>IIa</td>
<td>C</td>
</tr>
<tr>
<td>β-blockers may be considered in patients scheduled for low-risk surgery with risk factor(s)</td>
<td>IIb</td>
<td>B</td>
</tr>
<tr>
<td>Perioperative high-dose β-blockers without titration are not recommended</td>
<td>III</td>
<td>A</td>
</tr>
<tr>
<td>β-blockers are not recommended in patients scheduled for low-risk surgery without risk factors</td>
<td>III</td>
<td>B</td>
</tr>
</tbody>
</table>

**Treatment should be initiated optimally between 30 days and at least 1 week before surgery.** **Target: heart rate 60-70 beats/min. Systolic blood pressure >100mmHg.** Use β1-selective β-blockers without ISA and with a long half-life eg bisoprolol
Recommendations on ACE inhibitor use

For a hypertensive patient already receiving ACE inhibitors they should be discontinued 24 hours before surgery and resume after patient’s endovascular volume has been stabilized. When they are prescribed for heart failure their discontinuation at the preoperative phase should be examined more carefully.

IIa C
### Pre-operative evaluation of a hypertensive patient

<table>
<thead>
<tr>
<th>Recommendations on statins</th>
<th>Class</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>It is recommended that statins be started in high-risk surgery patients, optimally between 30 days and at least 1 week before surgery</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>It is recommended that statins be continued perioperatively</td>
<td>I</td>
<td>C</td>
</tr>
</tbody>
</table>

- **Discountinuation of statins may cause a rebound effect and be disadvantageous**
- **Numerous perioperatively factors can increase the risk of statin-induced myopathy such as impairment of renal function, multiple drugs use during anaesthesia**
- **Symptoms of statin induced myopathy and rhabdomyolysis can be blunted due to analgesic drugs!!**
Pre-operative evaluation of a hypertensive patient

Aspirin

- Meta-analysis: 41 Studies, 49,590 Patients

  Aspirin continuation: 1.5 fold increased Risk of Bleeding

  Aspirin withdrawal: 3 fold higher risk for cardiac events

Aspirin should only be discontinued if the bleeding risk outweighs the potential cardiac benefit
Preoperative evaluation of hypertensive patient on dual antiplatelet treatment
Cardiac algorithm for noncardiac surgery

**Step 1**
Need for emergency noncardiac surgery?
- Yes (Class I, LOE C) → Operating room → postoperative risk stratification and risk Factor management
- No

**Step 2**
Active cardiac conditions
- Yes (Class I, LOE B) → Evaluate and treat per ESC guidelines → Consider operating room
- No

**Step 3**
Low risk surgery
- Yes (Class I, LOE B) → Proceed with planned surgery
- No

**Step 4**
Functional capacity greater than or equal to 4 METs without symptoms
- Yes (Class IIa, LOE B) → Proceed with planned surgery
- No or unknown

**Step 5**
Vascular surgery
- 3 or more clinical risk factors → No clinical risk factors
- Consider testing if it will change management

Intermediate risk surgery
- 1 or 2 clinical risk factors
- Vascular surgery
- Intermediate risk surgery

Intermediate risk surgery
- Proceed with planned surgery with HR control I (Class IIa, LOE B) or consider noninvasive testing (Class IIa, LOE B) if it will change management
in our case....

He was advised to

- stop aspirin and the fixed combination of irbesartan/HCT
- Proceed with metoprolol, atorvostatin
  - Evaluate initiation of irbesartan/HCT when volume balanced and aspirin when bleeding risk is diminished (3rd and 7th day respectively)
- Monitor BP at home
- Re-evaluate after 4 weeks for control BP<140/90 mmHg and further assessment of target organ damage
PERIOPERATIVE SCREENING AND MANAGEMENT OF HYPERTENSIVE PATIENTS

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Hypertension (HTN) affects one billion individuals worldwide, particularly the elderly, and represents a major risk factor for coronary artery disease, heart failure, and renal and cerebrovascular disease. Elevated blood pressure is the most frequent preoperative health problem in non-cardiac surgery patients with an overall tendency for increased incidence. However, stage 1 or stage 2 HTN (< 160/110 mm Hg) is not an independent risk factor for perioperative cardiac complications [1]. Severe hypertension, existing untreated, or current use of ineffective antihypertensive agents, many patients have uncontrolled high blood pressure. Accordingly, the perioperative evaluation is a unique opportunity to identify patients with HTN and initiate appropriate therapy. Although pre-existing HTN is the most common medical reason for postponing a needed surgery, it is unclear whether postponing surgery in order to achieve optimal blood pressure control will lead to reduced cardiac risk [2].

In everyday clinical practice, very often we have to give answers to the following questions: Should I go ahead with a patient with uncontrolled HTN? is it safe to operate this patient? When should surgery be delayed or cancelled? Are there any other factors or data in the medical history that may help to answer some of these questions? In this case, we do not have strong data according to "evidence-based medicine" and much of the evidence for the perioperative risk assessment comes from retrospective studies performed before current (more effective) management was available.

Pathophysiology
Blood pressure elevation is sustained by an increase in systemic vascular resistance, increased preload, activation of the sympathetic nervous system (SNS) and renin-angiotensin system (RAS), baroreceptor denervation, rapid intravascular volume shifts, atherosclerotic overproduction, and altered cardiac output. The most important factor is increased peripheral vascular resistance. The increased peripheral vascular resistance caused by the hypertrophy of vascular smooth muscle and the reduced compliance of the blood vessels contribute to elevated blood pressure. When these vascular insults increase, the increased cardiac output is required to maintain normal blood flow. This leads to a chronic stimulation of the baroreceptors, which initiates a reflexive sympathetic response. The increased sympathetic activity can cause an increase in blood pressure of up to 30 mm Hg and heart rate increase of up to 20 beats/min in healthy individuals [3]. This response may be more pronounced in untreated HTN. As the vessels of the heart are the sites of anasthesia, sympathetic activation can cause an increase in blood pressure of up to 30 mm Hg and heart rate increase of up to 20 beats/min in patients with uncontrolled HTN [4]. In most cases, the patient recovers from the effect of anesthesia, blood pressure and heart rate decrease to baseline. The key factors in the optimal management of HTN are a reduction in blood pressure and control of plasma sodium levels.

Perioperative evaluation
Anesthesiologists are responsible for risk evaluation and medication and may have a transient increase in blood pressure. It is important for perioperative evaluation to follow the ESC guidelines for the preoperative risk assessment and diagnostic approach [3]. The next most important step is risk stratification because high-risk patients may need further evaluation whereas intermediate- and low-risk patients can undergo surgery without further delay. Perioperative complications following non-cardiac surgery constitute an enormous burden of perioperative morbidity and mortality (6). Preoperative noninvasive cardiac stress testing is associated with improved one-year survival and reduced hospitalization in high-risk patients; however, the benefits were minor in patients with intermediate risk (7). The American College of Cardiology and the American Heart Association recommend that patients with a history of coronary artery disease undergo preoperative evaluation, including risk stratification (6). Risk stratification includes the assessment of risk factors, symptoms, and the presence of coronary artery disease. The presence of coronary artery disease is an independent predictor of perioperative cardiac complications. Risk stratification includes the assessment of risk factors, symptoms, and the presence of coronary artery disease. The presence of coronary artery disease is an independent predictor of perioperative cardiac complications. The risk assessment tool proposed by the European Society of Hypertension (ESH) includes data on smoking status, diabetes, renal disease, and body mass index. The ESH risk assessment tool is simple to use and has been shown to be effective in identifying patients at risk of perioperative complications. The ESH risk assessment tool includes information on smoking status, diabetes, renal disease, and body mass index. The ESH risk assessment tool is simple to use and has been shown to be effective in identifying patients at risk of perioperative complications. The ESH risk assessment tool includes information on smoking status, diabetes, renal disease, and body mass index. The ESH risk assessment tool is simple to use and has been shown to be effective in identifying patients at risk of perioperative complications. The ESH risk assessment tool includes information on smoking status, diabetes, renal disease, and body mass index.
Perioperative management of hypertension

**Take home message**

1. Hypertension is a very common preoperative abnormality in surgical patients and is accompanied by multiple other CV risk factors.

2. Preoperative evaluation is an opportunity to check and optimize the control of high BP.

3. The extent of diagnostic approach beyond history, physical examination, laboratory evaluation and ECG depends on:
   - the urgent of surgery and the surgery-specific risk
   - The presence of active cardiac condition and other risk factors
   - the functional capacity of the patient

4. Patients on chronic antihypertensive treatment should continue taking their medications until the time of surgery.