



Management of Perioperative Hypertension in Non-Cardiac Surgery

Athanasios J. Manolis

Director Cardiology Department, Asklepeion Hospital, Athens, Greece



CV Risk at the Peri-operative Period The Size of the Problem in the Europe

- ✓ 7 million major surgical procedures annually**
- ✓ More than 150.000 patients suffered from major cardiac complication**
- ✓ In the age group 75+, 12% of the women and 18% of the men have some degree of CVD**
- ✓ By the year 2020, the elderly population will be increased by >50% and the annually conducted procedures by 25%**



CV Risk at the Peri-Operative Period

The Size of the Problem

- ✓ Hypertension is a leading cause of death and disability in most Western societies
- ✓ 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.



Peri-Operative Hypertension

Hypertension occurring in the pre-operative, intra-operative or post-operative period.

Importance:

- ✓ Increased risk of cardiovascular events
- ✓ Increased post-operative morbidity and mortality
- ✓ Association with end-organ damage



Pathophysiology of Perioperative HTN

- ✓ Increase SVR, increase preload
- ✓ Adrenergic stimulation (cardiac and neural)
- ✓ Baroreceptor denervation
- ✓ Rapid intravascular volume shifts
- ✓ Renin angiotensin activation
- ✓ Serotonergic overproduction
- ✓ Altered cardiac reflexes



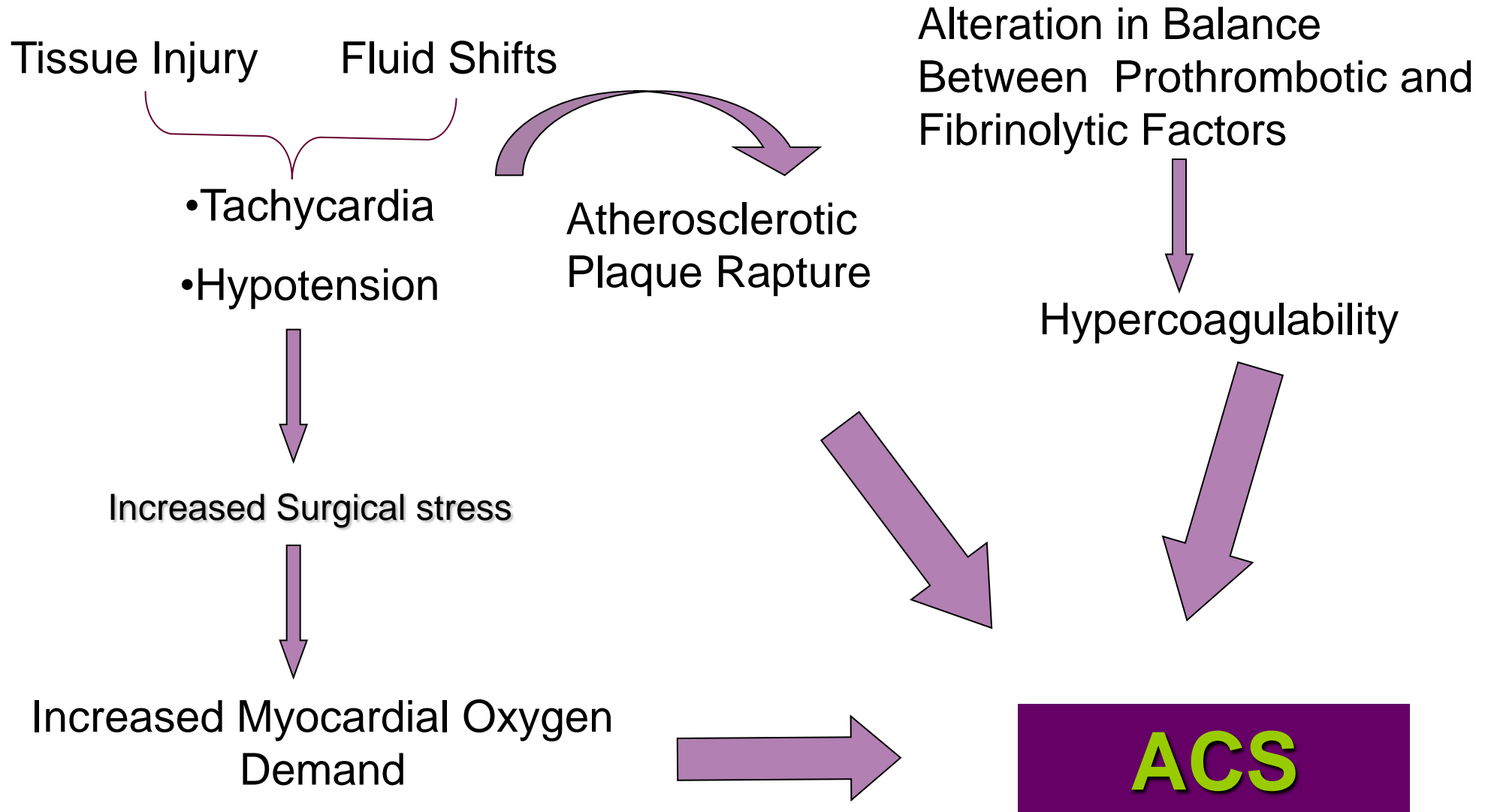
Effects of Peri-Operative Hypertension

CVS effects:

- ✓ Increased BP → ↑ afterload & myocardial oxygen demand → myocardial oxygen supply and demand imbalance.
- ✓ Chronic ↑ BP → myocardial hypertrophy → myocardial oxygen supply and demand imbalance
- ✓ Hypertrophied myocardium → decreased compliance → abnormal diastolic filling



Surgical Risk for Cardiac Events: Pathophysiology





Pre-Operative Evaluation of a Hypertensive Patient 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



Pre-operative Evaluation Of A Hypertensive Patient 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
- ✓ Pts who are taking chronic antihypertensive treatment should continue taking their medications until the time of surgery



Initial Pre-operative Evaluation Of Hypertensive Patient

- ✓ **History**
- ✓ **Physical examination**
- ✓ **Laboratory evaluation**
- ✓ **ECG**



Surgical Risk for Cardiac Events



Surgery - specific factors



Type Of Surgery

- Low Risk
- Intermediate Risk
- High Risk



Circumstances

- Emergent
- Urgent
- Elective



Patient-specific factors

Co-Morbidities



Type Of Surgery and Estimated 30–day Cardiac Events Rates (Cardiac Death and MI)

Surgical risk estimate (modified from Boersma et al.)		
Low-risk <1%	Intermediate-risk 1-5%	High-risk >5%
<ul style="list-style-type: none">▪ Breast▪ Dental▪ Endocrine▪ Eye▪ Gynaecology▪ Reconstructive▪ Orthopaedic-minor (knee surgery)▪ Urologic – minor	<ul style="list-style-type: none">▪ Abdominal▪ Carotid▪ Peripheral arterial angioplasty▪ Endovascular aneurysm repair▪ Head and neck surgery▪ Neurological / orthopaedic – major (hip and spine surgery)▪ Pulmonary renal/liver transplant▪ Urologic - major	<ul style="list-style-type: none">▪ Aortic and major vascular surgery▪ Peripheral vascular surgery



AHA/ACC: Clinical Predictors of Increased Perioperative CV Risk (MI, HF, Death) (I)

✓ Major

Unstable coronary syndrome

- ✓ Acute or recent MI with evidence of important ischemic risk by clinical symptoms or noninvasive study
- ✓ Unstable or severe angina (Canadian Class III or IV)

Decompensated heart failure

Significant arrhythmias

High-grade atrioventricular block

- ✓ Symptomatic ventricular arrhythmias in the presence of underlying heart disease
- ✓ Supra ventricular arrhythmias with controlled ventricular rate

Severe valvular disease



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



LEE Index

Six Major Predictors:

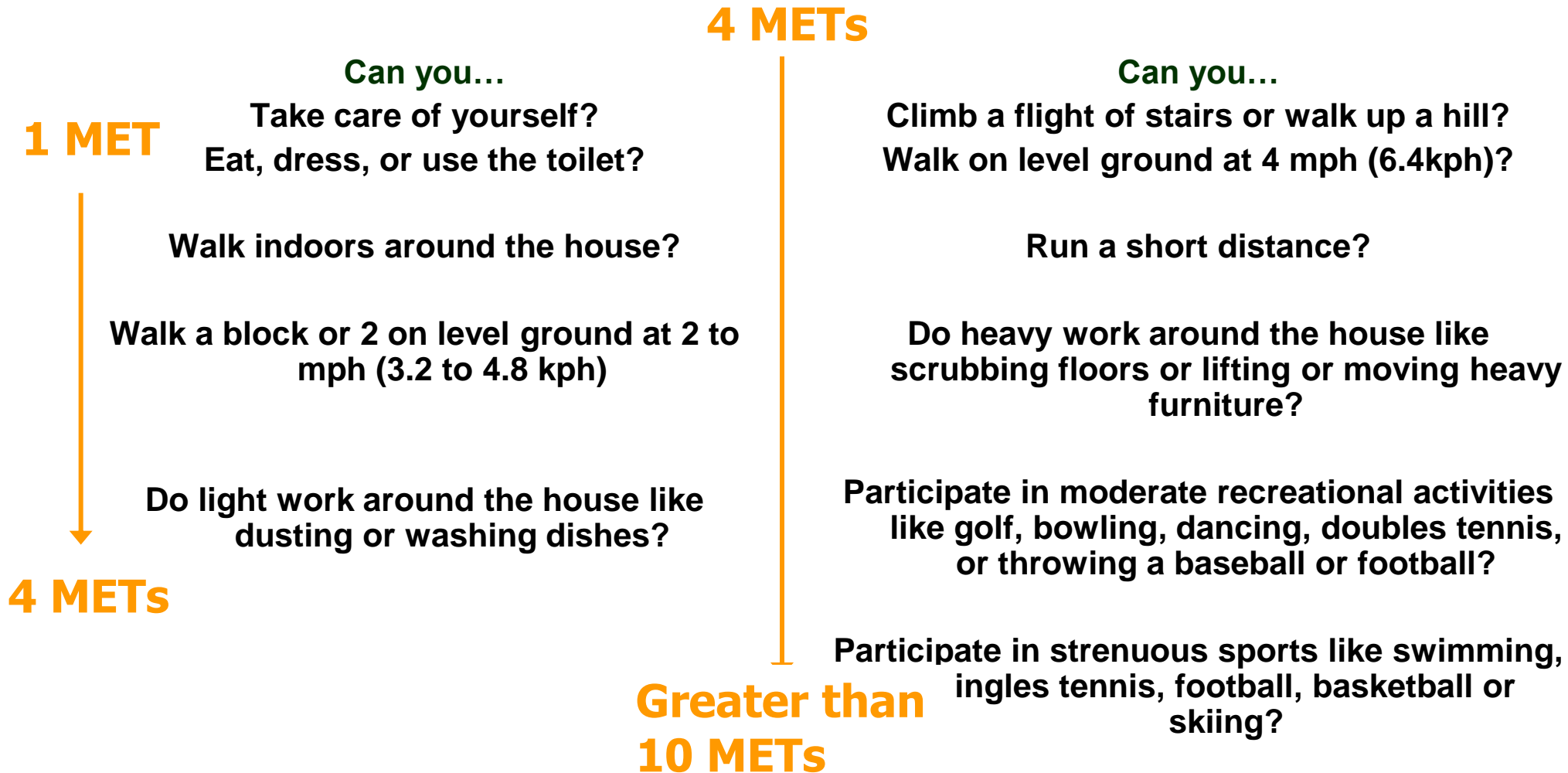
1. Ischemic Heart Disease
2. Cerebrovascular Disease
3. Heart Failure
4. Insulin Depended Diabetes Mellitus
5. Impaired Renal Function
6. High Risk Surgery

✓ Each predictor contributes equally 1 point

Score	Risk
0	0.4%
1	0.9%
2	7%
>3	11%



Assessment of Functional Capacity





Value of Pre-operative Cardiac Evaluation and the Urgency of Surgery

- ✓ **In emergency procedures** (major trauma, ruptured 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

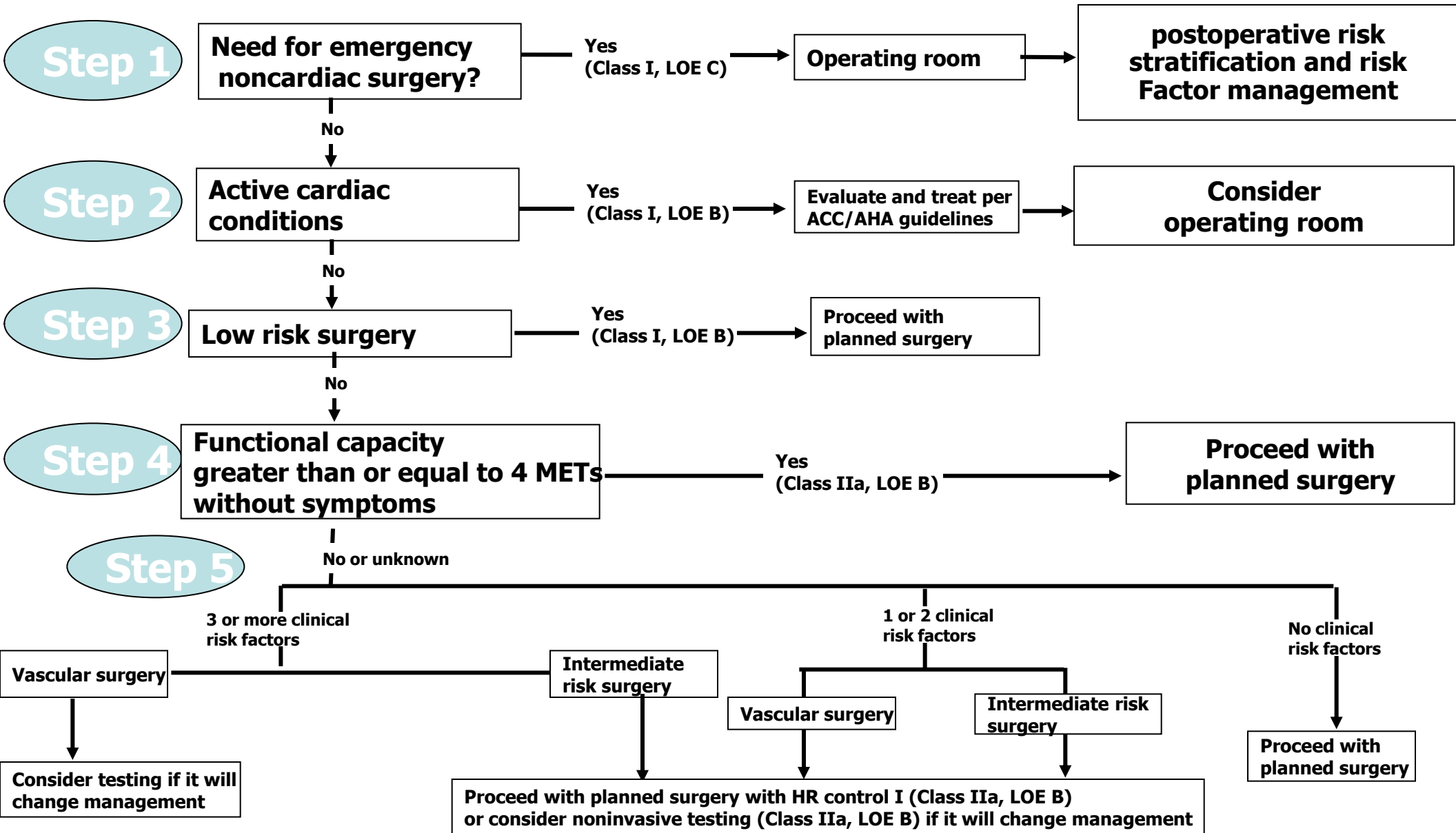


Hypertension And Non-cardiac Surgery Clinical Algorithm Based On 5 Steps

- 1. Is the operation urgent ?**
- 2. Has the patients any active cardiac condition?**
- 3. Which is the surgery-specific risk?**
- 4. Which is the functional capacity of the patient?**
- 5. Has the patient other clinical risk factors?**



Cardiac Algorithm For Noncardiac Surgery





The last thing the patient see prior to surgery



*“Don’t worry Mr. Jones:
everything will be just fine...”*



Perioperative Control of Hypertension

General Measures

- ✓ It is important to know if the patient had HBP before surgery and he was use to take antihypertensive treatment
- ✓ The effective pre-operative management of HBP is often the key to success for the control of HBP during the perioperative period. If preoperative BP > 180/110, the surgery should be deferred.
- ✓ HBP during surgery can be properly managed by analgesia and anesthesia and most of the modern anesthetic have a BP lowering effect
- ✓ Hypoxia and hypercapnia may increase BP by SNS activation
- ✓ All these issue should be considered and treated appropriately before any antihypertensive drug is given



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
- ✓ **During the immediate postoperative period** as patients recover from the effects of anesthesia, BP and HR slowly increase
- ✓ **There is no evidence of superiority of any specific anaesthetic agent in non-cardiac surgery**



Etiology of Intraoperative Hypertension

Preexisting causes	Undiagnosed or poorly controlled hypertension, pregnancy induced hypertension.
Increased sympathetic tone	Inadequate analgesia, inadequate anesthesia, Hypoxemia, Airway manipulation like laryngoscopy, extubation etc, Hypercapnia
Drug overdose	Adrenaline, epinephrine, ketamine, and ergometrine
Others	Hypervolemia, Aortic cross clamping, Phaeochromocytoma, and malignant hyperthermia



An anesthesiologist is a doctor

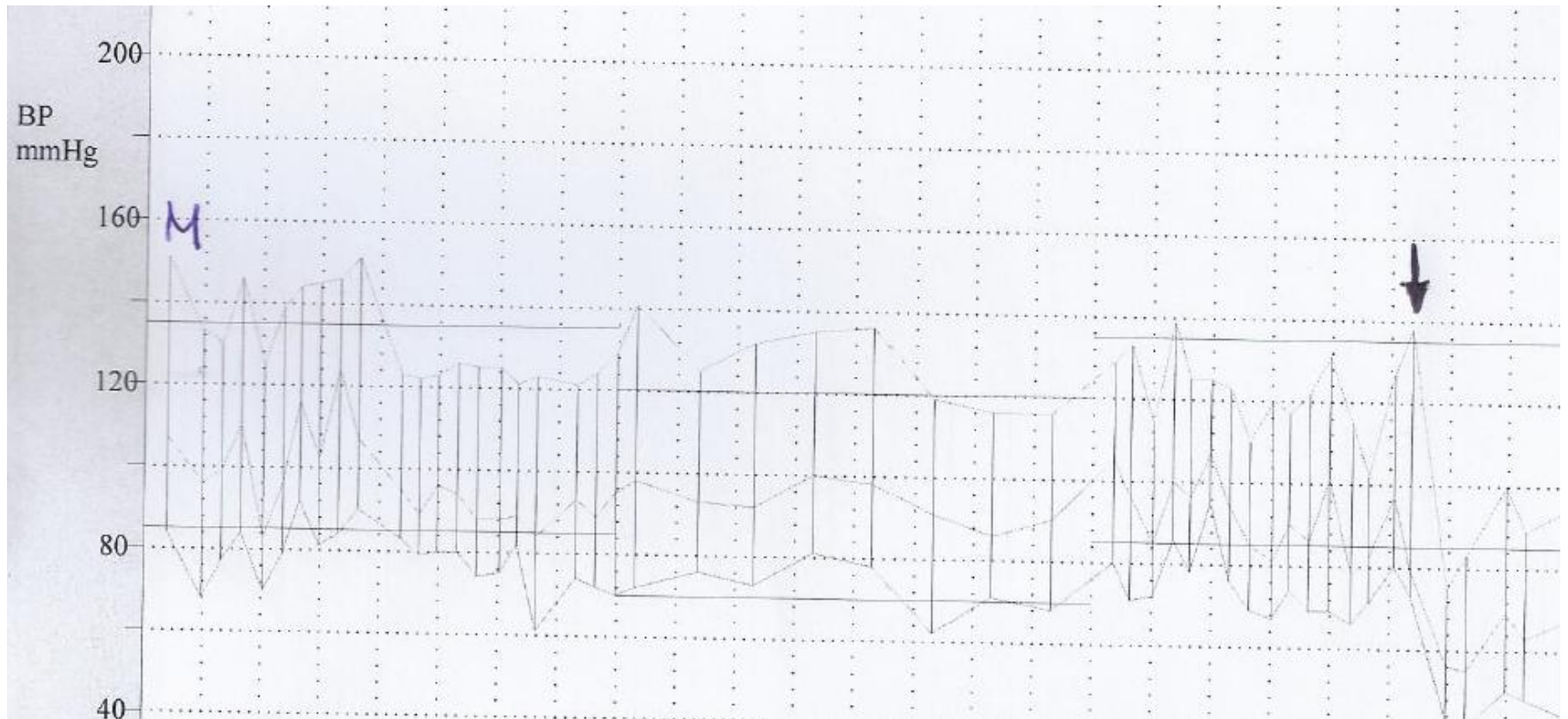
“half asleep”

who keeps a patient

“half awake”.



ABPM: Pre and Perioperative Measurements in a Lady 83 years old





Properties of the Ideal Drug for Perioperative BP Control

- ✓ Easy to prepare, stable at ambient temperature and light
- ✓ Given by continuous intravenous infusion
- ✓ Compatible with range of diluents
- ✓ Easily titrable, with rapid onset and short duration of action
- ✓ Free of untoward or undesirable effects

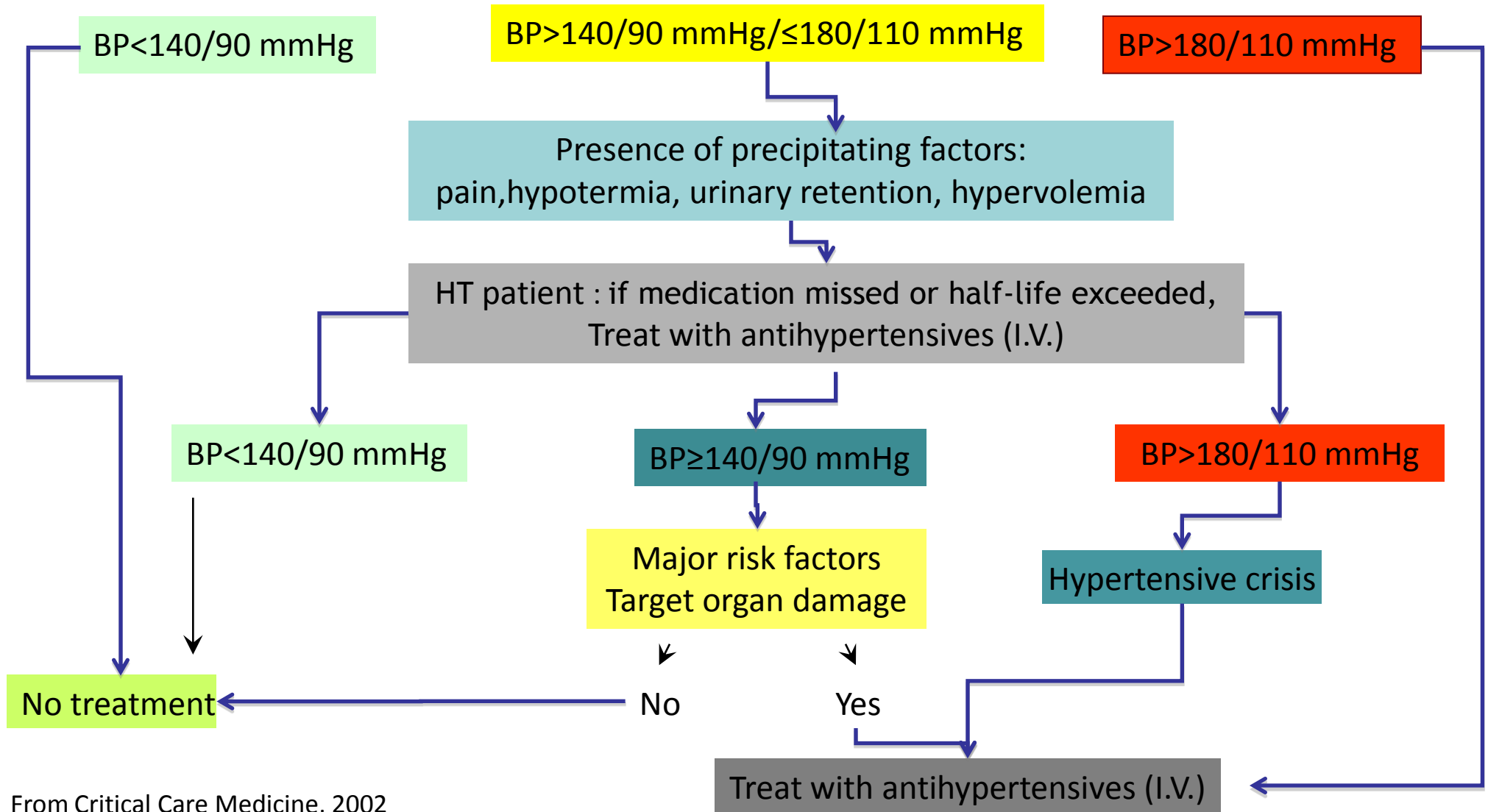


Properties of the Ideal Drug for Perioperative BP Control-2

- ✓ Free of effects on intracardiac conduction
- ✓ Mild reduction in myocardial contractility
- ✓ Vasodilator effects should be mostly confined to the arteriolar bed (i.e. resistance vessels)
- ✓ Vasodilator effects preferentially in vital organ beds, e.g. coronary, renal, splanchnic
- ✓ Effective treatment should maximise protective effects against complication of HTN, i.e. myocardial infarction



Treatment Algorithm Of Perioperative Hypertension



From Critical Care Medicine, 2002



Preoperative β blockers:

- ✓ Controversial
- ✓ Proven to be beneficial in cardiac surgeries
- ✓ For non-cardiac surgeries good results in high-risk patients but not in low-risk patients (NEJM 1996, 2005)
 - ✓ Associated with lesser incidences of perioperative ischemia
 - ✓ Intraoperative hypotension, precipitation of asthmatic attack, major disadvantage



POISE Trial

- ✓ The biggest randomized controlled trial (N=8351)
- ✓ Patients with known CVD or >3 risk factors or major vascular surgery
 - ✓ 100 mg metoprolol 2h prior operation
 - ✓ 100 mg metoprolol 6h after operation
 - ✓ 100 mg metoprolol maintenance dose 12h later

➤ **30% decrease in non-fatal MI**

➤ **33% increase in total mortality**

➤ **2 fold increase in strokes**

**Probably due to Metoprolol
Induced Hypotension**



Perioperative β -Blockers – POISE Trial

	Metoprolol (n=4174)	Placebo (n=4177)	P value
Primary composite*	5.8%	6.9%	.04
Nonfatal MI	3.6%	5.1%	.0007
Total mortality	3.1%	2.3%	.03
Stroke	1.0%	0.5%	.005
Signif hypotension	15.0%	9.7%	<.0001
Signif bradycardia	6.6%	2.4%	<.0001



Risk Reduction using B-blockers

Lee index >3 \longrightarrow Significant decrease in mortality

Lee index = 1 or 2 \longrightarrow No significant difference

Lee index = 0 \longrightarrow Increase in mortality

Preoperative b-blocker
withdrawal \longrightarrow Increase in mortality



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



Effects of Discontinuation of AIIA Before Surgery on Hemodynamic Events In Hypertensive Patients Crhonicly Treated With AIIA

	Group I (AIIA withdrawn)	Group II (AIIA given)	p
Systolic blood pressure			
Preinduction	159 ± 24	151 ± 26	NS
Postinduction	126 ± 33	109 ± 24	NS
Intubation	136 ± 34	121 ± 33	NS
Lowesr value	159 ± 24	151 ± 26	NS
Episodes of hypotension (No.)	1 ± 1	2 ± 1	<0.01
Patients with at least 1 episode (No.)	12	19	<0.01
Duration of episodes (min)	3 ± 4	8 ± 7	<0.01
Patients receiving ephedrine (No.)	12	17	NS
Dose of ephedrine (mg)	10 ± 10	15 ± 9	NS
Patients receiving neosynephrine	0	5	<0.02
Dose of neosynephrine (µg)	0 ± 0	47 ± 86	<0.05



Preoperative ACE inhibitors & AT-1 antagonists:

- ✓ Controversy regarding exaggerated hypotension
- ✓ As long as euvolemia, no hypotension

Pts. with preoperative BP elevations; Exaggerated intraoperative BP fluctuations & ECG evidence of ischemia.

Preop. Control of BP; ↓tendency to perioperative ischemia.



Recommendations On Calcium Channel Blockers

Recommendations	Class^a	Level^b
It is recommended that calcium channel blockers be continued during non-cardiac surgery in patients with Prinzmetal angina pectoris	I	C
Heart rate-reducing calcium channel blockers, in particular diltiazem, may be considered before non-cardiac surgery in patients who have contra-indications to β-blockers	IIb	C
Routine use of calcium channel blockers to reduce the risk of perioperative cardiovascular complications is not recommended	III	C

^aClass of recommendation

^bLevel of evidence



Agents Used In The Management of Perioperative Hypertension, Preferred Conditions, and Dosing-1

<i>Agent</i>	<i>Conditions</i>	<i>Dosing</i>
Enalaprilat	Congestive heart failure	IV injection of 1.25 mg over 5 min every 6 h, titrated by increments of 1.25 mg at 12 to 24 h intervals to a maximum of 5 mg every 6 h.
Esmolol	Acute myocardial ischemia	Loading dose of 500–1000 µg/kg over 1 min, followed by an infusion at 25 to 50 µg/kg/min, which may be increased by 25 µg/kg/min every 10 to 20 min until the desired response to a maximum of 300 µg/kg/min
Fenoldopam	Acute myocardial ischemia/Acute pulmonary edema/diastolic dysfunction, AIT/intracerebral bleed Acute renal failure/microangiopathic anemia Hypertensive encephalopathy Sympathetic crisis	An initial dose of 0.1 µg/kg/min, titrated by increments of 0.05 to 0.1 µg/kg/min to a maximum of 1.6 µg/kg/min.



Agents Used in The Management of Perioperative Hypertension, Preferred Conditions, and Dosing-2

Agent	Conditions	Dosing
Labetalol	Acute aortic dissection Acute myocardial ischemia^a Acute ischemic stroke/intracerebral bleed Eclampsia/Preeclampsia Hypertensive encephalopathy	Initial bolus 20 mg, followed by boluses of 20–80 mg or an infusion starting at 1–2 mg/min and titrated up to until the desired hypotensive effect is achieved is particularly effective. Bolus injections of 1 to 2 mg/kg have been reported to produce precipitous falls in BP and should therefore be avoided; maximum cumulative dose of 300 mg over 24 h
Nicardipine	Acute myocardial ischemiac Acute renal failure/microangiopathic anemia Acute ischemic stroke/intracerebral bleed Eclampsia/preeclampsia Hypertensive encephalopathy Sympathetic crisis/cocaine overdose	5 mg/h; titrate to effect by increasing 2.5 mg/h every 5 min to a maximum of 15 mg/h.



Agent	Dosage	Onset	Duration
Nitroprusside	0.5 – 10 ug/kg/min	30-60sec	1-5 mins
Nitroglycerine	0.5 – 10 ug/kg/min	1 min	3 – 5mins
Esmolol	0.5mg/kg in 1 min 50 – 300 ug/kg/min infusion	1 min	12-20 mins
Labetolol	5-20 mg	1-2mins	4-8 hrs
Propranalol	1-3 mg	1-2 mins	4-6 hrs
Trimethaphan	1-6 mg / min	1-3 mins	10-30 mins
Fentolamine	1-5 mg	1 – 10 mins	20-40 mins
Diazoxide	1-3 mg /kg slowly	2-10 mins	4 – 6 hrs
Hydralazine	5-20 mg	5-20 mins	4-8 hrs
Nifedipine s/l	10 mg	5-10 mins	4 hrs
Methyl dopa	250 – 1000 mg	2-3 hrs	6-12 hrs
Nicardipine	0.25 – 0.5 mg	1-5 mins	3-4 hrs
Enalapril	0.625 – 1 mg ³⁹	6-15 mins	4-6 hrs
Fenoldopam	0.1 – 1.6 ug/kg/min	5 mins	5 mins



Perioperative management of hypertension

Risk factors and diagnostic approach

Key Issues

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



Perioperative Management of HTN: Key Issues-1

- ✓ Some surgical procedure are associated with a high incidence of HTN: carotid endoarteriectomy, head and neck surgery, aortic and peripheral vascular surgery
- ✓ BP levels $> 180/110$ mmHg should be controlled prior to surgery; for elective surgery (cardiac, vascular), effective BP control can be achieved over several days to weeks of outpatient treatment
- ✓ Uncontrolled HTN before surgery is associated with wider fluctuations of BP during induction of anesthesia and intubation and may increase the risk for perioperative ischemic events
- ✓ Surgical candidates with controlled HTN should maintain their medications until the time of surgery (except for ACEI and ARB's), and therapy should be re-instituted as soon as possible postoperatively



Perioperative Management Of HTN: Key Issues-2

- ✓ **If a patients develops intraoperative HTN**, it is necessary ascertain that other causes of HTN have been ruled out (hypercarbia, distend bladder, hypertemia, hypoxia)
- ✓ **In urgent situations**, rapidly acting parenteral agents can be utilized to achieve BP control very rapidly
- ✓ **Sudden intraoperative HTN** is managed by the same parenteal antihypertensive agents that are utilized in the management of hypertensive emergencies
- ✓ **HTN is very common in the early postoperative period** and is related to increased sympathetic tone and vascular resistance that follows pain and increased intravascular volume, and may require parenteral drug and/ or (if possible) the re-insitution of previous oral treatment.



European Society of Hypertension Scientific Newsletter: Update on Hypertension Management

2010; 11: No. 47

PERIOPERATIVE SCREENING AND MANAGEMENT OF HYPERTENSIVE PATIENTS

Athanasios J. Manolis¹, Serap Erdine², Claudio Borghi³, Kostas Tsioufis⁴

¹Department of Cardiology, Asklepeion Hospital, Athens, Greece

²Cardiology Department, Cerrahpasa School of Medicine, Istanbul University

³Dipartimento di Medicina Interna, dell' Invecchiamento e Malattie Nefrologiche, Università degli studi di Bologna

⁴Cardiology Department, Hippokratio Hospital, University of Athens, Greece

⁴Cardiology Department, Hippokratio Hospital, University of Athens, Greece

³Dipartimento di Medicina Interna, dell' Invecchiamento e Malattie Nefrologiche, Università degli studi di Bologna

⁵Cardiology Department, Cerrahpasa School of Medicine, Istanbul University

¹Department of Cardiology, Asklepeion Hospital, Athens, Greece

Athanasios J. Manolis, Serap Erdine, Claudio Borghi, Kostas Tsioufis

© 2010 European Society of Hypertension. All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or by any information storage and retrieval system, without the prior written permission of the European Society of Hypertension.



Perioperative management of hypertension: A position paper of the Working Group “Hypertension and the Heart” of the European Society of Cardiology

Authors: Athanasios J. Manolis (Greece), Claudio Borghi (Italy), Jana Brguljan (Slovenia), Renata Cifkova (Czech Republic), Antonio Coca (Spain), Csaba Farsang (Hungary), Serap Erdine (Turkey), Antony Heagerty (Great Britain), Thomas Kahan (Sweden), Sverre E. Kjeldsen (Norway), Dragan Lovic (Serbia), Jean-Jacques Mourad (France), Gianfranco Parati (Italy), Roland E. Schmieder (Germany), Costas Thomopoulos (Greece), Philippe van de Borne (Belgium), Massimo Volpe (Italy), Costas Tsioufis (Greece)