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 prevalence of 20–25%. Numerous studies have shown that stage 1 or stage 2 HTN (< 180/110 mm Hg) is not an independent risk factor for perioperative cardiovascular complications [1]. Unfortunately, despite the high prevalence of HTN and the availability of numerous effective 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, or should I postpone the surgery? Are patients with uncontrolled HTN at an increased perioperative risk for cardiovascular complications? What is the risk of cardiac complications during and after surgery? How can that risk be reduced or eliminated? Are there any data on which I can base my decision? In this field, we do not have strong data according to 'evidence based medicine', and much of the evidence for the perioperative risks associated with HTN comes from uncontrolled studies performed before current (more effective) management was available.

Pathophysiology

Blood pressure elevation is sustained by an increase of systemic vascular resistance, increased preload, activation of the sympathetic nervous system (SNS) and renin-angiotensin system (RAS), baroreceptor denervation, rapid intravascular volume shifts, serotonergic overproduction, and altered cardiac reflexes. Decreased sympathetic tone during anaesthesia results in a relative decrease in cardiac preload and afterload. During the induction of anaesthesia, sympathetic activation can cause an increase in blood pressure of 20–30 mm Hg and heart rate increase of 15–20 bpm in normotensive individuals [3]. This response may be more pronounced in untreated HTN. As the period of anaesthesia progresses, patients with pre-existing HTN are more likely to experience intraoperative blood pressure lability, which may lead to myocardial ischaemia. During the immediate postoperative period, as the patient recovers from the effect of anaesthesia, blood pressure and heart rate slowly increase [4].

Perioperative evaluation

In this process we have to balance between two points: the safety of the patient during and after the operation and unjustified deferments and cancellations of surgery. It is important to know whether the patient carried the diagnosis of HTN before surgery and was receiving antihypertensive treatment, because many patients are anxious during the preoperative evaluation and may have a transient increase in blood pressure. It is important for physicians to follow the ESH/ESC recommendations for blood pressure measurement and diagnostic approach [5]. The next and 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.

Cardiovascular 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, and delay for cardiac work-up was associated with increased mortality in low-risk patients [7]. Previous or current cardiac disease, diabetes mellitus, functional status, body mass index, nutritional status, and renal insufficiency all confer higher risk for perioperative cardiac complications. Active cardiac conditions for which the patient should undergo detailed evaluation and treatment before surgery include acute coronary syndrome, decompensated heart failure, significant arrhythmia, and severe valvular disease. The revised cardiac risk index discriminated moderately well between patients at low versus high risk for cardiac events after non-cardiac surgery [8]. In addition, we have to pay attention to the identification of symptoms and signs indicative for secondary HTN from the history and physical examination. In a meta-analy-

sis of 30 observational studies the likelihood of experiencing an adverse perioperative cardiac event was found to be, on average, 1.31-fold higher in hypertensives than normotensives [9]. An abnormally low ankle-to-arm index is an independent risk factor for postoperative cardiac complications [10]. Although there seems to be a tendency for increased incidence of perioperative haemodynamic instability in patients with myocardial ischaemia and cardiac arrhythmias in severe hypertension, existing data do not unequivocally support the notion that postponing surgery to optimize blood pressure control will improve perioperative cardiac outcomes. This is in accordance with ACC/AHA guidelines, in which uncontrolled systemic HTN per se is considered only a minor risk factor that does not affect overall perioperative management [11]. However, we lack large-scale trials that include a sufficient number of patients with severe HTN to allow valid statistical analysis and hence to draw conclusions from these patient populations.

Electrocardiogram should be part of all routine assessments of subjects with high blood pressure in order to detect left ventricular hypertrophy, patterns of strain, ischaemia, and arrhythmias. The presence of Q waves or significant ST segment elevation or depression have been associated with increased incidence of perioperative cardiac complications. Therefore, it may be helpful in some cases to contact the referring physician in order to obtain more accurate arterial pressure values than the ones measured at hospital admission (white coat HTN). In these lines, the doctor can follow a clinical algorithm based on 5 questions: 1. Is the operation urgent? 2. Does the patient have any active cardiac condition? 3. Which is the specific risk associated with the particular surgery? 4. What is the functional capacity of the patient? 5. Does the patient have any other clinical risk factors? Figure 1 shows an algorithm with the diagnostic evaluation and approach of a patient undergoing non-cardiac surgery.

Perioperative management

As mentioned previously, careful evaluation prior to surgery to identify the underlying causes of HTN is important in selecting the best treatment option. However, not only HTN but also hypotension is a risk during the perioperative period. While hypertensive peaks need to be avoided, profound hypotension, especially when associated with baroreflex-mediated tachycardia, can be equally detrimental. Severe decrease in intraoperative arterial pressure (decrease to < 50% of preoperative levels or by > 33% for 10 min) was an independent predictor of perioperative adverse events [12]. Maintaining arterial pressure perioperatively at 70–100% of baseline and avoiding tachycardia are key factors in the optimal management of hypertensive surgical patients. Particular care should be taken to avoid withdrawal of β-blockers and clonidine because of potential heart rate or blood pressure rebound. In patients unable to take oral medications, parenteral β-blockers and transdermal clonidine may be used. For stage 3 HTN the potential benefits of delaying surgery to optimize the effects of antihypertensive medications should be weighed against the risk of delaying the surgical procedure. For those patients unable to take oral medication but requiring treatment, parenteral alternatives must be used. Intravenous β-blockers, including propranolol, atenolol, and metoprolol, are attractive because of their
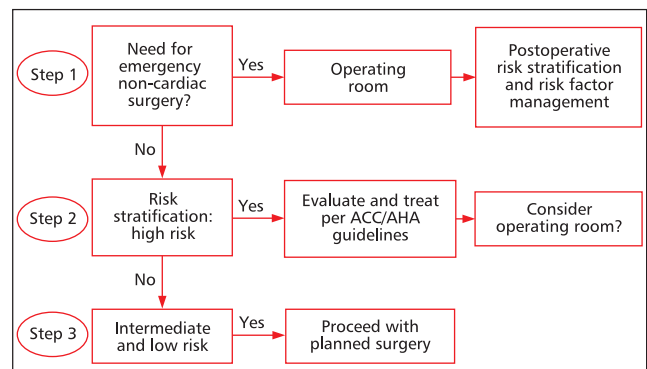

Figure 1. Cardiac algorithm for non-cardiac surgery

Table 1. Perioperative use of antihypertensive drugs

Drug	Perioperative use	Comments
Diuretics	Not on day of surgery	Potential hypokalaemia, volume depletion
Beta-blockers	Avoid starting previous day in high risk patients	With caution in intermediate and low risk
ACE-I/ARB's	Last dose day before operation	Restart ACE-I/ARB's with caution if the patient is euvolemic
Calcium channel blockers		Diltiazem effective in CHD and verapamil in supra-ventricular tachycardia
Clonidine	Continue dose	Withdrawal may cause blood pressure rebound
Esmolol		May cause bradycardia and pulmonary oedema
Labetalol		May cause bradycardia, heart block, and delayed hypotension

Table 2. Initial dosing of antihypertensive agents

Agent	Comment
Enalaprilat	Intravenous intermittent: 0.625–1.25 mg (lower dose if hyponatremia, possible volume depletion, concomitant diuretic therapy, or renal failure) over 5 min, then double at 4- to 6-h intervals until desired response, a single maximal dose of 1.25–5 mg, toxicity, or a cumulative dose of 20 mg within a 24-h period
Esmolol	Intravenous infusion: 250–500 μg/kg/min for 1 min, followed by a 50–100 μg/kg/min infusion for 4 min, then titrate using the same sequence until desired response, a maximal dose of 300 μg/kg/min, or toxicity
Hydralazine	Intravenous intermittent: 3–20 mg slow IV push every 20–60 min
Labetalol	Intravenous intermittent: 20 mg over 2 min, then double at 10 min intervals until desired response, a single maximal dose of 80 mg, toxicity, or a cumulative dose of 300 mg/d
Nitroglycerin	Intravenous infusion: 5 μg/min initially, then titrate in 5μg/min increments every 3–5 min until desired response or toxicity
Nitroprusside	Intravenous infusion: 0.25–0.5 μg/kg/min initially, then titrate dose every 12 min until desired response, a maximal dose of 10 μg/kg/min, or toxicity

anti-ischaemic benefits in the perioperative period. Other alternatives are intravenous enalapril verapamil, or diltiazem and a transdermal clonidine patch. For more serious hypertension, labetalol, nitroglycerin, and sodium nitroprusside are appropriate. Parenteral hydralazine should be avoided in patients with ischaemic heart disease (unless the patient is already under β-blockade) because the reflex tachycardia produced may lead to ischaemia. Use of sublingual nifedipine is absolutely contraindicated because it has been associated with strokes, MI, and death. During the intraoperative period, control of blood pressure may be achieved by deep sedation, the use of vasodilators such as nitroglycerin or nitroprusside, or a combination of the two (Tables 1, 2).

As the patient emerges from surgery, anticholinesterase or anticholinergic agents are frequently given to reverse the neuromuscular blockade used during anaesthesia. Post-anaesthesia blood pressure elevation is frequently caused by sympathetic activation due to patient anxiety and pain upon awakening, along with withdrawal from continuous infusion of narcotics. Intravenous agents of any class can be used during the immediate postoperative period; however, agents with slightly longer duration of action may be preferable. Because of the large volume shifts that occur during surgery, administration of blood, saline, or loop diuretics may be necessary depending on the individual needs of the patient [13]. Postoperative blood pressure treatment also includes the control of pain, anxiety, hypoxia, and hypothermia.

Diuretics. Special attention must be paid to the potassium levels of patients on diuretics. Diuretics should not be administered on the day of surgery because of the potential adverse interaction of diuretic-induced volume depletion and hypokalaemia and the use of anaesthetic agents. Hypokalaemia may cause arrhythmias and potentiate the effects of depolarizing and non-depolarizing muscle relaxants.

Beta-blockers. Recent studies have called into question the benefit of newly administered perioperative β-blockade, especially in patients at low to moderate risk of cardiac events. The specific issue of whether to initiate use of β-blockers perioperatively in such patients has been extremely controversial in the past few years, mostly due to conflicting data from two large clinical trials, POISE and DECREASE-IV. According to recently published 2009 ACC/AHA guidelines [14–15], in patients undergoing surgery who are already receiving β-blockers for treatment, β-blockers should be continued perioperatively (class I, recommendation C). For patients undergoing vascular surgery who are at high cardiac risk, β-blockers titrated to heart rate and blood pressure are probably recommended (IIa, B). For patients undergoing either intermediate-risk procedure or vascular surgery, the usefulness of initiating β-blockade is uncertain. The usefulness of β-blockers is also uncertain in patients undergoing lower-risk surgery. Findings from the POISE trial suggest that starting higher doses of β-blockers acutely on the day of surgery is associated with risk. When β-blockade is started preoperatively, it should be started well in advance of surgery at a low dose which can be titrated up as blood pressure and heart rate allow. The guidelines recommend careful patient selection, dose adjustment, and monitoring throughout the perioperative period.

Angiotensin-converting enzyme inhibitors (ACE-I) and angiotensin receptor blockers (ARB's). There is much debate in the literature over the use of ACE-Is or ARBs in the perioperative period due to their potential central vagotonic effects. These agents alone or in combination have been associated with moderate hypotension and bradycardia, particularly when discontinued less than 10 hours before surgery. In some patients this may be related to a decrease in intravascular volume. The continuation of ACE-I therapy in the morning is not associated with a better control of blood pressure and heart rate but causes a more pronounced hypotension which requires therapeutic intervention. Patients chronically treated with ACE-Is and ARBs should receive them last on the day prior to the operation and without premedication in the morning [16–17]. There is mixed evidence that prophylaxis with glycopyrrolate can attenuate this effect. Consideration should be given to restarting ACE-I in the postoperative period only after the patient is euvolemic, in order to decrease the risk of perioperative renal dysfunction.

Calcium channel blockers. In a meta-analysis of 11 studies involving 1007 patients, calcium channel blockers significantly reduced ischaemia and supraventricular tachycardia [18]. The majority of these benefits were attributable to diltiazem. Dihydropyridines and verapamil did not decrease the incidence of myocardial ischaemia although verapamil did decrease the incidence of supraventricular tachycardia.

Clonidine. Clonidine has a favourable sympathetic-mediated effect with a biphasic response (at lower doses central sympathetic suppression with a vasodilatory effect, at higher doses peripheral activation with a vasoconstrictor effect). It significantly reduces the rate of perioperative cardiovascular complications in patients with coronary artery disease. It is only partially effective for rapid blood pressure control in the perioperative period and contributes to analgesia and sedation.

Esmolol. Esmolol is a β1-selective adrenergic blocker that causes a reduction in heart rate and cardiac output but may increase systemic vascular resistance. It has a rapid onset and short duration of action, and may cause bradycardia, bronchospasm, seizures, and pulmonary oedema.

Labetalol. Labetalol is a non-selective combined α- and β-adrenergic blocker with little effect on heart rate and cardiac output. It has a moderate hypotensive action of long duration and is commonly used in emergency situations. It may cause bronchospasm, bradycardia, heart block, and delayed hypotension.

Nitroglycerin. Nitroglycerin is the most widely used drug. At lower doses it decreases the preload while in higher doses it decreases the afterload, and may increase the heart rate. It is the drug of choice in patients with coronary artery disease, as well as in pulmonary oedema and heart failure.

The key points of the perioperative management include: a) accurate documentation of preoperative medication, b) decision on stopping medications prior to surgery, c) monitoring of appropriate chemistry study results to determine dosages and the occurrence of adverse effects, d) appropriate management of pain, e) administration of adjunctive medications, and f) use of appropriate formulations [19–20].

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