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RESEARCH ARTICLE

RECENT UPDATES ON PREOPERATIVE HYPERTENSION: HOW HIGH IS TOO HIGH TO HANDLE?

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Abstract

The objective of administration of 'safe anaesthesia' is challenged by the patient's pathophysiology during perioperative period. Blood pressure (BP) of the patient, a surrogate marker of perfusion, if abnormal, puts the anaesthetist in a real-time challenging situation. With the surge in the incidence of hypertension worldwide, advanced age of the surgical patient, increasing number of complex surgeries, the anaesthetist, as a perioperative physician has a significant role in bringing the best outcome. This special article will focus on recent updates on the preoperative management of a surgical patient with hypertension, highlighting the importance of risk stratification, as well as, the proper plan of relevant investigations and the antihypertensive pharmacotherapy management.

Introduction:-

Hypertension, a significant public health concern, affects over one billion people worldwide [1]. The risks associated with hypertension and its complications pose significant challenges for theanaesthetists in perioperative period. End organ related major adverse events (MAE) may result in morbidity, prolonged hospital stays, increased healthcare cost and up to an 8-fold increase in mortality in the perioperative period [2]. The dilemma to proceed with or postponesurgery in a patient with uncontrolled preoperative hypertension is still a nightmare for anaesthetist. The clinical threshold value of preoperative blood pressure (BP) as a solecriterion for decision-making is now questioned. The anaesthetist needs to focus on the detection of hypertension-mediated organ damage (HMOD) and personalized risk assessment of a hypertensive patient in the preoperative period.

Classification and definition of hypertension

The 2024 European Society of Cardiology (ESC) guidelines define hypertension as a confirmed clinic systolic BP of ≥140mmHg or diastolic BP of ≥90mmHg [3]. ESC has recently introduced two new BP categories called ‘elevated BP’ and ‘non-elevated BP’ (Table 1). The guidelines by ESC recommend pursuing a target systolic BP of 120-129mmHg among adults receiving antihypertensives. The anaesthetist may advise the home or ambulatory measurement of BP for a preoperative patient with high BP readings at the pre-anaesthesia clinic (PAC). This should aim at confirming the diagnosis of hypertension and negating the possibility of white coat hypertension.

Hypertension as a global burden

The World Health Organization (WHO) global report 2023 on hypertension highlights hypertension as an emerging and alarming burden, significantly attributing to cardiovascular diseases (CVD). The report unleashesinteresting statistics, only 54% of adults with hypertension are diagnosed, 42% receive treatment, and mere 21% have their hypertension controlled. In addition, WHO regions of Europe and Americas have documented 41% increase in the number of adult hypertensive patients over the past thirty years (1999-2019) (Figure 1). In contrast, there has been a dramatic 144% surge in the WHO South-East Asia and Western Pacific regions [1]. Epidemiological studies depict a continuous and log-linear association between hypertension and adverse CVD outcomes [4].

With the advanced age of surgical patients and stricter definitions of hypertension, there is a significant increase in high-risk patients with uncontrolled hypertension in perioperative period. The incidence of perioperative hypertensive patientspresenting for elective non-cardiac surgery (NCS) exceeds 25% and hypertension is the leading cause of cancellations of surgery [5]. Lack of local guidelines and failure of implementation of international guidelines, adds to the problem. The type of surgery, the kind of anaesthesia, and the risk profile of the patient with hypertension is specific to an individual.

Hypertension-mediated organ damage (HMOD)

It is crucial to assess the preoperative patient for the end organ damage caused by long standing hypertension. In each of the organs involved, especially heart, the early changes such as increased left ventricle (LV) overload and LV hypertrophy (LVH), progress to advanced disease, such as systolic or diastolic heart failure, subsequently. HMOD affects micro- and macro-vasculature in organs of low resistance, in essence, retina, kidneys, and brain, resulting in retinopathy, chronic kidney disease (CKD) or stroke, respectively [6].

HMOD can progress from asymptomatic to symptomatic, finally resulting in overt CVD events [7]. The anaesthetist faces the challenge to uncover the clinical, as well as, subclinical complications of hypertension that indicate high risk for MAE.

Preoperative patient with hypertension

A comprehensive preoperative evaluation is the cornerstone of success of perioperative management of the surgical patient. In addition to a detailed history and proper examination, correct technique monitoring BP is essential. BP should be measured with the patient sitting in a quiet room, arm supported at heart level, using appropriately sized cuffs. Automated sphygmomanometers are routinely used in PAC. The pulse should always be palpated before measurement. If pulse is irregular, such as in atrial fibrillation, a common finding in patients of HMOD with left atrial enlargement, BP must be measured manually [8].

In PAC, if initial BP reading is ≥140/90, a total of three readings should be taken, at an interval of at least one minute. The lower of the last two readings is recorded as the patient's BP. If the BP reading is >140/90 and <179/109, the patient is in stage 1 or 2 hypertension. BP readings above 180/110 warrant same day specialty check-up and the elective surgery should be postponed [9]. The clinical threshold of BP reading of 180/110, below which the elective surgery should proceed, stands tall and corresponds to 'safe anaesthesia' [10].

A complete preoperative workup of hypertensive patients should include laboratory and clinical tests to detect CVD risk and comorbidities (Table2). The additional tests may be considered, if they are likely to change patient management and diagnose subclinical occult complications of HMOD (Table 3) [3].

HMOD assessment is the key to identify the preoperative patients who have high CVD risk (Figure 2). A standard two-dimensional echocardiogram (ECHO) is advised for patients with abnormal electrocardiogram (ECG), murmurs or symptoms of heart failure. ECHO may unleash the sub-clinical LV systolic or diastolic dysfunction. Furthermore, LVH detected by ECHO predicts cardiovascular mortality and risk of CVD events [11]. Cardiac computed tomography (CT) and biomarkers are reserved for high-risk patients with hypertension and known coronary artery disease. Carotid or femoral ultrasound can detect plaques and stenosis, helps anaesthetist in risk stratification of the perioperative patient [12].

The ocular examination is seldom ordered by anaesthetist, unless the patient has hypertensive emergency. Retinal fundoscopy may show microvascular changes, haemorrhages or exudates in a patient's previous records. The evaluation of kidney damage involves the measurement of serum creatinine, estimated glomerular filtration rate (eGFR) and urinalysis for proteinuria, as surrogate markers of HMOD [13]

Preoperative antihypertensive pharmacotherapy

It is routine for the anaesthetist to assess and manage the patient with hypertension in PAC. It is pertinent to be aware of various classes, types and mechanisms of actions of antihypertensive agents.

The first-line options of treatment of hypertension to decrease the risk of CVD events are angiotensin-convertase enzyme (ACE) inhibitors, angiotensin receptor blockers (ARBs), calcium channel blockers (CCBs) and diuretics (thiazide or thiazide-like diuretics). The continued use of ACE inhibitors in the preoperative period has been associated with increased incidence of intraoperative hypotension, not related with mortality or CVD events [14,15]. Most recently, interrupting ACE inhibitors have found to increase incidence of postoperative hypertension [16]. Continuation of ACE inhibitors and ARBs in the immediate preoperative period is still a matter of debate. However, ACE inhibitors and ARBs should be continued in patients with heart failure perioperatively, along with modification of doses of anaesthetic drugs and additional intensive monitoring.

Beta-blockers are second-line drugs, added to patients having angina, heart failure, post-myocardial infarction or for heart rate control. It is recommended to continue beta-blockers perioperatively [17]. However, routine initiation of beta-blocker in the immediate preoperative period is not acceptable [18]. Diuretics need patient-specific management, according to the individual's volume status and ejection fraction [19]. CCBs and statins are generally continued before and after surgery without any drastic effects. Patients having resistant hypertension are prescribed centrally acting agents, potassium sparing diuretics, alpha-blockers or vasodilators.

Recently, there is plethora of preoperative patients visiting PAC, on newer antihypertensive medications. These new therapies need special mention and attention, as they significantly interfere with perioperative patient's physiology. The angiotensin receptor-neprilysin inhibitor (ARNi) is a newer therapy of hypertension, usually prescribed in patients with heart failure with preserved ejection fraction and resistant hypertension [20]. ARNi medications should be held 24 hours before the surgery. In patients of diabetes along with hypertension, the favorable effects of sodium glucose transport protein 2 inhibitors (SGLT2i) on renal hemodynamics is partly due to their BP lowering potential. Preoperative fasting and metabolic stress of surgery can cause SGLT2i-associated perioperative ketoacidosis (SAPKA) in patients on this group of drugs [21]. SAPKA can be life-threatening and may shift the surgical patient to intensive care unit (ICU). This unique group of medications should be stopped 3-4 days before surgery. The new mineralocorticoid receptor antagonist (MRA), finerenone has a tendency to cause hyperkalemia in perioperative period, although less frequent and less severe than spironolactone [22].

The management of antihypertensive pharmacotherapy in preoperative period is summarized in Table 4. The introduction of 'polypills', which refers to a single tablet containing more than two groups of antihypertensive medications, poses real-time challenge for the anaesthetist to follow the recommendations in practice.

Address the cardiovascular risk, not hypertension

The advanced age and increasing incidence of chronic diseases of perioperative patients undergoing complex surgeries have led to difficulties in decision-making in PAC. Planned major surgery temporarily increases risk, especially in the patients with comorbidities. The best practice is to assess the patient's overall risk profile, taking in to consideration the multi-factorial approach to estimate the risk of MAE [23]. The most frequently utilized clinical risk calculator, called the revised cardiac risk index (RCRI), includes six factors, each corresponding to score 'one' (Table 5). Hypertension, per se, is not considered direct risk factor in perioperative period.

The traditional practice of canceling or postponing the surgery, based on high BP readings is now discouraged. The Association of Anaesthetists of Great Britain and Ireland (AAGBI), in joint effort with British Hypertension Society (BHS) produced consensus document, stating that elective surgery should proceed for patient with BP less than 180/110 mmHg in PAC [9]. Further, the stage of preoperative hypertension is not directly associated with perioperative haemodynamic instability, with no absolute increase in morbidity and mortality [24]. Thus, there is no evidence to postpone elective non-cardiac surgery solely based on high BP readings, in an asymptomatic individual. The Perioperative Quality Initiative (PQI) consensus statement on preoperative blood pressure strengthens this by stating that there are insufficient data that monitoring of preoperative BP should alter the decisions to proceed with surgery or not. Furthermore, there is lack of evidence that a certain threshold value of preoperative BP should be a benchmark to decide to proceed with surgery or not [25].

American College of Cardiology (ACC) and American Heart Association (AHA) has recently published the guidelines on the perioperative cardiovascular management for NCS and emphasized the role of preoperative risk assessment. It states that "In patients undergoing elective elevated-risk surgery who have cardiovascular risk factors for perioperative complications and recent history of poorly controlled hypertension (≥180/110 before the day of

surgery), deferring surgery may be considered to reduce risk of perioperative complications" [26]. The risk stratification of the surgical hypertensive patient using personalized approach is the standard of care.

Conclusion:-

Hypertension is a major risk factor for long-term CVD and its complications. For the perioperative patient, the question of whether the BP reading is high, too high or just normal, is debatable. The anaesthetists, as the perioperative physicians play pivotal role in bringing best outcome of the surgical patient. The overall individualized risk-based approach of the surgical hypertensive patient should be followed. It is prudent to consider that preoperative patients with hypertension are at risk if they suffer from HMOD, rather than the level of BP, is the key factor for success. The opportunity of identifying and assessing the HMOD in preoperative hypertensive patient should be targeted.

Categories of BP at locations	Clinic BP (mmHg)	Home/Ambulatory BP (mmHg)
Non-elevated BP	<120/70	<120/70
Elevated BP	120/70 – <140/90	120/70 – <135/85
Hypertension	≥140/90	≥135/85

Table 1: Blood Pressure (BP) categories for the diagnosis of hypertension, according to the European Society of Cardiology (ESC) guidelines for the management of elevated BP and hypertension, 2024.

Investigation	Clinical Relevance
FBS	Detection of comorbidities
HbA1c	If the FBS is elevated
12-lead ECG	• Assess rate & rhythm of the pulse. • Assess HMOD (LVH)
Serum creatinine, eGFR, urinalysis	• Baseline values help risk stratification • Assess HMOD (proteinuria)
Sodium, potassium	• Antihypertensive therapy leads to changes in electrolytes. • Preoperative optimization is required
Serum lipids	Assess CVD risk
CBC & coagulation	As routine

FBS – Fasting Blood Sugar
HbA1C – Glycosylated Hemoglobin
ECG – Electrocardiogram
LVH – Left Ventricular Hypertrophy
CBC – Complete Blood Count
CVD – Cardiovascular Disease
eGFR – Estimated Glomerular Filtration Rate
HMOD – Hypertension mediated Organ Damage.

Table 2: Routine preoperative tests and investigations for the hypertensive surgical patient.

Test	Clinical Relevance
Echocardiography	• Assess CVD (previous myocardial infarction, heart failure) • Assess HMOD (hypertensive heart disease)
Cardiac CT	Assess HMOD (coronary artery calcium score)
Carotid or femoral artery ultrasound	Assess HMOD (atherosclerotic plaques & their dimensions)
Cardiac biomarkers	Detect recent myocardial infarction
Fundoscopy	Assess HMOD (hypertensive retinopathy), must do in a hypertensive emergency

HMOD – Hypertension mediated Organ Damage.
CT –Computer Tomography
CVD – Cardiovascular Disease

Table 3. Additional preoperative tests for risk stratification of a surgical patient with Hypertension-mediated organ damage (HMOD) or known cardiovascular disease (CVD).

Drug Group	Examples	Preoperative Recommendations	Considerations
Angiotensin-Converting Enzyme (ACE) Inhibitors	Enalapril, Lisinopril Ramipril, Perindopril	Hold 24 hours	Resume postoperatively, if vitals are stable. Hemodynamic instability common during induction of anaesthesia, if not discontinued. Continue in patients with heart failure.
Angiotensin Receptor Blockers (ARB)	Losartan, Candesartan, Olmesartan, Valsartan	Hold 24 hours	Same considerations as ACE inhibitors.
Beta Blockers	Propranolol, Atenolol, Bisoprolol, Metoprolol	Continue	If no medical emergency, continue throughout hospital stay without interruption. Decrease oxygen demand, prevent arrhythmias, and decrease risk of myocardial ischemia perioperatively.
Calcium Channel Blockers	Amlodipine, Diltiazem, Verapamil	Continue	Continue throughout hospital stay.
Thiazide Diuretics	Hydrochlorothiazide (HCTZ), Chlorthalidone	May continue, as appropriate (depends on drug combination)	ACEI + HCTZ – Hold, Beta blocker + HCTZ – Continue, Resume postoperatively, if vitals are stable.
Loop Diuretics	Furosemide, Torsemide	Hold on day of surgery	Continue in patients with heart failure. Resume postoperatively. Risk of hypovolemia and hypokalemia, if continued.
Statins	Atorvastatin, Rosuvastatin	Continue	Continue during hospital stay. Cardioprotective.
Angiotensin Receptor/ Neprilysin Inhibitor (ARNI)	Sacubitril/Valsartan	Hold on day of procedure	Patients with hypertension and heart failure. Resume postoperatively, if no hypotension, no acute kidney injury, and patient is euvolumic.
Sodium-Glucose Co-transporter 2 (SGLT2) Inhibitors	Empagliflozin, Canagliflozin, Dapagliflozin	Discontinue 3 days before surgery	Facilitate renal perfusion and control hyperglycemia in diabetic patients. Risk of severe ketoacidosis in perioperative period.
Mineralocorticoid Receptor Antagonists (MRA)	Finerenone	Continue	Potent agent in resistant hypertension. Improves eGFR. May cause hyperkalemia.

Table 4: Preoperative management of antihypertensive pharmacotherapy in a surgical patient with hypertension.

Risk Factor	Description	Points
History of ischaemic heart disease	- History of myocardial infarction - History of positive exercise test - Current chest pain due to ischemia - Use of nitrate therapy or ECG with pathological Q waves	+1
History of congestive heart failure	- Pulmonary oedema, bilateral rales or S3 gallop - Paroxysmal nocturnal dyspnoea - Chest radiograph showing pulmonary vascular redistribution	+1
Elevated-risk surgery	- Intraperitoneal- Intrathoracic- Supra-inguinal vascular	+1
History of cerebrovascular disease	- Prior transient ischaemic attack or stroke	+1
Pre-operative treatment with insulin		+1
Pre-operative creatinine >2 mg·dL^{-1}	>176.8 µmol·L^{-1}	+1

RCRI Score	Risk of Major Cardiac Event (95% CI)
0	3.9% (2.8 – 5.4%)
1	6.0% (4.9 – 7.4%)
2	10.1% (8.1 – 12.6%)
≥3	15% (11.1 – 20.0%)

Table 5: Modified Revised Cardiac Risk Index (RCRI) for risk stratification of a preoperative patient.

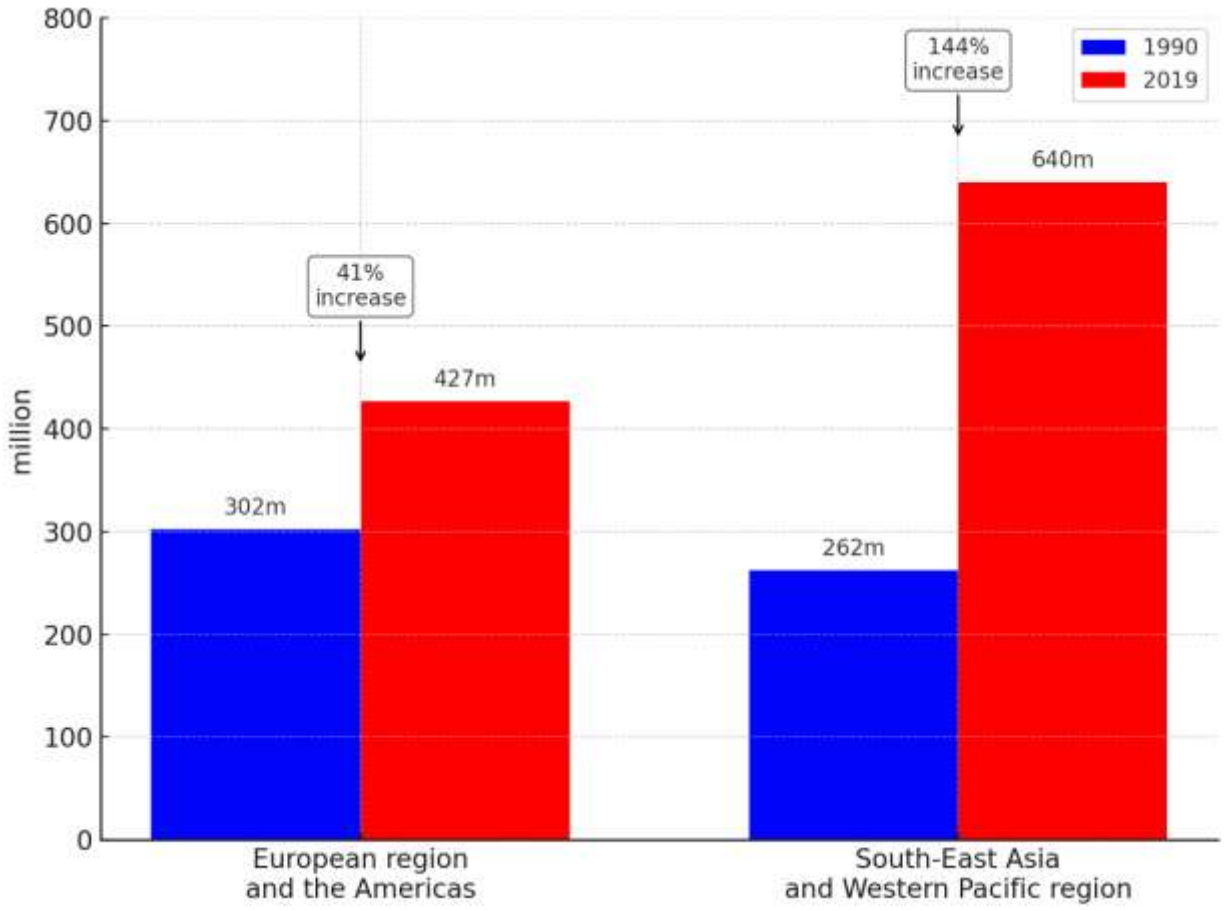

Figure 1: Surge in the incidence of hypertension during last 30 years globally (WHO, 2023).

Organ/System	Assessment & Criteria
Kidney	- eGFR <60 mL/min/1.73 m² (irrespective of albuminuria) - Albuminuria ≥30 mg/g (irrespective of eGFR)
Heart	**ECG –** **LVH:** • Sokolow–Lyon: SV1 + RV5 >35 mm • RaVL ≥11 mm **Echocardiography –** **LVH:** • LV mass/BSA: >115 (men), >95 (women) • LV concentric geometry: Relative wall thickness (RWT) ≥0.43 **Diastolic Dysfunction:** • LA volume/height² >18.5 (men), >16.5 (women) **Cardiac Biomarkers–** • NT-proBNP >125 pg/mL if age <75 years • NT-proBNP >450 pg/mL if age ≥75 years
Arteries	- **Carotid/femoral ultrasound:** Plaque (focal wall thickening >1.5 mm) - **Cardiac CT:** Coronary artery calcium score >100 Agatston units

Figure 2: Assessment of Hypertension-mediated organ damage (HMOD) in a hypertensive patient during the preoperative period.

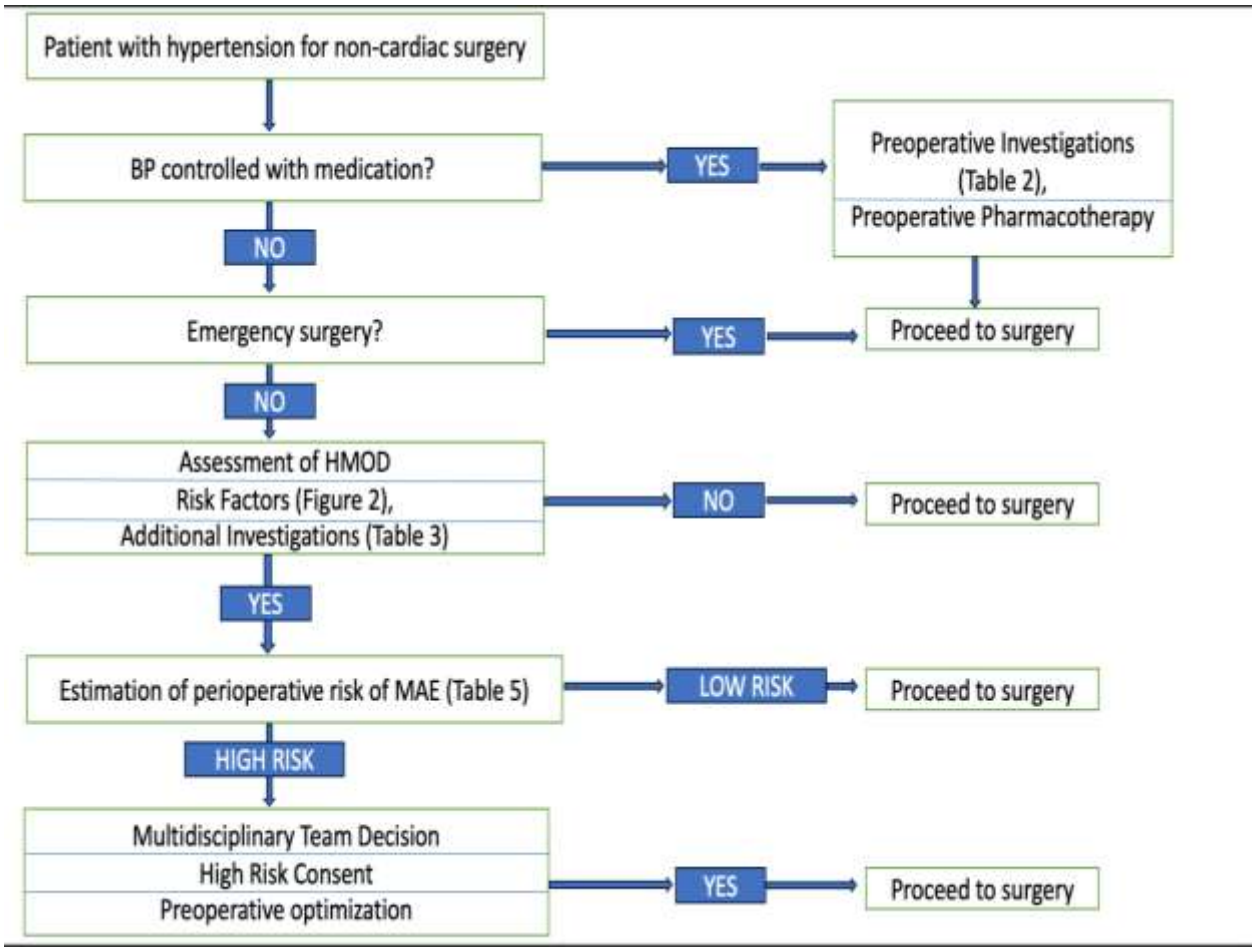

Figure 3: Preoperative pathway to address the individualized management of a surgical patient with hypertension.

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