Guidelines for the Management of Pre-Operative Hypertension

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* Equal contributions

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Summary and Key Recommendations

• The diagnosis and management of hypertension should normally take place within primary care.
• Patients should be referred for elective surgery from primary care if their mean blood pressures in the preceding 12 months are less than 160 mmHg systolic and less than 100 mmHg diastolic.
• Patients may be referred for elective surgery if they remain hypertensive despite optimal antihypertensive treatment or if they decline antihypertensive treatment.
• Pre-operative assessment should focus on the identification of patients at immediate risk to health in the peri-operative period.
• Pre-operative assessment staff should measure the blood pressure of patients who attend clinic without documented evidence of blood pressures less than 160 mmHg systolic and 100 mmHg diastolic by primary care within the preceding 12 months.
• Elective surgery should proceed for patients who attend the pre-operative assessment clinic if their blood pressure is less than 180 mmHg systolic and 110 mmHg diastolic when measured in clinic.
• Good communication with primary care should minimise unnecessary investigations and delays to treatment.
• Most antihypertensive agents should be continued pre-operatively with the exception of angiotensin converting enzyme inhibitors and angiotensin 2 receptor blockers which should be withheld 24 hours pre-operatively.
• It has been demonstrated that implementation of the AAGBI/BHS guidelines on the management of hypertension before elective surgery across primary and secondary care results in a reduction in surgical cancellation rates due to peri-operative hypertension.
INTRODUCTION

Hypertension is defined as a systolic blood pressure (SBP) equal to or greater than 140 mmHg or a diastolic blood pressure (DBP) equal to or greater than 90 mmHg. Over a quarter of the UK’s adult population have hypertension which may be controlled with medication, inadequately controlled on medication or chronically untreated [1]. It is widely accepted that uncontrolled hypertension is one of the most important preventable risk factors for premature morbidity and mortality [2]. Hypertension is almost always asymptomatic and is most commonly diagnosed following screening in the primary care setting. Hypertension may be classified into four categories and management options are influenced by the stage of hypertension (Table 1), the estimated cardiovascular risk as well as evidence of target organ damage (Table 2).

Table 1. Categorisation of the stages of hypertension

<table>
<thead>
<tr>
<th>Category</th>
<th>Systolic blood pressure; mmHg</th>
<th>Diastolic blood pressure; mmHg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 1</td>
<td>140–159</td>
<td>90–99</td>
</tr>
<tr>
<td>Stage 2</td>
<td>160–179</td>
<td>100–109</td>
</tr>
<tr>
<td>Stage 3</td>
<td>180–209</td>
<td>110–119</td>
</tr>
<tr>
<td>Stage 4</td>
<td>≥ 210</td>
<td>≥ 120</td>
</tr>
</tbody>
</table>

Table 2. Hypertension-related target organ damage

<table>
<thead>
<tr>
<th>Organ</th>
<th>Common manifestations of hypertension-related organ damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart</td>
<td>Left ventricular hypertrophy</td>
</tr>
<tr>
<td></td>
<td>Heart failure, both reduced ejection fraction (systolic)</td>
</tr>
<tr>
<td></td>
<td>and preserved ejection fraction (diastolic)</td>
</tr>
<tr>
<td></td>
<td>Ischaemic heart disease</td>
</tr>
<tr>
<td>Brain</td>
<td>Ischaemic stroke</td>
</tr>
<tr>
<td></td>
<td>Intracerebral haemorrhage</td>
</tr>
<tr>
<td></td>
<td>Small vessel cerebral ischaemic disease</td>
</tr>
<tr>
<td></td>
<td>Vascular dementia</td>
</tr>
<tr>
<td>Kidneys</td>
<td>Proteinuria</td>
</tr>
<tr>
<td></td>
<td>Chronic kidney disease</td>
</tr>
<tr>
<td>Vascular</td>
<td>Aortic dissection</td>
</tr>
<tr>
<td></td>
<td>Peripheral vascular disease</td>
</tr>
<tr>
<td>Eyes</td>
<td>Hypertensive retinopathy</td>
</tr>
</tbody>
</table>

Most cases of hypertension are primary and are not associated with any underlying medical cause. Some secondary causes for hypertension may be associated with the indication for proposed surgery and these groups of patients are excluded from this guidance, although many of the general points covered in this chapter may apply (Table 3).
Managing hypertension pre-operatively is a complex matter. Important considerations include whether the detection of hypertension should lead to further investigation and treatment, with the possibility of postponement of the proposed surgery. Conversely, if the surgery does proceed, consideration should be given to the impact of untreated hypertension on the perioperative outcome. Cancellations and postponements of planned surgical procedures have significant psychological, social and financial implications for patients, their families and the NHS. In view of this, diligent care should be taken to avoid unnecessary cancellations.

This chapter only applies to the period before planned surgery and clarifies what can be regarded as a ‘safe’ high blood pressure threshold for elective surgery. The guidance focuses on blood pressures which may cause an increased risk of harm during the perioperative period rather than those that may increase morbidity and mortality in the longer term. It has been demonstrated that the implementation of the AAGBI/BHS guidelines reduces the number of elective surgical patients being cancelled solely due to hypertension [3,4].

However, improvement in practice is still required and it is hoped that the guidance set out in this chapter will: 1) continue to reduce the number of cancellations of elective surgery due to hypertension alone; 2) improve detection of significant hypertension before elective surgery; and 3) reduce the number of patients referred from preoperative assessment clinic back to primary care for the management of hypertension. It is important to note that the blood pressure values cited and the treatments recommended in this chapter are based on the current NICE guidance [2], and if this guidance were to change, then so would the advice provided in this chapter.

**Table 3. Groups of surgical patients excluded from this guidance**

<table>
<thead>
<tr>
<th>Type of Surgery</th>
<th>Reasons for exclusion from this guidance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-elective surgery</td>
<td>Urgent and emergency surgery should not be delayed by the presence of hypertension.</td>
</tr>
<tr>
<td></td>
<td>Blood pressures greater than 180 mmHg systolic and 110 mmHg diastolic should be managed by the perioperative team as guided by the clinical situation.</td>
</tr>
<tr>
<td></td>
<td>The incidental finding of hypertension during an emergency surgical admission should be communicated to the General Practitioner for follow-up.</td>
</tr>
<tr>
<td>Cardiac, endocrine, neurosurgery, renal and vascular surgery</td>
<td>Peri-operative hypertension is often present secondary to the underlying pathology.</td>
</tr>
<tr>
<td></td>
<td>Specialist management will be required and is beyond the scope of this guidance.</td>
</tr>
<tr>
<td>Paediatrics</td>
<td>Childhood hypertension is uncommon</td>
</tr>
<tr>
<td></td>
<td>Specialist management will be required and is beyond the scope of this guidance.</td>
</tr>
</tbody>
</table>

**ASSOCIATION BETWEEN HYPERTENSION AND PERI–OPERATIVE HARM**

The association between uncontrolled hypertension and adverse perioperative outcomes is well established [5,6]. Higher incidence of myocardial ischaemia [7], perioperative cardiovascular death [8], renal dysfunction [9] and cerebral vascular disease [10] are seen in patients with uncontrolled...
hypertension undergoing anaesthesia. Diastolic hypertension [11] and raised pre-operative pulse pressure is associated with an increased risk of myocardial injury, even when SBP is controlled [12]. There is very little data regarding the degree of hypertension and subsequent risk of perioperative mortality. However, it appears that patients with a SBP of less than 180 mm Hg or DBP less than 110 mmHg (i.e. stage 1 or 2 hypertension) and no associated target organ damage do not experience an increased risk of perioperative cardiovascular morbidity or mortality. [13].

Patients with stage 3 or 4 hypertension are more likely to have target organ damage. There is some evidence to suggest that hypertension with target organ damage is associated with a small increased incidence of peri-operative major adverse cardiovascular events [14]. However, it is not known whether or not reducing blood pressure in these patients during a short postponement of elective surgery will result in a reduction of their perioperative risk. Any decision should take into account factors other than blood pressure, namely: comorbidity, functional capacity, frailty, and the urgency and indication for surgery. Therefore, the anaesthetist needs to consider whether the blood pressure should be reduced before surgery and consider whether doing this for a short period of time preoperatively actually reduces the patients’ perioperative risk.

Patients with hypertension (controlled or uncontrolled) demonstrate a more labile haemodynamic profile than their non-hypertensive counterparts [15]. The induction of anaesthesia and airway instrumentation can lead to a pronounced increase in sympathetic activation, which may lead to a significant increase in blood pressure and heart rate. A reduction in systemic vascular resistance soon after the induction of anaesthesia commonly leads to varying degrees of hypotension. Reduction in vascular resistance is multifactorial and may be secondary to loss of the baroreceptor reflex control, central neuraxial blockade, and direct effects of anaesthetic agents. The effect on vascular tone will be exaggerated by ‘deep’ or excessive anaesthesia and in patients who are fluid-depleted. This, and the often exaggerated haemodynamic response to surgery, pain and emergence from anaesthesia, have also been described as being more common in the hypertensive population [16].

In order to mitigate the effects of labile haemodynamics in hypertensive patients, there are a number of available anaesthetic techniques which can be adopted to attain haemodynamic stability during surgery, such as choice of induction drugs, depth-of-anaesthesia monitoring and invasive arterial and cardiac output monitoring with targeted vasopressor and fluid therapy. There is growing evidence that the intra-operative management of blood pressure, particularly the avoidance of hypotension, has a significant effect on morbidity, and this effect may be greater than pre-operative hypertension, other than extremes described in this guidance [17].

How to measure blood pressure

Blood pressure should be measured in a calm and comfortable environment with calibrated and validated equipment. Before commencing measurement, the patient should be seated with their supported arm outstretched for at least one minute and the pulse rate and rhythm should be recorded. When the pulse is irregular, blood pressure should be measured by auscultation over the brachial artery during manual deflation of an arm cuff since automated sphygmomanometers are inaccurate in this situation.

The patient is considered to be normotensive if the blood pressure measurement is less than 140/90 mmHg. If the initial measurement is found to be equal to or higher than 140/90 mmHg, the blood pressure should be measured a further two times at least one minute apart to mitigate the effect of ‘white coat hypertension’. Of these 3 blood pressure readings, the lower of the last two should be documented.
BLOOD PRESSURE IN PRIMARY CARE BEFORE REFERRAL FOR SURGERY

Non-urgent surgical referrals from primary care should not be made without blood pressure measurement (Fig. 1) and surgical outpatients should arrange for primary care to supply blood pressure readings if these have not been documented in the referral letter. Blood pressure should be measured in pre-operative assessment clinic for all patients who attend without documented blood pressure readings from the last 12 months.

If the reading in primary care is between 140/90 mmHg and 179/109 mmHg, the patient may have stage 1 or 2 hypertension and should be offered ambulatory (ABPM) or home blood pressure monitoring (HBPM) to establish their true blood pressure.

Lifestyle advice and pharmacological treatment may be offered in primary care after a diagnosis of hypertension is made. The blood pressure target in primary care prior to referral to surgery is SBP less than 160 mmHg and DBP less than 100 mmHg. Patients found to be incidentally hypertensive during this referral process should undergo the same hypertension management pathway as any other primary care patient. The referral letter to surgeons should include details if the patient has declined hypertension treatment or where all appropriate attempts have been made to reduce persistently high blood pressure, which might have included specialist investigations.

Figure 1
Pathway in primary care blood pressure assessment prior to elective surgical referral. *Investigations and treatment should continue to achieve blood pressures < 140/90 mmHg. ABPM and HBPM, ambulatory and home blood pressure measurement; DBP and SBP, diastolic and systolic blood pressure. With permission from the 'AAGBI/BHS Hypertension Guidelines'.
MEASUREMENT OF BLOOD PRESSURE DURING PREOPERATIVE ASSESSMENT

If the blood pressure measured in preoperative assessment clinic is raised above 180 mmHg systolic or 110 mmHg diastolic, the patient should be referred back to primary care for assessment and management of their blood pressure, unless there is documented evidence of blood pressures less than 160 mmHg systolic and 100 mmHg diastolic measured in primary care (Fig. 2). If the blood pressure is above 140 mmHg systolic or 90 mmHg diastolic, but below 180 mmHg systolic and below 110 mmHg diastolic, the GP should be informed for the concurrent determination of whether hypertension is present, but elective surgery should not be postponed. If the reading is equal to or higher than 180/110 mmHg in primary care, the patient should be screened for red flags (Table 4) which may indicate a hypertensive crisis and will require immediate treatment.

Table 4. Red flags which may indicate a hypertensive crisis

<table>
<thead>
<tr>
<th>System</th>
<th>Clinical features</th>
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</table>
| Neurological | Generalised neurological symptoms, such as agitation, delirium, stupor, seizures, or visual disturbances  
Nausea and vomiting, which may be a sign of increased intracranial pressure  
Focal neurological symptoms that could be due to an ischaemic or haemorrhagic stroke  
History of acute head injury or trauma |
| Eyes     | Fresh flame haemorrhages, exudates (cotton-wool spots), or papilloedema seen on direct fundoscopy                                                  |
| Cardiovascular | Chest discomfort or pain, which may be due to myocardial ischaemia or aortic dissection  
Dyspnoea, which may be due to pulmonary oedema  
Acute, severe back pain, which might be due to aortic dissection |
| Other    | Acute use of drugs that can produce a hyperadrenergic state (e.g. cocaine, amphetamines, phencyclidine, or monoamine oxidase inhibitors)  
Recent discontinuation of clonidine or, less commonly, other antihypertensive agents |

Pre-operative assessment clinics should inform general practitioners when they measure raised blood pressures in patients who have not had readings taken in primary care in the preceding 12 months. The letter should request that the general practitioner investigate whether patient has hypertension and whether or not surgery will proceed without a diagnosis of hypertension being made or treatment commenced.
White-coat hypertension

A finding of significant hypertension (greater than 180 mmHg systolic and/or 110 mmHg diastolic) on the day of surgery should be judged in context of the presence or absence of: i) evidence of previously controlled blood pressure; ii) clinical features of a hypertensive crisis and; iii) anxiety. In a patient with documented evidence of satisfactory control of blood pressure in the 12 months leading up to surgery, the presence of significant hypertension (without any red flag signs) is most likely secondary to anxiety i.e. ‘white coat hypertension’. In this scenario, clinical judgement should be applied and surgery may proceed (some may consider a trial of anxiolytic medication prior to induction of anaesthesia). It is particularly important in these patients, that intraoperative blood pressure targets are based on the patient’s usual preoperative blood pressure rather than the blood pressure measured on the day of surgery.

Figure 2
Secondary care blood pressure assessment of patients after referral for elective surgery. *The GP should be informed of blood pressure readings in excess of 140 mmHg systolic or 90 mmHg diastolic, so that the diagnosis of hypertension can investigated and treated as necessary. DBP and SBP, diastolic and systolic blood pressure. Adapted with permission from the ‘AAGBI/BHS Hypertension Guidelines’.
This section summarises the recommendations for antihypertensive pharmacological therapy in primary care following the diagnosis of hypertension and are summarised in Figure 3. There is good evidence for the treatment of hypertension with one or more of the following: diuretics (thiazide, chlorthalidone and indapamide); beta-blockers; calcium channel-blockers (CCB); angiotensin converting enzyme (ACE) inhibitors, or an angiotensin-2 receptor blocker (ARB). The threshold for treating high blood pressure might change according to cardiovascular risk.

**Figure 3**

*Summary of the recommendations for antihypertensive pharmacological therapy in primary care following the diagnosis of hypertension. angiotensin converting enzyme (ACE) inhibitors, or an angiotensin-2 receptor blocker (ARB), calcium channel-blockers (CCB).*

**Step 1 treatment**

Patients aged less than 55 years should be offered an ACE inhibitor, or an ARB. If an ACE inhibitor is prescribed but is not tolerated (for example, because of cough), offer an ARB. ACE inhibitors and ARBs are not recommended in women of childbearing potential and should not be used in combination.

Patients aged over 55 years and patients of African or Caribbean family origin of any age should be offered a CCB. If a CCB is not suitable, for example because of oedema or intolerance, or if there is evidence of heart failure or a high risk of heart failure, a thiazide-like diuretic should be offered.

Beta-blockers are not a preferred initial therapy for hypertension. However, beta-blockers may be considered in younger patients, particularly those with an intolerance or contraindication to ACE inhibitors and ARBs, or women of childbearing potential or patients with evidence of increased sympathetic drive. If beta-blockers are started and a second drug is required, add a CCB rather than a thiazide-like diuretic to reduce the person’s risk of developing diabetes.
**Step 2 treatment**
Before considering Step 2, check that drugs from Step 1 have been prescribed at optimal doses. If blood pressure is not controlled by Step 1 treatment, use a CCB in combination with either an ACE inhibitor or an ARB. If a CCB is not suitable for Step 2 treatment (e.g. intolerance, oedema, signs of heart failure), offer a thiazide-like diuretic. For patients of African or Caribbean family origin, consider an ARB in preference to an ACE inhibitor, in combination with a CCB.

**Step 3 treatment**
Before considering Step 3 treatment, check that drugs from Step 2 have been prescribed at optimal doses. If treatment with three drugs is required, the combination of ACE inhibitor or ARB, CCB and thiazide-like diuretic should be used.

**Step 4 treatment**
If resistant blood pressure exceeds 140/90 mmHg in clinic after treatment with the optimal or highest-tolerated doses of an ACE inhibitor, or an ARB plus a CCB, with a diuretic; expert advice should be sought whilst also considering adding a fourth antihypertensive drug.

**Patients aged over 80 years**
Standing as well as seated blood pressures should be measured in the over-80s. In those with a significant postural drop or symptoms of postural hypotension, the decision to treat should be based on the standing blood pressure measurement. NICE now recommends that patients aged ≥ 80 years should be offered drug treatment if they have stage 2 hypertension and to consider drug treatment in those with stage 1 hypertension if their clinic blood pressure is over 150/90 mmHg [2]. In both groups, clinical judgement about whether to start drug therapy should be applied in people with frailty or multimorbidity. Patients who were started on treatment when younger should not have their current therapy altered once over the age of 80 years if this treatment continues to be well tolerated.

**PRE-OPERATIVE MANAGEMENT OF ANTIHYPTERTENSIVE MEDICATION**
Each antihypertensive agent has different pharmacological properties and may be used as monotherapy or in combination. The decision to stop or continue antihypertensive agents pre-operatively must involve balancing the risks of withholding the agent with continuing it. Unfortunately, there are no large randomised controlled trials on which to base advice in this setting. The guidance in Table 2 is based on balancing the patient's perioperative cardiovascular risk and the anticipated effect of the drug on the patient's haemodynamic stability during anaesthesia.

*Angiotensin converting enzyme inhibitors / angiotensin 2 receptor blockers*
Withholding angiotensin-converting enzyme inhibitors/angiotensin receptor blockers (ACEIs/ARBs) 24 h before surgery appears to be associated with fewer significant peri-operative haemodynamic fluctuations [18].

*Calcium channel blockers*
Data from small randomised controlled trials suggest that calcium channel blockers may be associated with improved outcomes [19,20].

*Thiazide and thiazide-like diuretics*
Limited evidence to suggest continuing these agents is not associated with harm [21]. However a diuresis on the day of surgery can be both a nuisance for the patient and counter-productive to keeping good preoperative hydration.
**Beta-blockers**

Beta-blockers should not be commenced in the perioperative period due to increases in postoperative mortality, secondary to hypotension and stroke [22]. Conversely, those patients established on beta blockade therapy should continue this treatment as omission may be associated with myocardial ischaemia.

**Table 5. Pre-operative management of antihypertensive medication**

<table>
<thead>
<tr>
<th>Drug</th>
<th>Pre-operative advice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angiotensin converting enzyme inhibitors / angiotensin 2 receptor blockers</td>
<td>Hold 24 h pre-operatively</td>
</tr>
<tr>
<td>Calcium channel blockers</td>
<td>Continue</td>
</tr>
<tr>
<td>Thiazide and thiazide-like diuretics</td>
<td>Continue</td>
</tr>
<tr>
<td>Beta-blockers</td>
<td>Continue</td>
</tr>
<tr>
<td>Other (clonidine, moxonidine, alpha-methyldopa)</td>
<td>Continue – abrupt withdrawal can be associated with adverse events</td>
</tr>
</tbody>
</table>

**FUTURE OF HYPERTENSION TREATMENT: ASSESSING CARDIOVASCULAR RISK**

The extent by which cardiovascular disease is reduced by treatment for hypertension is dependent on the composite cardiovascular risk, not the blood pressure alone. It is likely that future treatment of hypertension will be based on the composite 5 or 10 year risk of stroke; myocardial infarction; heart failure; and cardiovascular morbidity and mortality [23]. This change in perspective is driven partly by the uncertainty in how long it takes for cardiovascular risk to fall with antihypertensive medication as opposed to how long it takes for blood pressure to fall. This should be balanced against the 1% relative increase in perioperative cardiovascular risk due to the patient ageing that accompanies each delayed month. Nevertheless this chapter has been written based on current guidance and best practice where hypertension is diagnosed before elective surgery.
References