Guidelines

Measurement and management of adult blood pressure in the peri-operative period: updated guidelines from the Association of Anaesthetists and the British and Irish Hypertension Society

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Summary

Introduction Maintaining stable blood pressure during surgery is a key responsibility of anaesthetists. Peri-operative omission and reintroduction of antihypertensive drugs, general anaesthesia, neuraxial and regional techniques can all cause significant fluctuations in blood pressure, particularly in patients with hypertension. Since the first edition of this guideline there has been more literature regarding peri-operative management, but some areas still lack standardisation.

Methods This was a planned update of the 2016 guidelines from the Association of Anaesthetists and British Hypertension Society: *The measurement of adult blood pressure and management of hypertension before elective surgery*. An expert working party was convened. We conducted a targeted literature review followed by a modified Delphi process to formulate recommendations.

Results We make recommendations on the management of blood pressure in the peri-operative period (from time of decision to operate until 30 days after surgery) for adults having planned surgery (excluding cardiothoracic, obstetric and endocrine surgeries). These include when and how to measure blood pressure; blood pressure thresholds for postponement of planned surgery; and the peri-operative management of blood pressure. Key recommendations include: secondary care peri-operative teams should accept patient referrals that document a clinic blood pressure measurement < 160/100 mmHg, or an ambulatory or home blood pressure measurement < 155/95 mmHg in the past 12 months; and patients who attend the pre-operative assessment clinic without documentation of normotension in primary care may proceed to elective surgery if their clinic blood pressure measurement is < 180/120 mmHg or ambulatory or home blood pressure measurement < 175/115 mmHg.

Discussion Managing hypertension in the peri-operative period requires a nuanced approach, balancing immediate peri-operative risks with long-term cardiovascular health. Clear communication between primary care, hospital departments and patients is essential to minimise conflicting advice and ensure safe surgical outcomes.

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Plain Language Summary is available on the journal website.

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Accepted: 17 September 2025

Keywords: blood pressure; hypertension; peri-operative; surgery
This is a consensus document produced by expert members of a Working Party established by the Association of Anaesthetists. It has been seen and approved by the Board of Trustees of the Association of Anaesthetists (Great Britain & Ireland) and the British and Irish Hypertension Society.
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Recommendations

1 Patients referred for elective surgery should have a blood pressure measurement taken in a clinical setting in primary or secondary care in the past 12 months < 160/100 mmHg, or an ambulatory or home blood pressure measurement < 155/95 mmHg. Secondary care peri-operative teams should accept these blood pressure measurements (weak recommendation based on low-quality evidence).
2 If primary care blood pressure readings from the last 12 months are undocumented in the referral letter these should be requested (recommendation based on consensus opinion).
3 Patients who attend pre-operative assessment clinic without evidence of a clinic blood pressure measurement < 160/100 mmHg or an ambulatory or home blood pressure measurement < 155/95 mmHg being documented by primary care or secondary care in the preceding 12 months should have their blood pressure measured (recommendation based on consensus opinion).
4 Patients who attend the pre-operative assessment clinic without documentation of normotension in primary care may only proceed to elective surgery if their clinic blood pressure measurement is < 180/120 mmHg or ambulatory or home blood pressure measurement < 175/115 mmHg (recommendation based on consensus opinion).
5 Pre-operative assessment clinics provide an opportunity to identify adverse effects of antihypertensive therapy, pre-operative hypotension and to address these before surgery (recommendation based on consensus opinion).
6 Patients at risk of postural hypotension including those who are symptomatic, aged > 80 y or who are diabetic, should be screened with a supine-to-stand blood pressure assessment or a sit-to-stand assessment (if more pragmatic). In patients with significant drops in blood pressure on standing (drop of 20 mmHg systolic and/or 10 mmHg within 3 min), review medication and subsequently measure and manage blood pressure to standing blood pressure values. Consider referral to specialist care if postural hypotension persists (moderate recommendation based on low-quality evidence).
7 Patients should normally take their antihypertensive therapy, including angiotensin-converting enzyme inhibitors and angiotensin receptor blockers, on the day of surgery (moderate recommendation based on moderate-quality evidence).
8 Excess and prolonged intra-operative hypotension should be avoided. Intra-operative blood pressure management should be targeted to the individual patient and surgical procedure. Intra-operative targets that are used commonly in higher risk patients are mean arterial pressure > 70 mmHg and/or systolic blood pressure > 100 mmHg (moderate recommendation based on moderate-quality evidence).
9 In patients at greater risk of complications of peri-operative hypotension or hypertension, anaesthetists should, at a minimum, reduce the interval of non-invasive blood pressure measurements and have a low threshold for continuous invasive blood pressure monitoring (weak recommendation based on moderate-quality evidence).
10 Postoperative hypotension should be managed using standard treatments in a timely manner, targeting the patient's pre-operative blood pressure, surgical procedure and their postoperative physiology (weak recommendation based on moderate-quality evidence).
11 In the postoperative period, antihypertensive therapy should be reintroduced according to patients' blood pressure (weak recommendation based on moderate-quality evidence).

What other guideline statements are available on this topic?

This is an update of guidelines produced by the Association of Anaesthetists and British Hypertension Society in 2016 [1]. There is new guidance from the European Society for Hypertension [2], which quotes our original guideline. The National Institute for Health and Care Excellence (NICE)

hypertension guideline was renewed in 2019 with more recent updates [3] but this does not cover the peri-operative period. The Perioperative Quality Initiative has provided guidance on intra-operative blood pressure management [4]. The European Society of Cardiology [5] and the American College of Cardiology/American Heart Association Joint Committee guidelines [6] cover blood pressure management in the peri-operative period, whilst the German Society of Anaesthesiology and Intensive Care Medicine has released guidelines on intra-operative haemodynamic monitoring [7].

Why was this guideline developed?

All guidelines from the Association of Anaesthetists are reviewed after five years; this review was delayed because of the COVID-19 pandemic. This guideline considers new research evidence including the UK Clinical Practice Research Datalink observational study [8] and an audit of cancellation rates due to peri-operative hypertension. [9]. The main criticism of the original guideline was that it did not consider low blood pressure [8]. Another consideration was that community measurement of blood pressure is now more based on home or ambulatory blood pressure monitoring rather than clinic blood pressure measurement. Whilst the diagnosis may be relatively unchanged, treatment thresholds have decreased in international guidelines.

How do these guidelines differ from existing guidelines?

The recent European and American guidelines [5–7], broadly say the same things as this guideline but their definition of severe diastolic hypertension starts at 115 mmHg rather than 120 mmHg. We have adapted this new guideline to match the recent NICE guidance in that respect [3]. The other main difference is that we recommend that primary care and out of office measurements are preferred to hospital clinic measurements. With regards to intra-operative and postoperative blood pressure management, this guideline is broadly similar to the Perioperative Quality Initiative statements [4, 10] and the European Society of Cardiology and American College of Cardiology/American Heart Association guidelines [5, 6]. Our intra-operative guidance differs from the German guideline [7], recommending both mean and systolic arterial pressures and slightly higher thresholds.

Introduction

The peri-operative management of hypertension balances the risks of anaesthesia, treatment and delay for the individual patient. Most causes of hypertension are primary but, in a small minority, may be associated with the reason for surgery. Cancellations and postponement of planned surgery due to hypertension are a long-standing global issue; this quantifiable loss is balanced against unquantifiable but significant psychological, social and financial implications of postponement for patients.

Despite existing guidelines for treating elevated blood pressure, there is a relative lack of literature and standardised management for peri-operative management of patients with hypertension undergoing non-cardiac surgery. Identifying patients at increased risk of complications, and determining when to delay surgery or initiate rapid antihypertensive treatment is key to reducing peri-operative risks. Peri-operative hypertension can arise from sympathetic stimulation during induction of anaesthesia, during surgery or as a result of acute pain, hypothermia, hypoxia or fluid overload, especially within the first 24–48 h of surgery [11–13].

Evidence regarding the effect of pre-operative hypertension on patient outcomes is very limited. Historically, local guidelines for the pre-operative management of hypertension existed but were superseded in 2016 by the Association of Anaesthetists/British Hypertension Society guideline [1]. There are conflicts between community and peri-operative blood pressure management due to the different management goals. General practitioners and hypertension physicians aim for long-term blood pressure control to prevent organ damage, targeting systolic and diastolic targets. Anaesthetists and peri-operative teams focus on shorter-term peri-operative complications, typically targeting mean arterial pressure and systolic pressure. Note, mean arterial pressure is not generally used by non-anaesthetist clinicians.

Patients with hypertension having surgery pose additional considerations for anaesthetists. Chronic hypertension impacts peri-operative and long-term cardiovascular risk, but it is unclear whether high blood pressure measured in primary care settings should be reduced before surgery. Poorly controlled hypertension can lead to significant blood pressure reductions during anaesthesia, with patients with hypertension often exhibiting a lower blood pressure nadir than those who are normotensive.

While hypertension [14] and hypotension [15] are associated with increased peri-operative complications [16, 17], there is no clear evidence that stage 1 or 2 hypertension (Table 1) without evidence of target organ damage increases peri-operative cardiovascular risk [18]. Patients with stage 3 hypertension, who are more likely to have

Table 1 Categorisation of the stages of hypertension using clinic, home or ambulatory blood pressure measurement.

Stage	Clinic systolic/diastolic blood pressure threshold; mmHg	Home/ambulatory systolic/diastolic blood pressure threshold; mmHg
1	140/90	135/85
2	160/100	150/95
3	180/120	Non-applicable

target organ damage and who are at greater risk of peri-operative adverse events [11], have not been subjected to rigorous trials of peri-operative interventions and it is unknown whether blood pressure reduction whilst surgery is deferred would reduce this rate of events. The latest guidelines published by NICE, in conjunction with the British and Irish Hypertension Society, recognise the importance of target organ damage in the management of hypertension by targeting a lower threshold for further medical intervention [3]; however, it is unknown if these thresholds and targets should be applied in the peri-operative setting.

Intra-operative hypotension is common during anaesthesia due to the physiological state of the patient, comorbidities and the cardiovascular effects of anaesthesia. Intra-operative hypotension is associated with various adverse outcomes during non-cardiac surgery, including myocardial injury [19, 20], renal injury [21, 22] and increased mortality [23–25]. Causative links may not be inferred from observational studies, but pooled data show that the greater the magnitude and longer the duration of hypotension [20, 25–27], the greater the association with harm. Interventional studies on tighter intra-operative blood pressure control using vasopressors have produced variable results [28–31], with a recent meta-analysis concluding there was no difference in outcomes between controlled and permissive intra-operative blood pressure management [32]. This suggests that intra-operative hypotension may be a marker, rather than a mediator, of adverse outcomes. There is clearly a point at which intra-operative hypotension does cause harm, but what these studies perhaps show is that blood pressure biology is more complex than a number [33].

Cardiovascular changes during surgery are multifaceted and intra-operative hypotension is a final common pathway caused by a variety of mechanisms [34]. Arterial pressure, whilst readily and universally measured, is not the only determinant of perfusion, and macrocirculatory changes may not affect what is happening in the microcirculation. Liberal and non-targeted use of vasopressors, inotropes or excessive fluid therapy may be harmful and may not reduce the incidence of adverse outcomes [35, 36]. Applying the results of population-based studies to an individual patient, whose organ autoregulation thresholds are unknown, could leave the anaesthetist in a quandary: avoidance of profound and prolonged intra-operative hypotension seems advisable, but the optimal management strategy remains to be determined. In short, intra-operative hypotension is bad; the lower and longer the blood pressure the worse it is, but how much, how to avoid it and how to treat it, remains uncertain.

Postoperative hypotension and hypertension are also common and harmful, but limited high-quality evidence exists on their management. A pragmatic, patient-specific approach is recommended.

Methods

This guideline was created by a re-formed working party consisting of members of the Association of Anaesthetists and the British and Irish Hypertension Society with interests and expertise in the subject matter. The members were divided into pre-, intra- and postoperative working groups, who met virtually. At the first meeting, the scope of the guideline was discussed and delegates were tasked with reviewing the relevant literature before presenting draft consensus statements to the group. Evidence to inform recommendations was sought using a systematic review of the literature targeting studies published since the previous guideline (1 January 2016–31 August 2024). Papers published before 2016, whose findings remain relevant, were also included. Recommendations were made using data from included studies and, in the absence of sufficient evidence, by expert opinion from the working party members. Recommendations underwent a Delphi approach within the working party to allow refinement.

Strength of recommendation judgements were made by the expert panel based on analysis of the evidence (using a structure consistent with NICE guidance) and consensus voting and discussion through the Delphi process. Where a pragmatic recommendation was made without a strong supporting evidence base, this was made clear. We specifically asked for and received comments from the patient group, Blood Pressure UK. The Council and

Executive of the respective societies provided final approval.

The following groups of patients were specifically not considered, although many of the general points covered in the guideline may still apply.

Emergency/urgent surgery

These patients have no or very limited time for investigation, treatment or postponement. Such surgery must almost always proceed, any delay only being for resuscitation of (usually low) blood pressure but all those involved, including the patient, must be aware of any associated increased risk.

Obstetrics

Most cases of hypertension in pregnancy will be directly related to the pregnancy (although with an ageing obstetric population and higher rates of obesity, this may be less so), and hypertension may be the indication for surgical delivery. The monitoring and treatment of blood pressure are a specific and integral part of obstetric care, regardless of the need for surgery, and even an elective caesarean section must occur within a limited time window with very little opportunity for delay.

Paediatrics

Childhood hypertension and its epidemiology and natural history are relatively unclear and there are no definitive trials on screening. Thus, its diagnosis and management, including pre-operatively, are specialist areas beyond the scope of the general guidance in this publication.

Endocrine surgery

This includes surgery for phaeochromocytoma and other endocrine tumours. Raised blood pressure may be part of the presentation for these conditions and haemodynamic instability may complicate the peri-operative period. The peri-operative management of blood pressure in such patients is a specialist area beyond the general guidance in this publication.

These following two patient population groups were included in the updated guidelines after consultation with the Association for Cardiothoracic Anaesthesia and Critical Care (ACTACC) and the Society for Obesity and Bariatric Anaesthesia (SOBA).

Cardiac surgery

Peri-operative hypertension often complicates surgery for congenital and acquired cardiac disease. Management will be affected by many other factors including: the planned procedure; use of cardiopulmonary bypass; and the other indications for vasoactive medication. Patients presenting for elective cardiac surgery should be managed in accordance with this guideline. Inpatients scheduled to undergo urgent cardiac surgery (i.e. within 7 days) should have antihypertensive medication optimised. Decisions to withhold antihypertensive medication, particularly angiotensin-converting enzyme inhibitors (ACEI) or angiotensin receptor blockers (ARB), should be made on a case-by-case basis. The intra-operative management of blood pressure in this population was judged to be a specialist area beyond the scope of the general guidance in this guideline.

Bariatric surgery

Patients living with obesity were not included in the first edition of this guideline; however, expert opinion is that they should now fall within its scope. Patients living with obesity have specific issues with accurate blood pressure measurement and diagnosis of hypertension.

Results

This guideline is aimed at the peri-operative period (from time of decision to operate until 30 days after surgery) for adults having planned surgery. Blood pressures which may cause an immediate risk to health are specified, rather than those that may cause risk over the long term. We describe a different scenario of diagnostic cut-offs to the usual situation in both primary and secondary care because the focus is on the short-term peri-operative period. In usual practice, the diagnosis of hypertension is established if the clinic blood pressure measurement is ≥ 140/90 mmHg. For the purpose of a decision on whether or not to postpone surgery for further management of hypertension, that threshold is ≥ 160/100 mmHg in primary care and ≥ 180/120 mmHg in secondary care.

Measurement of blood pressure

Blood pressure measurement should be undertaken in primary care before non-urgent referral for surgery. If not already documented in the initial referral letter, surgical and pre-operative teams should liaise with the patient's primary care team before surgery to request the most recent (within 12 months) blood pressure readings. Patients who attend a pre-operative assessment clinic without documented blood pressure readings from within the last 12 months should have their blood pressure measured by a healthcare professional at the clinic. The method of blood pressure

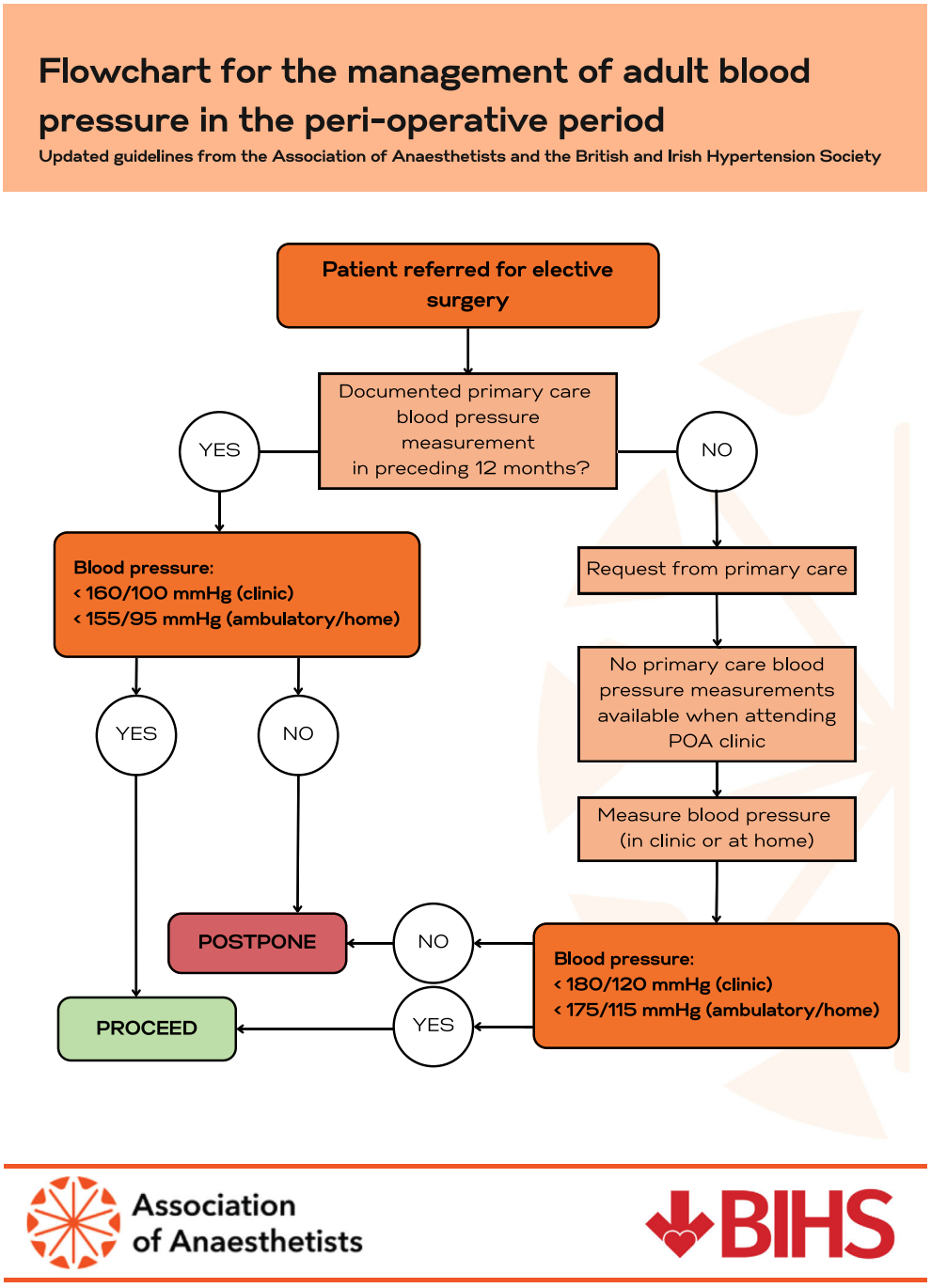

Figure 1 Flowchart for the measurement of pre-operative blood pressure. POA, pre operative assessment

measurement should follow the principles mandated for primary care (detailed below).

Categorisation of stages of hypertension are shown in Table 1. Clinic blood pressure measurements ≥ 140 mmHg systolic or 90 mmHg diastolic (stage 1 hypertension) but < 180 mmHg systolic and 120 mmHg diastolic (stage 3 hypertension) in a secondary care setting (e.g. pre-operative clinic) should not prohibit elective surgery (Figs 1 and 2 and the infographic in online Supporting Information Figure S1). However, the patient should be asked to attend their primary care practice for further blood pressure assessment to determine if hypertension is present. If the blood pressure is raised above stage 3 hypertension thresholds (≥ 180/120 mmHg), the patient

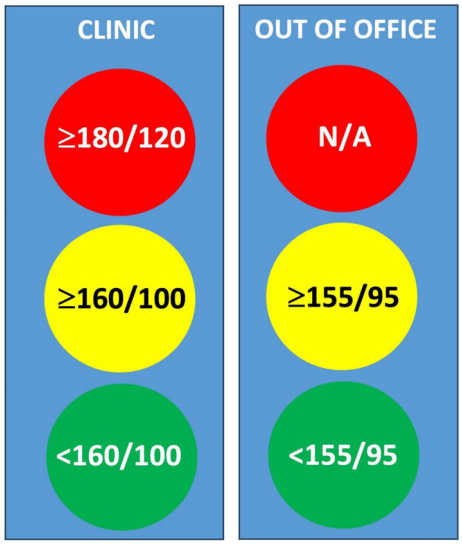

Figure 2 Traffic light system for blood pressure measurements before non-urgent surgery. The traffic lights are separated into clinic and `out of office´ (home or ambulatory) measurements. Red, the procedure should not proceed until the high blood pressure is addressed; green, the procedure can go ahead; yellow, further treatment should be initiated before the procedure. Values are in mmHg.

should return to their primary care practice for assessment and management of their blood pressure; surgery should be postponed until primary care blood pressures are < 180/120 mmHg.

Blood pressure should be measured, preferably at the brachial artery, in a standardised, quiet, relaxed and temperate environment using a current (< 5 years old if using a home measurement device), calibrated (within 12 months) and validated (according to an established protocol) blood pressure device and appropriate cuff size [37]. The bladder of the cuff should fit around 80% of the upper arm, but no more than 100%. If the patient has a large arm circumference and the cuff is too small, e.g. due to obesity (even when using a large or extra-large cuff), consider wrist or forearm blood pressure measurement. If upper arm or wrist measurements are not feasible (e.g. in the case of amputations, altered muscle tone after stroke or limb deformities, presence of vascular access devices, etc.), consider ankle blood pressure measurement [38–40]. The patient should be seated and have their arm outstretched and supported for at least 3–5 min (if feasible) [41] before the initial blood pressure reading is taken; neither the patient nor the healthcare professional (if present) should talk during the measurement. The pulse rate and rhythm should be recorded before the blood pressure is measured by a validated device. Automated sphygmomanometers are generally inaccurate when the pulse is irregular (and in the case of bradycardia and tachycardia); auscultation over the brachial artery during manual deflation of an arm cuff is therefore the preferred method [41, 42] and should be repeated at least three times, using the average of these measurements as the blood pressure reading. Blood pressure should be measured in both arms when considering a diagnosis of hypertension; if the systolic blood pressure between arms is > 5 mmHg, repeat the measurements; subsequently, measure and manage the arm with the higher reading blood pressure.

If the blood pressure measurement is < 140/90 mmHg, then the patient is normotensive and requires no further action. If the first measurement is equal to, or higher than, the stage 1 hypertension thresholds (Table 1), the blood pressure should be measured at least once more (and repeated if the second reading is substantially different from the first) with each reading being measured at least 60 s apart. The lower of the last two readings should be recorded as the clinic blood pressure measurement. The threshold values for hypertension using clinic blood pressure measurement are shown in Table 1.

In primary care, the patient should be offered ambulatory blood pressure measurement (using an average of 14 measurements taken during usual waking hours), or if unsuitable or intolerable, home blood pressure measurement (using two consecutive measurements taken at least 60 s apart, repeated at least twice daily, preferably in the morning and evening, for 4–7 days) to establish their true blood pressure and confirm the diagnosis of hypertension. The threshold values for hypertension using automated or home blood pressure measurement are shown in Table 1.

If the clinic blood pressure measurement is equal to, or higher than, the stage 3 hypertension threshold in primary care, the patient should be considered for immediate treatment; management options should be discussed and commenced in line with NICE and British and Irish Hypertension Society guidance [3, 43]. This process can take place at the same time as urgent surgical referral, but a reduction in blood pressure to < 160/100 mmHg (the threshold for stage 2 hypertension) should precede non-urgent surgical referral, if possible. The referral letter should document that an informed discussion, using a shared decision-making approach, has taken place with patients who decline treatment [44], or detail that all appropriate attempts have been made to reduce blood pressure for patients with persistent hypertension, which might have included specialist

investigations (online Supporting Information Appendix S1).

Postural hypotension

Postural hypotension may be associated with postoperative falls and increased duration of hospital stay [45]. Standing blood pressure measurement should be undertaken in those patients diagnosed with hypertension, diabetes, aged > 80 y or with symptoms of postural hypotension. A thorough postural hypotension assessment should ideally be undertaken with blood pressure measured in the supine position and within 3 min (preferably at 1 min) of the patient moving to a standing position. If a supine measurement if not feasible, consider a sit-to-stand assessment as a practical alternative.

Those patients with significant drops in blood pressure (≥ 20/10 mmHg) or with symptoms of postural hypotension on standing (e.g. dizziness, syncope, confusion) should have medication reviewed and subsequent blood pressures measured and managed according to the standing blood pressure values. If postural symptoms persist, consider referral for specialist care.

Treatment of hypertension

Peri-operative risk should be assessed by considering the surgical-specific risk and patient-specific predictor(s) of increased risk [5]. Patients with well-controlled hypertension are less likely to experience intra-operative blood pressure lability and postoperative complications. Therefore, normalisation of blood pressure values before surgery represents ideal practice. However, there is no evidence that delaying surgery to optimise blood pressure is beneficial [46].

In patients who require blood pressure reduction before surgery, NICE recommendations (online Supporting Information Appendix S1) should be followed. The suggestion from NICE is to start pharmacological treatment in adults with stage 2 hypertension or greater, or stage 1 hypertension with additional cardiovascular risk factors (target organ damage, established cardiovascular disease, renal disease, diabetes or an estimated 10-year risk of cardiovascular disease of ≥ 10%). However, in the context of peri-operative hypertension management we suggest a pragmatic approach aimed at avoiding delays to surgery. Patients with clinic blood pressure measurements in primary care below the thresholds for stage 2 hypertension (< 160/100 mmHg) or home/ambulatory blood pressure measurements < 155/95 mmHg should be referred for surgery without further delay; blood pressure values should be reassessed in primary care as per routine clinical practice.

Patients not on treatment with clinic, home or ambulatory blood pressure measurements above stage 2 hypertension thresholds require hypertension management before surgical referral (depending on the urgency of the referral). In terms of achieving timely pre-operative blood pressure control, the British and Irish Hypertension Society recommends starting treatment with a calcium channel antagonist (such as amlodipine 5 mg daily, titrated to 10 mg daily after 2 weeks depending on the clinical response) aiming to achieve values below stage 2 hypertension. In patients who cannot tolerate the higher dose calcium channel blockade, who have markedly elevated blood pressure values at presentation and/or who require more stringent hypertension management based on their overall cardiovascular risk, combination treatment with a calcium channel antagonist and an ARB can be considered (e.g. losartan 50 mg daily and amlodipine 5 mg daily). Thiazide-like diuretics (such as indapamide slow release 1.5 mg) can be used instead of amlodipine (alone or in combination with an ARB) in patients who are unable to tolerate a calcium channel antagonist.

Hypertension management in patients already on pharmacological treatment for hypertension should follow NICE recommendations and the adult hypertension pathway therapeutic management algorithm endorsed by the British and Irish Hypertension Society [3]. Patients with stage 3 hypertension should be assessed to exclude a hypertensive crisis and started promptly on pharmacological treatment following NICE recommendations. Table 2 highlights patients who are at increased risk of peri-operative blood pressure fluctuations.

Pre-operative clinic

A blood pressure measurement should be performed in the pre-operative clinic using best practice as outlined in this guideline. Surgery should proceed unless the blood pressure is ≥ 180/120 (stage 3 hypertension). If stage 3 hypertension is detected, the clinic should follow NICE guidance and arrange out-of-office measurements within 7 days. If the patient has red flag signs or symptoms of accelerated hypertension, then a same-day assessment by a specialist trained in the treatment of accelerated hypertension is warranted. If the patient requires clinically urgent surgery, for example cancer surgery, then a consensus decision should be agreed between the anaesthetist, surgeon, patient and peri-operative physician

Table 2 Patients at increased risk of complications due to peri-operative blood pressure fluctuations.

	Examples
Blood pressure-related	Consistent > 180/120 mmHg Untreated hypertension Evidence of target organ damage ≥ Four medicines required to manage hypertension Postural hypotension (measured or symptomatic)
Effects of blood pressure on comorbid disease	Ischaemic heart disease Stroke/cerebrovascular disease Peripheral arterial disease Diabetes Chronic kidney disease stages 3–5

(if involved) on whether to proceed. The presence of a pulse pressure > 62 mmHg is associated with an increased incidence of cardiac injury in the first 30 postoperative days [47].

Day of surgery: pre-operative evaluation and intra-operative management

Patients should normally take their oral antihypertensive medications on the day of surgery (online Supporting Information Appendix S1). Antihypertensive drug therapy should not be stopped abruptly. In cases of non-cardiac surgery, it has been common practice to withhold ACEIs or ARBs due to concerns over intra-operative hypotension and associated postoperative complications [48], but several recent studies suggest that there is no additional risk in continuing ACEIs/ARBs [49, 50] (online Supporting Information Appendix S1). Patients should continue all routine antihypertensive medications pre-operatively, i.e. not stop ACEIs or ARBs.

Applying the available evidence to the patient having surgery requires individualised decision-making, considering organ function and the surgical procedure. Target values for blood pressure and how to achieve these during surgery remain to be established. Whilst elevated blood pressure should be controlled, care should be taken to reduce blood pressure cautiously. Many definitions of intra-operative hypotension have been published [51], but recent consensus statements have shown more concordance on suggested thresholds, coalescing around avoiding mean arterial pressure < 60–70 mmHg, systolic blood pressure < 100 mmHg, or a pressure decrease of > 20% from baseline for > 10 min [4, 5]. Targeting an absolute value rather than a threshold relative to a pre-operative baseline is easier to achieve and seems to be what anaesthetists do in practice [21, 52].

To ensure intra-operative blood pressure fluctuations are treated promptly, non-invasive blood pressure monitoring intervals should be reduced and monitoring alarm thresholds adjusted appropriately for the patient. Anaesthetists should consider invasive arterial blood pressure monitoring (i.e. an arterial line) in patients at increased risk of adverse effects of peri-operative hypo- or hypertension or having major surgery [53]. Peripheral vasopressor infusions are increasingly used proactively, to counter the vasodilatory effects of anaesthesia in patients at risk of intra-operative hypotension, rather than as reactionary boluses, which can cause significant blood pressure variability in patients with hypertension.

Advances in patient monitoring since the previous guideline may facilitate management of intra-operative haemodynamics with fluid and vasopressor therapy and should be considered for surgical procedures and patients assessed as being high-risk. These include indices derived from plethysmography such as perfusion index [54]; processed EEG monitoring [55]; tissue near infrared-spectroscopy [56–58]; cardiac output monitors [59, 60]; and monitors predicting hypotension [61]. Underlying all of this is the provision of meticulous anaesthesia, carefully monitored and diligently tailored to the patient and surgery delivered by a skilled anaesthetist.

Postoperative management

After surgery, the patient's blood pressure should be monitored regularly [62] as postoperative hypotension and hypertension are common and associated with adverse outcomes.

Acute postoperative hypertension is relatively common during the emergence period of anaesthesia but is not well defined [10]. The frequency of acute postoperative hypertension varies by type of surgery, for instance affecting 20% of patients undergoing elective noncardiac surgery but between 57% and 91% in patients undergoing intracranial neurosurgery [15]. It is associated with multiple adverse events [10]. Frequently, the hypertension subsides with the treatment of the underlying cause (e.g. pain, anxiety, hypoxia, hypothermia). If it persists, management should be targeted at the suspected underlying issue, but drugs used commonly include administration of intravenous or topical nitroglycerin, magnesium sulphate, beta blockers and calcium channel antagonists. Hydralazine and sodium nitroprusside are used less frequently [15].

Although it is less studied and less well defined than intra-operative hypotension, postoperative hypotension is also common and associated with harm [10, 63], especially if occurring for a prolonged period or on postoperative days

1–4 [64]. Clinicians frequently use judgement rather than objective measures to determine the physiological cause of hypotension and treat with fluids and vasopressors empirically, but without good supporting evidence for this practice. Prompt clinical assessment and targeted therapy are recommended to reduce harm. Further research in this area is warranted.

Once the patient's blood pressure has returned to their normal values, restarting and adjustment of their pre-operative oral antihypertensive therapy should be considered as soon as possible [63]. By its nature, this process will be specific to the individual patient and their clinical situation. Consideration should be given to reduced doses in the early postoperative period with subsequent titration according to blood pressure measurements. It is possible that patients may not need their normal antihypertensive doses during postoperative inpatient stays. Lying and standing blood pressure measurements can be used to guide their reintroduction. Any adjustments made in hospital and further titration necessary in the community should be highlighted in the discharge letter. Primary care review of antihypertensive therapy is recommended according to the clinical situation and a shared decision on reintroducing therapy agreed [65–67].

These guidelines have some limitations. We did not include a full systematic review or perform quantitative or qualitative synthesis of the evidence identified. Many of the recommendations were supported by weak or modest evidence which limited our ability to formally grade them. Given the lack of high-quality published evidence, especially in relation to the peri-operative period, many of the recommendations made are designed with pragmatism in mind. We were unable to make recommendations on cardiothoracic, obstetric or endocrine surgery, and future research involving these patient populations would be of value. Finally, these guidelines focus on UK peri-operative practice, although many of the principles can be generalised to other healthcare settings.

In conclusion, maintaining stable blood pressure levels during surgery is a key responsibility of anaesthetists. Peri-operative omission and reintroduction of antihypertensive drugs, general anaesthesia, neuraxial and regional techniques can all cause significant fluctuations in blood pressure, particularly in patients with hypertension. Although there are several guidelines for treating elevated blood pressure (both in primary and secondary care), the paucity of literature relating to the peri-operative management of patients with hypertension undergoing non-cardiac surgery means that this remains an area of clinical uncertainty. The adverse effects of intra-operative hypotension on patient outcomes are well described, but there is also morbidity (and potentially mortality) associated with the cancellation or postponement of surgery due to hypertension. This multidisciplinary guideline provides clear recommendations for the management of hypertension in the peri-operative period and encompasses thresholds for both primary and secondary care.

Managing hypertension in the peri-operative period requires a nuanced approach, balancing immediate peri-operative risks with long-term cardiovascular health. Clear communication between primary care, hospital departments and patients is essential to minimise conflicting advice and ensure safe surgical outcomes. These updated guidelines aim to support peri-operative teams in this endeavour.

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Acknowledgements

The authors are grateful for the contributions of the Blood Pressure UK Patient Panel in reviewing this document and making the positive suggestion regarding the inclusion of a patient infographic (online Supporting Information Figure S1). TM is an advisor and investigator for AstraZeneca and Medtronic, and sub-investigator for Alnylam, in respect to the management of resistant hypertension. TM was a guideline committee member for NICE NG126 (Hypertension) and NG180 (Peri-Operative Care) and is the immediate Past President of the British and Irish Hypertension Society. AW is a consultant for Edwards Lifesciences. SM is funded by a NIHR School for Primary Care Research (SPCR) Postdoctoral Fellowship. MW is the Editor-in-Chief of *Anaesthesia* and a board member of the Association of Anaesthetists. SA was a guideline development group member for the WHO Prevention and Diagnosis of rheumatic fever and rheumatic heart disease guideline (2024). AH is Past President of the Association of Anaesthetists and Past Chair of the Editorial Board *Anaesthesia* (ex officio from former post). No data or statistical code were generated. No other competing interests declared.

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Supporting Information

Additional supporting information may be found online via the journal website.

Appendix S1. Peri-operative blood pressure medication management.

Figure S1. Infographic for the measurement of peri-operative blood pressure.