

Review Article

Management of severe asymptomatic hypertension in the hospitalized patient



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Manuscript received August 4, 2016 and accepted October 30, 2016

Abstract

Hypertension is common in the hospital setting. While the epidemiology, management, and outcomes of chronic hypertension are well defined, data and clinical guidance on the management of severe blood pressure elevations in the hospitalized patient are lacking. This article aims to review the literature related to the risks and benefits of managing severe asymptomatic hypertension in the hospitalized patient, summarize the concerns regarding managing severe asymptomatic hypertension with as-needed antihypertensive medication, and suggest alternative management strategies. *J Am Soc Hypertens* 2016;10(12):974–984. Copyright © 2016 American Society of Hypertension. All rights reserved.

Keywords: Antihypertensive; hospitalized.

Introduction

Hypertension is common in the hospital setting with a prevalence of 24–70%.^{1,2} While the epidemiology, management, and outcomes of chronic hypertension are well defined, these data are lacking for severe hypertension in the hospitalized patient. In 2011, an editorial on treating acute hypertension in the hospital was published. The author of the commentary argued that asymptomatic acute hypertension was common in the hospital, it was often perceived as a problem requiring immediate treatment, and treatment tended to be overly aggressive. The author called for the discussion of and research into the treatment of acute hypertension in the hospitalized patient.³ Since this editorial, only a handful of articles have been published on this topic. The purpose of this article is to review the literature related to the risks and benefits of managing severe asymptomatic hypertension in the hospitalized

patient, summarize the concerns regarding managing severe asymptomatic hypertension with as-needed antihypertensive medication, and suggest alternative management strategies.

Definitions for Severe Hypertension

Definitions for severe hypertension are inconsistently described in the literature.^{4,5} For the purpose of this review, we use the following terminology for the types of severe hypertension (**Figure 1**). Severe hypertension is defined as an elevation in blood pressure (BP) of ≥ 180 mm Hg systolic or ≥ 110 –120 mm Hg diastolic.^{5–10} Severe hypertension can be subdivided into hypertensive emergency and severe asymptomatic hypertension. Hypertensive emergency is considered an acute form of severe hypertension that is associated with end-organ damage such as acute coronary syndrome, aortic dissection, hypertensive encephalopathy, acute renal failure, acute heart failure, ischemic stroke, and hemorrhagic stroke.^{10–12} Severe asymptomatic hypertension is not associated with evidence of end-organ damage. Hypertensive urgency is a form of acute severe asymptomatic hypertension in patients at increased risk for progressive end-organ damage due to a history of conditions such as congestive heart failure, unstable angina, coronary artery disease, chronic kidney disease, transient ischemic attack, or stroke.^{6,7,10,13} Patients with severe

Conflict of interest: Dr Sheryl Vondracek, Dr Sarah Scoular, and Dr Toral Patel declare no conflicts of interests or financial interests in any product or service mentioned in this manuscript, including grants, employment, gifts, stock holdings, and honoraria.

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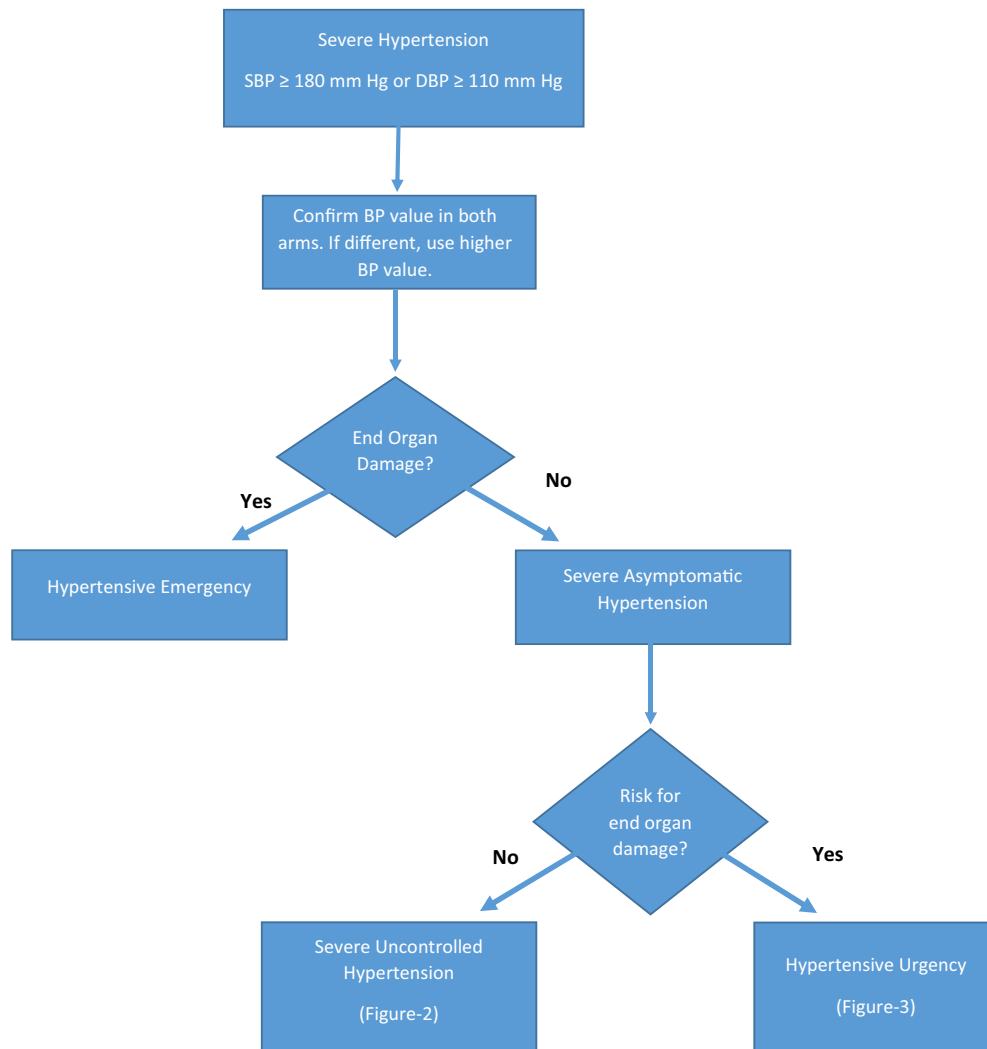


Figure 1. Determining the type of severe hypertension. End-organ damage: acute coronary syndromes, aortic dissection, hypertensive encephalopathy, acute renal failure, acute heart failure, ischemic stroke, and hemorrhagic stroke. Risk for end-organ damage: History of congestive heart failure, unstable angina, coronary artery disease, chronic kidney disease, transient ischemic attack, or stroke. BP, blood pressure; DBP, diastolic blood pressure; SBP, systolic blood pressure.

uncontrolled hypertension are not at risk for end-organ damage.

Prevalence of Severe Asymptomatic Hypertension in the Hospitalized Patient

Hypertension in the hospitalized patient is common. Axon et al² conducted a systematic review of articles that reported the prevalence of hypertension in the inpatient setting. Nine articles were deemed suitable for inclusion in their review. All were cross-sectional or retrospective cohort studies. The diagnostic criteria for hypertension in the majority of the studies were a hypertension diagnosis in the hospital record and/or BP $\geq 140/90$ mm Hg. None of the studies specifically evaluated patients with severe

hypertension. Overall, the prevalence of hypertension ranged from 23.8% to 72%. Two of the studies that reported higher prevalence rates of 56.4–72.6% used 24-hour BP monitoring. Shorr et al¹⁴ conducted a retrospective cohort study to examine the prevalence of severe acute hypertension in patients admitted through the emergency department (ED). Severe acute hypertension, defined as at least one BP >180 mm Hg systolic, was present in 13.8% of the 1,290,804 admissions. Major disease systems associated with the primary reason for the acute care admission were nervous (29%), circulatory (16%), endocrine (14.7%), kidney/urinary (13.5%), and infectious (7%). Based on these studies, it is still difficult to know the true prevalence of severe asymptomatic hypertension in the hospitalized patient.

Causes of Severe Asymptomatic Hypertension in the Hospitalized Patient

There are several reasons why patients may experience severe asymptomatic elevations in BP while hospitalized.⁷ Many of these patients have a previous diagnosis of hypertension, and the elevations may be due to inadequately treated chronic hypertension or medication nonadherence as an outpatient. In a longitudinal study that evaluated risk factors for hypertensive crisis in hospitalized patients, nonadherence was the most important factor with a hazard ratio of 5.88 (1.59–21.77).¹⁵ For others, uncontrolled pain from trauma or surgery, acute volume overload, anxiety, newly started medications known to increase BP, or having home antihypertensive medications held during the hospital stay may lead to BP elevations.^{3,16,17} In particular, abruptly stopping clonidine or beta-blockers has been shown to lead to rebound hypertension.¹⁸ For some patients without a previous diagnosis of hypertension, sustained elevations in BP during hospitalization may indicate untreated chronic hypertension that will likely persist after discharge.^{1,11} In a prospective study of patients with unknown or untreated hypertension presenting to the ED, outpatient hypertension could be predicted with a specificity greater than 90% if the mean BP was 165/105 mm Hg or higher after 60–80 minutes in the ED.¹⁹ Similar findings have been seen in other ED studies.¹¹ [Table 1](#) summarizes causes for severe hypertension. Clinicians should be aware of these especially in patients without a history of hypertension that present with or develop severe hypertension during their hospital stay. [Table 2](#) summarizes the correctable causes for severe asymptomatic hypertension in the hospitalized patient and suggested management strategies. These causes should be investigated in any patient developing severe asymptomatic hypertension while hospitalized. Hypertension may be improved without the need for treatment if these correctable causes are addressed.

Table 1
Selected causes for severe hypertension.^{5,9,20–22}

Renovascular disease (eg, renal artery stenosis)
Renal parenchymal disease (eg, glomerulonephritis, systemic lupus erythematosus)
Endocrine disease (eg, pheochromocytoma, cushing syndrome, primary hyperaldosteronism)
Illicit drug use (eg, cocaine, amphetamines)
Preeclampsia/eclampsia
Medications (eg, oral contraceptives, cyclosporine, tacrolimus, erythropoietin, systemic corticosteroids, phentermine, phenylephrine, modafinil, tricyclic antidepressants, venlafaxine, monoamine oxidase inhibitors, nonsteroidal anti-inflammatory drugs)
Herbal supplements (eg, ephedra, ma huang)

Consequences of Severe Asymptomatic Hypertension

Long-term consequences of severe uncontrolled BP are well known.^{23–25} However, data regarding the short-term consequences of severe asymptomatic hypertension are lacking. A retrospective chart review of trauma patients admitted to a level I trauma center evaluated the association between in-hospital acute hypertension and morbidity and mortality.²⁶ Patients either experiencing or not experiencing an acute hypertensive episode as defined by a single systolic blood pressure (SBP) reading ≥ 180 mm Hg or diastolic blood pressure (DBP) reading ≥ 110 mm Hg or at least two readings of SBP ≥ 160 mm Hg or DBP ≥ 100 mm Hg were compared. At least one acute hypertensive episode occurred in 42.6% (69/162) of patients evaluated. Patients experiencing an acute hypertensive episode during hospitalization were more likely to have a documented medical history of chronic hypertension (63.8 vs. 36.6%, $P = .001$). The primary outcome was a composite end point of myocardial infarction, stroke, venous thromboembolism, new-onset atrial fibrillation, or acute kidney injury during hospitalization. A total of 10.5% patients experienced the composite end point, with significantly more events occurring in the acute hypertensive episode group compared to the nonhypertensive group (17.4% vs. 5.4%, $P = .012$). Ninety-day mortality was also higher in the acute hypertensive episode group, but this finding was not significant (7.2% vs. 1.1%, $P = .084$). Obvious limitations of this study include the small sample size, single-center, retrospective design, and most importantly, the lack of control for confounding variables. Despite these limitations, this study is the first to suggest an increased risk for in-hospital morbidity with an acute hypertensive episode. More data are needed to understand the risks associated with acute severe hypertension in the hospitalized patient, in particular for those that are asymptomatic.

Benefits and Risks of Acute Blood Pressure Lowering

In addition to the lack of data on the risks of severe asymptomatic hypertension, no studies have demonstrated a benefit from acute BP lowering, even in patients with hypertensive emergency.³ A meta-analysis was conducted with the objective to find and quantify the randomized controlled trial evidence for antihypertensive drug treatment of patients with hypertensive emergency.²⁷ Fifteen trials were included in the analysis. Most of the trials were small, and all but one were open label and considered to be of poor quality. None of the studies were powered to show a difference in clinical outcomes. The authors concluded that there was no evidence from randomized controlled trials that antihypertensive drugs reduce morbidity or mortality in patients with hypertensive emergencies.

Table 2Correctable causes for severe asymptomatic hypertension in the hospitalized patient^{7,10,18}

Cause	Management
History of poorly controlled blood pressure prior to admission	Consider intensifying home antihypertensive regimen
History of untreated severe hypertension prior to admission	Consider starting a long-term antihypertensive regimen per national guidelines
Home antihypertensive medications held or doses reduced on admission	Reinstitute home antihypertensive regimen (in particular beta-blockers or clonidine that can cause rebound hypertension when abruptly stopped).
Home antihypertensive medications stopped by patient prior to admission	Investigate reason(s) why medications were stopped (nonadherence)
Inadequately controlled pain	Address better pain management
Fluid overload	Address underlying cause of fluid overload; avoid NSAID use and medications high in sodium content; consider short-term, low-dose loop diuretic
Institution of an NSAID, systemic corticosteroids, or other medication associated with hypertension (See Table 1)	Consider alternate therapy if possible
Stress/anxiety related to illness/hospitalization	Consider instituting nonpharmacological measure to help relieve stress/anxiety
Withdrawal from illicit drugs (eg, cocaine, amphetamines) and alcohol	Check urine toxicology screen; consider instituting CIWA for alcohol withdrawal

CIWA, the Clinical Institute Withdrawal Assessment for Alcohol; NSAID, nonsteroidal anti-inflammatory drug.

In addition to the scarcity of data on the benefits of acute BP lowering in the hospital setting, safety data are also deficient in the literature. Several articles mention risks associated with acute BP lowering; however, the data for harm come mostly from studies that used immediate release nifedipine as a BP-lowering agent.^{28,29} There is a theoretical basis for the increased risk for harm especially in the elderly or patients with prolonged elevations in BP. Over time, changes can occur to the autoregulatory curve such that higher systemic pressure is needed to maintain perfusion to critical organs. If the BP is lowered too rapidly and BP drops below the level at which adequate tissue perfusion can be maintained by autoregulation, kidney, cerebral, or myocardial ischemia may occur.^{5,9,10} Because of this, references recommend slowly lowering BP over hours in most patients with hypertensive emergency and hours to days in patients with hypertensive urgency.^{5,9,21,30} There are no recommended BP-lowering time frames for patients with severe uncontrolled hypertension. More data are needed on the safety of acute BP lowering in the hospitalized setting.

Clinical Guidance on the Management of Severe Asymptomatic Hypertension in the Hospitalized Patient

There is a paucity of data and clinical guidance on the management of severe asymptomatic hypertension in the hospitalized patient. Pak et al³¹ conducted a systematic literature search to identify guidelines for the acute management of hypertension. Only three guidelines, published between January 1, 2003, and June 15, 2014, were identified that discussed the management of severe hypertension in adults. The Seventh Report of the Joint National

Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure National Heart, Lung, and Blood Institute provided some specific guidance for BP reduction goals and parenteral antihypertensive options in hypertensive emergencies.²⁰ However, for hypertensive urgencies, the guidelines were vague stating that “the term ‘urgency’ has led to overly aggressive management of many patients with severe, uncomplicated hypertension” and that “patients with BPs \geq 180/110 mm Hg should be evaluated and treated immediately or within 1 week depending on the clinical situation and complications.” The updated 2014 report from the Eighth Joint National Committee does not address hypertensive emergency or urgency.²³

The American College of Emergency Physicians Clinical Policy 2013: Critical Issues in the Evaluation and Management of Adult Patients in the Emergency Department with Asymptomatic Elevated Blood Pressure addressed the critical issue of whether ED medical intervention of asymptomatic elevated BP reduced rates of adverse outcomes.³² There were three consensus-based patient management recommendations related to this issue: (1) in patients with asymptomatic markedly elevated BP (defined as \geq 160 mm Hg systolic or 100 mm Hg diastolic), routine ED medical intervention is not required; (2) in select patient populations (eg, poor follow-up), emergency physicians may treat markedly elevated BP in the ED and/or initiate therapy for long-term control; (3) patients with asymptomatic markedly elevated BP should be referred for outpatient follow-up. No recommendations for choice of therapy are given.

The European Society of Hypertension/European Society of Cardiology Guidelines for the Management of Arterial

Hypertension contains a section on hypertensive emergencies and urgencies.⁶ Limited guidance is given regarding the management of hypertensive emergency. With regards to hypertensive urgency, the guidelines only state that “Isolated large BP elevations without acute organ damage are often associated with treatment discontinuation or reduction as well as with anxiety. It should not be considered an emergency but treated by reinstitution or intensification of drug therapy and treatment of anxiety.” No other recommendations are provided.

As-Needed IV Antihypertensive Medication for the Management of Severe Asymptomatic Hypertension

While detailed guidance on the management of severe hypertension is lacking, guidelines do support a less aggressive approach to the management of patients with severe asymptomatic hypertension. Despite this, there are several studies that demonstrate the unnecessary use of intravenous (IV), as-needed (PRN), antihypertensive medication for the management of severe asymptomatic hypertension in the hospitalized patient.^{16,17,33,34}

The first was a single-center observational study that evaluated patients admitted to acute care surgery and orthopedic surgery services that had received IV PRN antihypertensive medication (hydralazine, labetalol, and/or metoprolol).¹⁶ Over the 4-month observation period, 10.6% of patients (114 out of 1071) admitted to these services had received a total of 522 PRN antihypertensive administrations. It was unknown if patients had symptoms at the time of medication administration. The most common antihypertensive medications used were labetalol (60%) and hydralazine (28%). Seventeen percent of patients received medication for a SBP between 140 and 159 mm Hg, 46% for a SBP between 160 and 179 mm Hg, and 21% for a SBP >180 mm Hg. A small portion of drug doses were associated with over treatment defined as a SBP <90 mm Hg (two drug administrations) or a heart rate <60 beats/min (10 drug administrations). Approximately 45% of the patients who received an antihypertensive administration did not have a history of hypertension. Of these patients, only 13.3% received a diagnosis of hypertension on discharge. Twenty-four percent of the patients with a diagnosis of hypertension prior to admission were not continued on their home medications and only received PRN antihypertensive medication during the hospital stay.

The second study was descriptive and evaluated the use of as-needed to PRN IV hydralazine and labetalol in all patients admitted to the University of Michigan Hospital during a one-year time period.¹⁷ During the study, 7.4% of all adult admission (2189 patients) received an order for a PRN IV antihypertensive medication. For 39.7% of these patients, the medications were never given. Of the patients

who received drug, 31.2% received at least one dose of both hydralazine and labetalol, 44% received at least one dose of hydralazine only, and 24.7% received at least one dose of labetalol only. Of the 2189 patients, only 64 (2.9%) had diseases for which aggressive BP-lowering therapy would be indicated (ie, hypertensive emergency). Length of hospital stay was longer in patients in whom IV antihypertensive medication was administered compared to those in whom it was ordered, but not administered (12 ± 15.9 days vs. 7.1 ± 9.1 days).

The third retrospective study evaluated the prescribing and use of episodic IV antihypertensive agents over a 3-month time period in noncritically ill patients without evidence of a hypertensive emergency that were admitted to an urban academic hospital.³⁴ During the study period, 246 patients met the inclusion/exclusion criteria and had at least one order for an IV antihypertensive agent. Seventy percent of these patients received at least one dose of an IV antihypertensive. Hydralazine was the most commonly prescribed IV antihypertensive agent at 80% followed by labetalol at 15.6% and metoprolol at 4.4%. Fifty-six percent of orders contained defined BP criteria for administration with 84.5% of these having a SBP threshold for administration that was <180 mm Hg. Only 52% of patients had their inpatient oral antihypertensive regimen intensified after receiving a dose of an IV antihypertensive. Patients who had their oral antihypertensive regimen intensified after receiving an IV antihypertensive had a significantly greater reduction in their BP from admission to discharge. Overall, 32.6% of patients experienced a >25% reduction in BP within 6 hours of receiving an IV antihypertensive, which could have put them at an increased risk for target organ ischemia.

The fourth study was a prospective observational study of patients admitted to medical and surgical nonintensive care floors of a University Teaching Hospital that received at least one dose of IV hydralazine.³³ During the 7-month study period, a total of 201 doses of IV hydralazine were administered to 94 patients. The majority of patients had a previous history of hypertension (89.4%), and four patients (2%) had a probable hypertensive emergency. Approximately half of the doses were one-time stat doses, and half were ordered on the night shift (between 11 PM and 7 AM). Only 7.5% of patients were evaluated by a physician prior to, and 18% were evaluated by a physician after receiving IV hydralazine. The mean BP before drug administration was $175/82 \pm 25/16$ mm Hg. Changes to baseline antihypertensive regimens occurred in 25% of the patients within 24 hours after hydralazine administration. Eight percent of doses resulted in adverse events, the majority of which were hypotension and dizziness/lightheadedness.

There are several important findings of these studies. IV antihypertensive drugs are frequently ordered and administered to patients with acute elevations in BP that do not meet the BP threshold for severe hypertension and do not

have evidence of hypertensive emergency. Patients who receive IV antihypertensive medication during hospitalization also frequently do not have adjustments made to their home antihypertensive regimens. Adverse events, while rarely reported, were not negligible or inconsequential. There were also several limitations worth noting. There was possible underreporting of adverse events as well as other documentation errors because all the studies were observational or retrospective. All the studies were single center, and the results may not represent practices at other hospitals. None of the discussed studies compared the clinical benefits and risks of acute antihypertensive therapy versus no therapy in patients with severe asymptomatic hypertension.

Management Strategies

The routine use of PRN antihypertensive medication for the management of patients with severe asymptomatic hypertension is not appropriate. There are no data to support a need for a rapid reduction in BP in the majority of these patients, and there is the potential for adverse consequences if BP is reduced too rapidly. As-needed medication administration based only on a BP cutoff may not allow for appropriate assessment of the presence of or risk for end-organ damage and does not address the BP issue long term. Figures 1–3 describe the approach to determining the type of severe hypertension and discuss the management of hospitalized patients with severe uncontrolled hypertension.

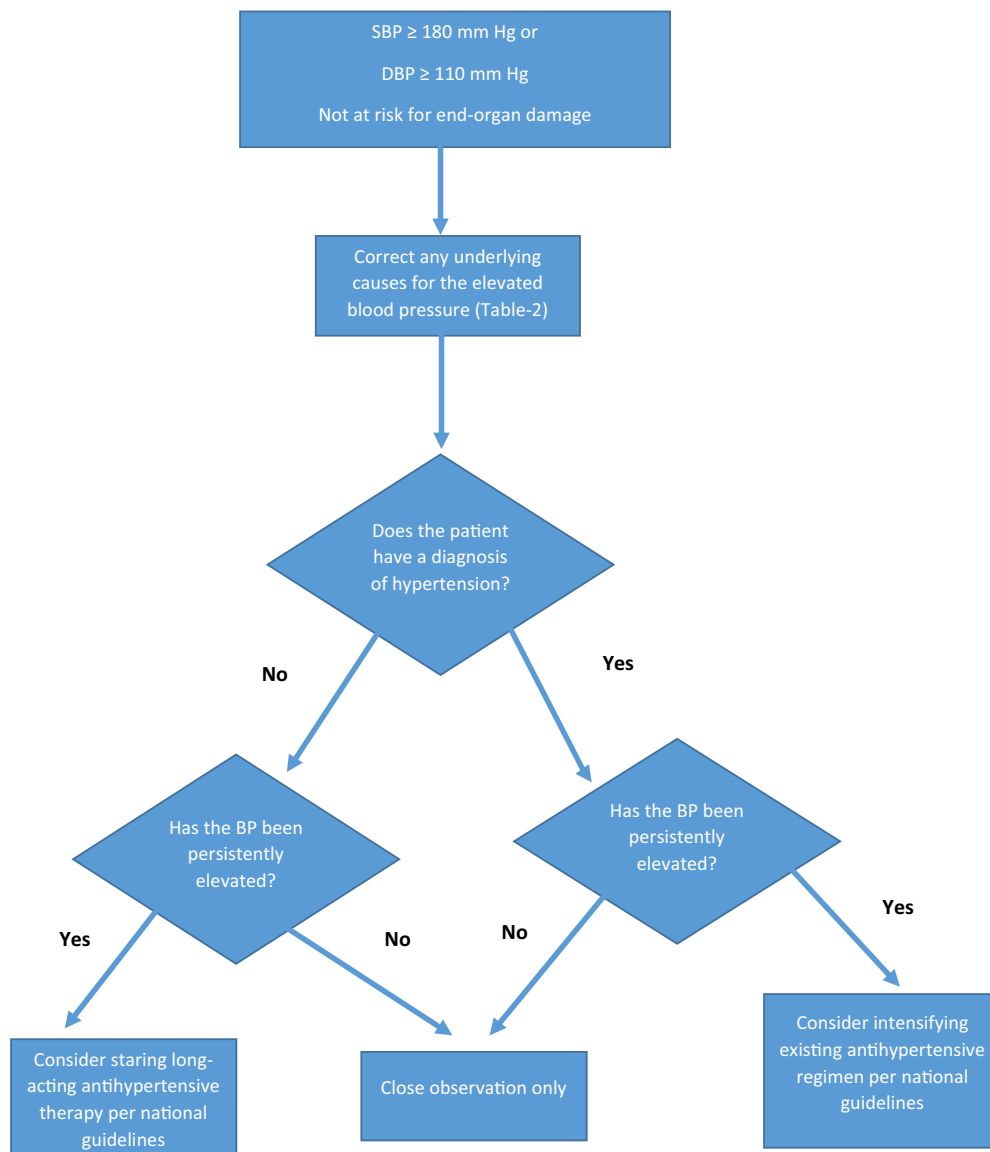


Figure 2. Management of severe uncontrolled hypertension. BP, blood pressure; DBP, diastolic blood pressure; SBP, systolic blood pressure.

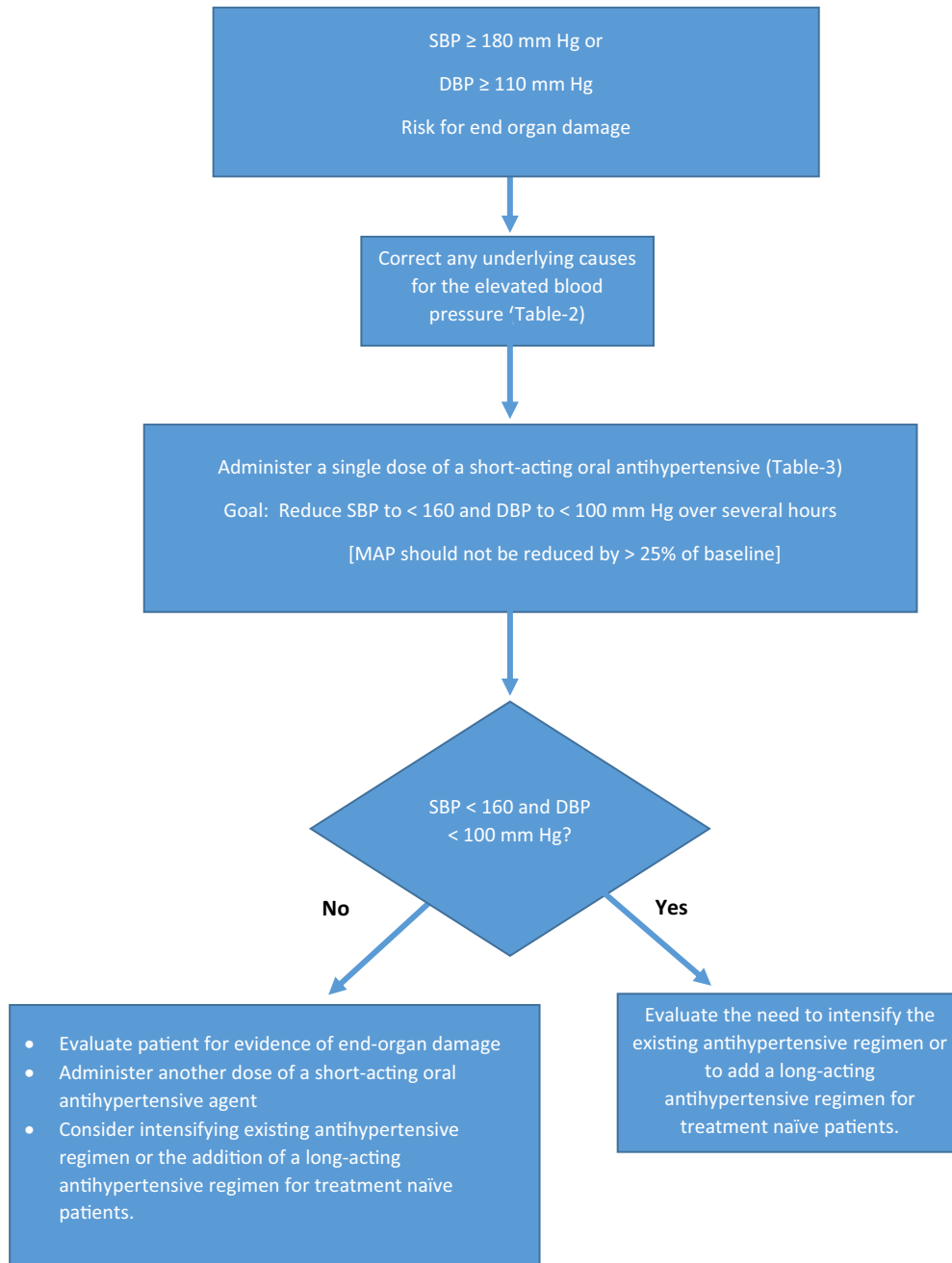


Figure 3. Management of hypertensive urgency. DBP, diastolic blood pressure; MAP, mean arterial pressure; SBP, systolic blood pressure.

hypertension and hypertensive urgency. The first step in Figure 1 is to confirm the presence of severe hypertension by verifying that the SBP is ≥ 180 mm Hg or the DBP is ≥ 110 mm Hg in both arms. If a difference in readings between arms is more than 20 mmHg, then the BP should be repeated. If the difference remains on the second measurement, then subsequent BPs should be measured in the arm with the higher reading.^{35,36} BP elevations below these values may still warrant treatment, but they do not meet the

threshold for severe hypertension. Second, verify the absence of end-organ damage. If end-organ damage is present, then the patient should be treated for hypertensive emergency. Management of hypertensive emergency is out of the scope of this article, and the reader is referred to the following article.⁵ If the patient does not have evidence of end-organ damage, then they have severe asymptomatic hypertension. The third step is to check if the patient is at risk for end-organ damage (eg, history of

congestive heart failure, stroke). If the patient does not have risks for end-organ damage, they are considered to have severe uncontrolled hypertension. Management options for these patients are summarized in Figure 2. If the patient is at risk for end-organ damage, they are considered to have hypertensive urgency. The management options for these patients are summarized in Figure 3.

Figure 2 describes the management of hospitalized patients with severe uncontrolled hypertension. After correcting any underlying causes for the uncontrolled BP, consideration should be given to increasing the dose of existing antihypertensive medication, adding on additional antihypertensive medication or instituting a new antihypertensive regimen in treatment naïve patients with persistently elevated BP.^{23,35} In this patient population, the goal would be to reduce BP to <160 mm Hg SBP and <100 mm Hg DBP over several days. Some patients may need more rapid BP lowering in selected circumstances such as prior to kidney biopsy.³⁷

Figure 3 describes the management of hospitalized patients with hypertensive urgency. In these patients, the goal would be to lower BP to <160 mm Hg SBP and <100 mm Hg DBP over several hours. The mean arterial pressure should not be reduced by more than 25% baseline to reduce the risk for target end-organ ischemia.^{20,38} Single doses of short-acting oral antihypertensive are best to achieve this reduction. The best agents are labetalol, captopril, or clonidine (Table 3). A loop diuretic, such as furosemide, can be used if significant edema is present. Hydralazine, while frequently used, is not recommended by several resources due to unpredictable BP lowering and the risk for reflex tachycardia.^{40–42} Oral hydralazine in particular can be problematic due to variability in the first pass elimination with slow and fast acetylators.⁴⁰ Immediate release nifedipine should never be used to

acutely lower BP due to reports of increased risk for stroke and myocardial infarction.^{29,42–45} As previously discussed, PRN BP medications are not appropriate as they do nothing to correct the long-term problem and they do not allow for proper assessment of the patient between doses.

In hospitalized patients with severe asymptomatic hypertension, correctable causes need to be investigated and addressed (Table 2). First, it is important to determine the patient's hypertension history. If the patient does not have a documented diagnosis of hypertension, this could represent undiagnosed hypertension. Institution of a long-term antihypertensive regimen per national guidelines should be considered. Second, determine if there is any information about BP control and medication adherence prior to admission. The patient's severely increased BP could represent uncontrolled baseline BP or nonadherence. Management would include education, assessment of barriers to medication adherence, and possible long-term changes to the patient's home antihypertensive regimen. Third, determine if any of the patient's home medications were discontinued or doses were reduced on admission to the hospital. If so, then reinstitution of the previous medications or dosing should be considered. Fourth, investigate possible reasons for the acute elevation in BP such as inadequately controlled pain, fluid overload, or the institution of medications that can contribute to BP elevation. Correcting a potential underlying cause for the elevated BP is essential for effective management.

Discharge of the Patient With Severe Asymptomatic Hypertension While Hospitalized

Problems exist not only with the inpatient management of severe hypertension, but also the subsequent management of these patients on discharge from the hospital. In

Table 3

Short-acting oral antihypertensive agents for hypertensive urgency^{10,39}

Drug	MOA	Typical Oral Dose	Onset (O) Peak (P) Duration (D)	Cautions
Labetalol	α 1-blocker + nonselective β -blocker	200 mg	O: 20 min–2 hr P: 2–4 hr D: 8–12 hr	Avoid in second- or third-degree heart block, severe bradycardia, severe bronchospastic disease, or compensated HF
Clonidine	Centrally acting, α 2-agonist	0.1–0.2 mg	O: 30–60 min P: 2–4 hr D: 3–12 hr	Side effects: dry mouth, constipation, sedation, orthostatic hypotension, confusion
Captopril	ACE inhibitor	6.25–25 mg	O: 15–30 min P: 60–90 min D: 6 hr	Impaired kidney function, elevated serum potassium
Hydralazine	Direct arterial vasodilator	10–25 mg	O: 20–30 min P: 3–8 hr D: 3–8 hr	Not recommended due to unpredictable response and risk for reflex tachycardia. ^{40–42} Can worsen angina and possibly lead to acute MI

ACE, angiotensin-converting enzyme; HF, heart failure; MI, myocardial infarction; MOA, mechanism of action.

the previously discussed systematic review by Axon et al.² three studies reported that 37–77% of inpatients with hypertension still had BPs >140/90 mm Hg at the time of discharge, and in one study, 50% were uncontrolled at 6-month follow-up. According to four of the studies, 8–44% of patients were discharged without a documented diagnosis of hypertension, and in one study, only 53% of patients with uncontrolled BP received intensification of therapy on discharge. Due to the low number and poor quality of the studies included in this review, conclusions should be cautiously drawn. However, this review indicates improvements could possibly be made in the discharge management of patients who experience hypertension while hospitalized.

Not all patients who experience severe asymptomatic hypertension while hospitalized will need intensification of their therapy on discharge. In a prospective observational study of 106 hospitalized older adults (mean age = 80.1 ± 7.7 years) with hypertension on stable antihypertensive regimens, significant decreases in BP were noted from admission to discharge and at home 7 days after discharge.⁴⁶ More patients had well-controlled BP at home compared to at the time of discharge (70.8% vs. 52.8%, $P < .001$). This study suggests that BP elevations during hospitalization, especially in older patients with hypertension, may be transient and can possibly improve after discharge.

Patients with persistent asymptomatic elevations in BP during hospitalization may warrant intensification of their home antihypertensive regimen or institution of long-term antihypertensive medication(s) if treatment naïve. In patients without an established primary care provider prior to admission, these changes can be made by the inpatient care team with recommended follow-up with a new provider within 1–2 weeks after discharge. For patients with an established primary care provider, changes to antihypertensive regimens can be deferred to the outpatient with follow-up within 1 week of discharge. The discharge summaries for these patients should clearly document the persistent BP elevations during hospitalization. In patients without persistent elevations in BP during hospitalization or in the elderly, repeat BP monitoring within 1–2 weeks after discharge may be warranted prior to making changes to home antihypertensive regimens.

Hypertension is common in the hospital setting, but the true incidence of severe asymptomatic hypertension is unknown. No studies have evaluated the benefits and the risks of treating severe asymptomatic hypertension in the hospitalized setting. In general, existing guidelines support less aggressive management of these patients to a goal SBP <160 mm Hg and DBP <100 mm Hg over hours to days. Short-acting, single doses of oral antihypertensive agents or changes to long-acting oral medications are sufficient to achieve these BP goals. However, IV antihypertensive medications are frequently

prescribed, exposing patients to risks associated with IV therapy and too rapid BP lowering. Evidence and guidance for the management of severe asymptomatic hypertension in hospitalized patients is desperately needed to ensure optimal outcomes.

References

1. Conen D, Martina B, Perruchoud AP, Leimenstoll BM. High prevalence of newly detected hypertension in hospitalized patients: the value of in-hospital 24-h blood pressure measurement. *J Hypertens* 2006;24:301–6.
2. Axon RN, Cousineau L, Egan BM. Prevalence and management of hypertension in the inpatient setting: a systematic review. *J Hosp Med* 2011;6:417–22.
3. Weder AB. Treating acute hypertension in the hospital: a Lacuna in the guidelines. *Hypertension* 2011;57:18–20.
4. Cherney D, Straus S. Management of patients with hypertensive urgencies and emergencies: a systematic review of the literature. *J Gen Intern Med* 2002;17:937–45.
5. Muiesan ML, Salvetti M, Amadoro V, di Somma S, Perlini S, Semplicini A, et al. An update on hypertensive emergencies and urgencies. *J Cardiovasc Med (Hagerstown)* 2015;16:372–82.
6. Mancia G, Fagard R, Narkiewicz K, Redon J, Zanchetti A, Böhm M, et al. 2013 ESH/ESC guidelines for the management of arterial hypertension: the Task Force for the Management of Arterial Hypertension of the European Society of Hypertension (ESH) and of the European Society of Cardiology (ESC). *Eur Heart J* 2013;34:2159–219.
7. Kessler CS, Joudeh Y. Evaluation and treatment of severe asymptomatic hypertension. *Am Fam Physician* 2010;81:470–6.
8. Devlin JW, Dasta JF, Kleinschmidt K, Roberts RJ, Lapointe M, Varon J, et al. Patterns of antihypertensive treatment in patients with acute severe hypertension from a nonneurologic cause: Studying the Treatment of Acute Hypertension (STAT) registry. *Pharmacotherapy* 2010;30:1087–96.
9. Rodriguez MA, Kumar SK, De Caro M. Hypertensive crisis. *Cardiol Rev* 2010;18:102–7.
10. Shayne PH, Pitts SR. Severely increased blood pressure in the emergency department. *Ann Emerg Med* 2003;41:513–29.
11. Slovis CM, Reddi AS. Increased blood pressure without evidence of acute end organ damage. *Ann Emerg Med* 2008;51:S7–9.
12. Baumann BM, Cline DM, Pimenta E. Treatment of hypertension in the emergency department. *J Am Soc Hypertens* 2011;5:366–77.

13. Flanigan JS, Vitberg D. Hypertensive emergency and severe hypertension: what to treat, who to treat, and how to treat. *Med Clin North Am* 2006;90:439–51.
14. Shorr AF, Zilberberg MD, Sun X, Johannes RS, Gupta V, Tabak YP. Severe acute hypertension among inpatients admitted from the emergency department. *J Hosp Med* 2012;7:203–10.
15. Saguner AM, Dür S, Perrig M, Schiemann U, Stuck AE, Bürgi U, et al. Risk factors promoting hypertensive crises: evidence from a longitudinal study. *Am J Hypertens* 2010;23:775–80.
16. Miller CP, Cook AM, Case CD, Bernard AC. As-needed antihypertensive therapy in surgical patients, why and how: challenging a paradigm. *Am Surg* 2012;78:250–3.
17. Weder AB, Erickson S. Treatment of hypertension in the inpatient setting: use of intravenous labetalol and hydralazine. *J Clin Hypertens (Greenwich)* 2010;12:29–33.
18. Garbus SB, Weber MA, Priest RT, Brewer DD, Hubbell FA. The abrupt discontinuation of antihypertensive treatment. *J Clin Pharmacol* 1979;19:476–86.
19. Dieterle T, Schuurmans MM, Strobel W, Battegay EJ, Martina B. Moderate-to-severe blood pressure elevation at ED entry: hypertension or normotension? *Am J Emerg Med* 2005;23:474–9.
20. Chobanian AV, Bakris GL, Black HR, Cushman WC, Green LA, Izzo JL, et al. Seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. *Hypertension* 2003;42:1206–52.
21. Johnson W, Nguyen ML, Patel R. Hypertension crisis in the emergency department. *Cardiol Clin* 2012;30:533–43.
22. Grossman E, Messerli FH. Drug-induced hypertension: an unappreciated cause of secondary hypertension. *Am J Med* 2012;125:14–22.
23. James PA, Oparil S, Carter BL, Cushman WC, Dennison-Himmelfarb C, Handler J, et al. 2014 evidence-based guideline for the management of high blood pressure in adults: report from the panel members appointed to the Eighth Joint National Committee (JNC 8). *JAMA* 2014;311:507–20.
24. Ninomiya T, Perkovic V, Turnbull F, Neal B, Barzi F, Cass A, et al. Blood pressure lowering and major cardiovascular events in people with and without chronic kidney disease: meta-analysis of randomised controlled trials. *BMJ* 2013;347:f5680.
25. Merlo C, Bally K, Tschudi P, Martina B, Zeller A. Management and outcome of severely elevated blood pressure in primary care: a prospective observational study. *Swiss Med Wkly* 2012;142:w13507.
26. Saliba L, Stawicki SP, Thongrong C, Bergese SD, Papadimos TJ, Gerlach AT. Association between in-hospital acute hypertensive episodes and outcomes in older trauma patients. *Intern Emerg Med* 2014;9:553–8.
27. Perez MI, Musini VM. Pharmacological interventions for hypertensive emergencies: a Cochrane systematic review. *J Hum Hypertens* 2008;22:596–607.
28. Yanturali S, Akay S, Ayrik C, Cevik AA. Adverse events associated with aggressive treatment of increased blood pressure. *Int J Clin Pract* 2004;58:517–9.
29. O'Mailia JJ, Sander GE, Giles TD. Nifedipine-associated myocardial ischemia or infarction in the treatment of hypertensive urgencies. *Ann Intern Med* 1987;107:185–6.
30. Acelajado MC, Calhoun DA. Resistant hypertension, secondary hypertension, and hypertensive crises: diagnostic evaluation and treatment. *Cardiol Clin* 2010;28:639–54.
31. Pak KJ, Hu T, Fee C, Wang R, Smith M, Bazzano LA. Acute hypertension: a systematic review and appraisal of guidelines. *Ochsner J* 2014;14:655–63.
32. Wolf SJ, Lo B, Shih RD, Smith MD, Fesmire FM. Committee ACoEPCP. Clinical policy: critical issues in the evaluation and management of adult patients in the emergency department with asymptomatic elevated blood pressure. *Ann Emerg Med* 2013;62:59–68.
33. Campbell P, Baker WL, Bendel SD, White WB. Intravenous hydralazine for blood pressure management in the hospitalized patient: its use is often unjustified. *J Am Soc Hypertens* 2011;5:473–7.
34. Lipari M, Moser LR, Petrovitch EA, Farber M, Flack JM. As-needed intravenous antihypertensive therapy and blood pressure control. *J Hosp Med* 2016;11:193–8.
35. Weber MA, Schiffrin EL, White WB, Mann S, Lindholm LH, Kenerson JG, et al. Clinical practice guidelines for the management of hypertension in the community a statement by the American Society of Hypertension and the International Society of Hypertension. *J Hypertens* 2014;32:3–15.
36. Martin U, Holder R, Hodgkinson J, McManus R. Inter-arm blood pressure differences compared with ambulatory monitoring: a manifestation of the 'white-coat' effect? *Br J Gen Pract* 2013;63:e97–103.
37. Torres Muñoz A, Valdez-Ortiz R, González-Parra C, Espinoza-Dávila E, Morales-Buenrostro LE, Correa-Rotter R. Percutaneous renal biopsy of native kidneys: efficiency, safety and risk factors associated with major complications. *Arch Med Sci* 2011;7:823–31.
38. Zeller KR, Von Kuhnert L, Matthews C. Rapid reduction of severe asymptomatic hypertension. A prospective, controlled trial. *Arch Intern Med* 1989;149:2186–9.
39. DRUGDEX® System (electronic version). Truven Health Analytics, Greenwood Village, Colorado,

- USA. Available at: <http://www.micromedexsolutions.com/>. Accessed October 06, 2016.
40. Shepherd AM, McNay JL, Ludden TM, Lin MS, Musgrave GE. Plasma concentration and acetylator phenotype determine response to oral hydralazine. *Hypertension* 1981;3:580–5.
 41. Ludden TM, McNay JL, Shepherd AM, Lin MS. Clinical pharmacokinetics of hydralazine. *Clin Pharmacokinet* 1982;7:185–205.
 42. Varon J. Treatment of acute severe hypertension: current and newer agents. *Drugs* 2008;68:283–97.
 43. Jung SY, Choi NK, Kim JY, Chang Y, Song HJ, Lee J, et al. Short-acting nifedipine and risk of stroke in elderly hypertensive patients. *Neurology* 2011;77:1229–34.
 44. Semplicini A, Pessina AC. Nifedipine for hypertensive emergencies. *JAMA* 1997;277:787–8. author reply 90–91.
 45. Grossman E, Messerli FH, Grodzicki T, Kowey P. Should a moratorium be placed on sublingual nifedipine capsules given for hypertensive emergencies and pseudoemergencies? *JAMA* 1996;276:1328–31.
 46. Astengo M, Bonetto M, Isaia G, Comba M, Fonte G, Bo M. Blood pressure variations after hospital discharge in older adults with hypertension. *J Am Geriatr Soc* 2010;58:1406–7.