



# Management of Acute Hypertension in Cerebrovascular Accidents

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## Abstract

Cerebrovascular Accidents (CVA) are commonly associated with acute rise in Blood Pressure (BP). This rise in BP is associated with worse outcomes. However, reduction to the normal range is not simply the solution, because elevated pressure may be necessary and protective to maintain the cerebral perfusion. Efforts have been made to determine the target BP in different CVAs, and the appropriate regimen to achieve the best outcomes. Determination of the type of CVA by neuroimaging is crucial and guides further management. Blood pressure control in hemorrhagic CVA should be rapid, while, in ischemic CVA, is usually more insidious.

**Keywords:** Acute ischemic stroke; Hemorrhagic stroke; Cerebrovascular accident; Hypertension; Hypertensive encephalopathy; Labetalol; Nicardipine

## Introduction

Hypertension (HTN) is one of the most common prevalent diseases in the World [1]. According to the American Heart Association 2018 statistical update, around 86 million Americans aged >20 years have high blood pressure [2]. Chronic HTN remains the main risk factor for a Cerebrovascular Accident (CVA), both ischemic and hemorrhagic [3]. The brain is also extremely liable to acute changes in Blood Pressure (BP) and is the most common organ injured in hypertensive emergencies [4].

Cerebrovascular accidents remain one of the leading causes of high mortality in the United States, responsible for death of over 140,000 Americans per year, which represent 1 out of every 20 deaths [5]. It is also a leading cause of significant long-term disability [6]. In 2011, about 19% of Medicare patients with CVA were discharged to inpatient rehabilitation facilities; 25% were discharged to skilled nursing facilities; and 12% received home health care [2]. The estimated cost of CVAs in the United States alone, including the cost of health care services, medications, and missed days of work, is \$34 billion each year [7].

Over fifty percent of patients admitted *via* the Emergency Department (ED) with a diagnosis of CVA, have increased BP [8]. Controlling BP in patients with acute CVAs represents a major clinical challenge, as it requires a delicate balance to minimize the damaging effects of hypertension without brain hypoperfusion.

## Pathophysiology

Acute HTN can be a response, or a cause of a CVA [9,10]. The sudden elevation of BP can rupture the Charcot-Bouchard micro aneurysms, formed by lipohyalinosis of small arterioles due to chronic HTN [11]. On the other hand, CVAs may involve transient or permanent damage to the areas involved in the brain regulation of cardiovascular functioning, such as BP, Heart Rate (HR), through direct injury, or through Increased Intracranial Pressure (ICP) [8]. Such injuries involve the sympathetic and parasympathetic systems and dysregulate BP control [12].

## Clinical Evaluation

The clinical presentation of CVAs is quite variable depending on the etiology and the area of the brain involved [13,14]. Hemorrhagic CVAs have more acute onset of symptoms than ischemic CVAs and are usually associated with signs and symptoms of ICP such as acute onset of headache, nausea, and vomiting, and may be loss of consciousness [15]. In contrast, ischemic CVAs usually have more insidious onset, and classically present with neurological deficits, without other symptoms after awakening in the morning [15-17].

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Neuroimaging studies with Computed Tomography (CT) or Magnetic Resonance Imaging (MRI) are critical to assess patients with acute CVAs [18,19]. The American College of Radiology recommends a non-contrast CT, as the initial modality of choice in suspected CVAs, to confirm the diagnosis, subtype localization, and to make sure there is no hemorrhage involved [20]. Computed tomography is a rapid, and widely available, imaging modality with high sensitivity to exclude the presence of acute hemorrhage or other intracranial pathologies that can mimic an acute ischemic stroke such as a tumor [10,21]. Non-contrast CT has also a high sensitivity (85%) in acute ischemic CVAs, but only 48 hours after the inciting event, while its sensitivity is only 32% in the first 12 hours [22]. On the other hand, MRI can show increased signal in diffusion-weighted imaging just few minutes after the vascular occlusion [23].

Clinicians should have in their mind that hypertensive encephalopathy can have similar presentation to CVAs [24]. However, neurological symptoms due to hypertensive encephalopathy (e.g., headache, confusion) most of the time resolve once HTN is resolved [25]. In fact, hypertensive encephalopathy is most often a diagnosis of exclusion, confirmed retrospectively, when the mental status improves after control of BP [26].

### Management

The management of blood pressure in acute ischemic CVA is different from the approach in acute hemorrhagic CVA, and differentiation between them by neuroimaging is crucial [27]. After recognition of the type of CVA, there are 3 main questions that will generally direct the management of the patient. What is the target BP? How rapidly should the target BP be achieved? What medications that can be used safely?

### Ischemic CVA

In Acute Ischemic Stroke (AIS), the elevation of BP can be secondary to chronic HTN or a sympathetic response to ensure adequate cerebral perfusion [28]. One of the important observations from different studies is that there is a “U” shaped relationship between AIS and BP, and there is a higher risk of recurrence with SBP >200 mmHg AIS and BP, and there is a higher mortality rate with SBP<120 mmHg [29,30].

The decision to treat hypertension in AIS or not, depends mainly on whether the patient is a candidate for thrombolysis or not [31]. A large observational study of 11,080 patients with AIS treated with intravenous thrombolytic, showed strong association between high SBP after thrombolytic and poor outcomes [32]. Current guidelines recommend lowering blood pressure to <185/110 mmHg before initiation of thrombolytic, and maintaining it below that level for at least 24 hours after administration [33]. Otherwise, thrombolytic therapy is contraindicated as the risks outweigh the benefits [34].

In patients who are not candidates for thrombolytic agents, antihypertensive should be avoided, unless BP is higher than 220/120 mmHg or the patient has another co morbidities, such as aortic dissections, or severe heart failure that mandate emergent BP reduction [33,35].

The best agent to use in these cases remains elusive. Agents such as Labetalol, Nicardipine, and clevidipine are good options [36]. These agents have proved their efficacy and safety [37]. Sodium nitroprusside, although a potent vasodilator, should be avoided due to special concern of raising ICP and decreasing cerebral blood flow,

among other significant side effects [24].

### Hemorrhagic CVA

Systolic Blood Pressure (SBP) has been suggested as the main “player” in intracranial hematoma growth/expansion [38]. The ATACH and INTERACT clinical trials showed that rapid and aggressive reduction of SBP to less than 140 mmHg within 3 hours to 6 hours after initiation of symptoms is both safe and feasible [38,39]. However, these clinical trials didn't show improvement in mortality or major morbidity with this aggressive regimen over the conventional recommendation (keep SBP <180 mmHg) [40,41]. Some authors suggest that the diffusion reduction noted on MRIs after rapid reduction of BP needs to be considered, and can explain the lack of improvement in mortality rates, with aggressive BP control regimens [42]. Nevertheless, the current American Heart Association/American Stroke Association guidelines recommend rapid aggressive control of SBP <140 mmHg (mainly due to evidence from the INTERACT2 trial, showing better functional recovery among the survivors) [41,43].

Currently, no specific anti-hypertensive agent is considered universally superior in these clinical settings [44]. In the STAT registry, Labetalol and Nicardipine were among the most widely used agents [45]. Both agents were found to be safe and effective [46,47]. The CLUE trial, however, showed that Nicardipine achieved target SBP more rapidly than Labetalol [48].

### Conclusion

The control of BP in CVAs is inherently different between hemorrhagic and ischemic CVAs due to the different nature of each one. Determination of the type of CVA early in the management is extremely important. Rapid reduction of SBP to <140 mmHg is recommended in hemorrhagic CVAs, while, more insidious approach is recommended for ischemic types.

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