

## Clinical overview of hypertensive crisis in children

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### Abstract

Hypertensive emergencies and hypertensive urgencies in children are uncommonly encountered in the pediatric emergency department and intensive care units, but the diseases are potentially a life-threatening medical emergency. In comparison with adults, hypertension in children is mostly asymptomatic and most have no history of hypertension. Additionally, measuring accurate blood pressure values in younger children is not easy. This article reviews current concepts in pediatric patients with severe hypertension.

**Key words:** Hypertensive crisis; Hypertensive urgency; Hypertensive emergency; Blood pressure

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**Core tip:** Hypertensive crisis in children is a disease easily mismanaged in the emergency department. The physician should carefully search for evidence of end organ injury to distinguish between hypertensive emergency and hypertensive urgency. Only patients with hypertensive emergency require immediate reduction in markedly elevated blood pressure to prevent and arrest progressive end organ damage. In all other patients, the elevated blood pressure can be lowered slowly using oral agents, *i.e.*, esmolol, nicardipine, labetalol and fenoldopam. All young children should receive complete examinations to look for the underlying cause of secondary hypertension.

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## DEFINITIONS OF HYPERTENSION IN CHILDREN: HYPERTENSIVE CRISIS AND HYPERTENSIVE ENCEPHALOPATHY

Hypertension in children older than 12 mo was defined as blood pressure (BP) level > 140/90 mmHg, as in adults, until the updated definition of "The fourth report on the diagnosis, evaluation and treatment of high blood pressure in children and adolescents" in 2004<sup>[1]</sup>. Hypertension is identified when the systolic BP (SBP) or diastolic BP (DBP) is greater than or equal to the 95<sup>th</sup> percentile for gender, age and height: stage 1 hypertension is SBP or DBP within the range of the 95<sup>th</sup> percentile to the 99<sup>th</sup> percentile plus 5 mmHg; stage 2 hypertension is greater than the 99<sup>th</sup> percentile plus 5 mmHg. Height and gender revealed no statistical difference from the previous study<sup>[2-4]</sup>.

Hypertensive crisis is defined as a severe elevation in BP, classified as hypertensive emergencies and hypertensive urgency<sup>[5]</sup>. Hypertensive encephalopathy is a hypertensive emergency and characterized by an abrupt or prolonged elevated BP that overcomes the autoregulatory capacity of the cerebral vasculature. It appears as severe hypertension associated with headache, altered mental status, seizure, visual disturbances or stroke, and the lesion may be revealed as reversible posterior leukoencephalopathy<sup>[6-11]</sup>.

## EPIDEMIOLOGY

Although the prevalence of hypertension tends to be increasing today, pediatric hypertension still accounts for about 0.5%-1% in children and its incidence is obviously less in younger children and infants<sup>[12,13]</sup>. Until now, data of the incidence of hypertensive crisis in children have not been analyzed enough to give a definite result, but in adults, approximately 1% of hypertensive individuals have been reported to have hypertensive crisis<sup>[14]</sup>.

## ETIOLOGY

Generally, primary hypertension is identifiable in children and adolescents, whereas secondary hypertension is more common in younger children. In primary hypertension, there is a strong association of high BP with being overweight and BMI should be calculated as part of physical examination, with the marked increase in the prevalence of overweight children.

In newborn infants with hypertension, the most likely definable causes are renal artery thrombosis or stenosis, congenital renal malformation, or coarctation of the aorta<sup>[15]</sup>. In children between infancy and 6 years of age, coarctation of the aorta, renal parenchymal diseases and renal artery stenosis are the three most common causes of secondary hypertension. In children older than 6 years, renal artery stenosis and renal parenchymal diseases are the leading causes of diastolic

BP over 90-100 mmHg. Primary hypertension accounts for 90% of the causes of hypertension in patients aged over 15 years<sup>[16-19]</sup>.

## PATHOPHYSIOLOGY

In the long term in children, high BP levels could be associated with the early development of cardiovascular changes<sup>[20]</sup>. In the acute phase of hypertensive crisis, rapid increases in systemic vascular resistance could be precipitated as a result of increases in the circulating vasoconstrictor substances, including norepinephrine, angiotensin II, or anti-natriuretic hormone<sup>[21]</sup>. Arteriolar fibrinoid necrosis may induce a consequence of the severely elevated BP, precipitating endothelial damage with resultant end organ ischemia. Ischemia could trigger the further release of vasoactive substances, causing further vasoconstriction and myointimal proliferation<sup>[21]</sup>. This may appear to be an important part<sup>[22]</sup>. Activation of the renin-angiotensin system could also be highly involved<sup>[23-25]</sup>.

## CLINICAL MANIFESTATIONS

Compared to adults, the clinical presentations of hypertensive crisis in children are more likely asymptomatic<sup>[26]</sup>. Our previous study reported that no specific clinical manifestation correlated with the age factor<sup>[27]</sup>. Patients with hypertensive crisis in different age groups did not have specific different clinical presentations in this study<sup>[27]</sup>. In addition, the signs of end organ dysfunction are hypertensive encephalopathy, acute left ventricular failure and acute myocardial ischemia, papilledema, elevated liver function tests, etc. For children with complaints of any symptoms such as persistent headache, nausea/vomiting and altered mental status, hypertensive crisis should be ruled out immediately to prevent further damage. According to some clinical analyses, the related risk factors for hypertensive encephalopathy were male gender, stage 2 hypertension and some clinical symptoms. In pediatric patients with hypertensive crisis caused by essential hypertension, symptoms of chest tightness and no family history of hypertension may show a lower risk for hypertensive encephalopathy<sup>[27]</sup>. Moreover, the recurrence was 29.1%<sup>[27]</sup>.

## EVALUATION

Detailed medical history taking and complete physical examinations are both required in children presenting with suspected hypertensive crisis. In laboratory tests, serum electrolytes, complete blood counts, blood urea nitrogen, creatinine and urinalysis should be considered for children with suspected hypertensive crisis. Chest radiograph and electrocardiogram may be also performed in patients with chest pain and tachypnea. A brain computed tomography scan may be needed in

hypertensive children with neurological signs<sup>[28]</sup>.

## MANAGEMENT

Pediatric patients with hypertensive crisis require immediate and appropriate reduction in BP levels, whereas patients with hypertensive urgency require a slower rate of reduction in BP levels over 24 to 48 h. However, rapidly decreasing BP levels may result in decreasing the blood flow of organs, causing ischemia and infarction<sup>[29-31]</sup>. In patients with hypertensive encephalopathy combined with chronic hypertension, it is important to reduce the mean arterial pressure gradually during the first hour<sup>[32]</sup>. Accordingly, patients with hypertensive emergency should be treated in an intensive care unit. The drugs of choice should depend on the end organs involved and the monitoring environment. Once the reductions in mean arterial pressure to less than 20% or to a DBP of 100 mmHg have been reached, oral maintenance therapy may be given instead of the intravenous agent. Another important part of BP control in hypertensive crisis is volume depletion. Adequate fluid replacement will restore organ perfusion.

The agent of choice should depend on the clinical presentation and the severity of the hypertensive crisis. The preferred agents include esmolol, labetalol, fenoldopam and nicardipine, but phentolamine and trimethaphan camsylate may be less commonly used today. Nevertheless, they appear to be useful in some particular situations, such as catecholamine-induced hypertensive crises, such as pheochromocytoma<sup>[33,34]</sup>. Sodium nitroprusside could be used in patients with acute pulmonary edema and/or severe left ventricular dysfunction and in patients with aortic dissection. However, this agent has some limitations for application in the pediatric ED because of the requirement of intra-arterial BP monitoring and protection from light<sup>[35]</sup>. Short-acting, immediate-release oral nifedipine and sublingual nifedipine have been used for effective reduction of severe elevated BP, but some studies cautioned against it as being potentially dangerous in patients with hypertensive crises. Clonidine and angiotensin-converting enzyme inhibitors are long acting and difficult to titrate, but these agents may be still useful in some clinical conditions<sup>[36]</sup>.

## CONCLUSION

Hypertensive crisis in children is a rare but important disease easily mismanaged in the ED. Pediatric patients with hypertensive emergencies need immediate reduction of BP levels to arrest further end organ damage. For patients with hypertensive urgency, BP may be lowered slowly.

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