

Original Research Article

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Study of clinical and etiological profile of hypertensive emergencies in children admitted in pediatric emergency department

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ABSTRACT

Background: Hypertension (HTN) in children, all though an uncommon entity is associated with end-organ damage. With increasing prevalence of hypertension and obesity in children; hypertensive emergencies are also increasing over recent years and screening is must. The primary objective of this study was to determine the incidence of hypertensive emergencies, the clinical presentation and etiological diagnosis at different age groups and to access the real burden of primary hypertension in causing hypertensive emergencies in children.

Methods: This study was a prospective, descriptive, analytical cohort study done on children attending the emergency department of pediatrics, government general hospital, a tertiary referral pediatric center attached to Kurnool medical college, Kurnool, over a period of 18 months i.e., from January 2016 to June 2017. Data was collected in a pre-determined proforma after institutional ethical committee clearance and appropriate informed concerned.

Results: Among 98 children with hypertension; 30 had hypertensive emergency. Incidence was 0.3%. Intrinsic renal and renal vascular causes were the commonest. Headache, dizziness and vomiting were the common presentation. Half of them had encephalopathy. Younger children had more of secondary HTN and in children (older than 7 years) primary hypertension increased as did family history of hypertension.

Conclusions: With increasing primary hypertension among older children, hypertensive emergencies are increasing. As most of the children with HTN are asymptomatic; detection of target organ damage is vital.

Keywords: Pediatric hypertension, Hypertensive emergencies, Incidence, Clinical presentation

INTRODUCTION

Pediatric hypertension is defined as the sustained elevation of either the systolic or diastolic blood pressure at or above the 95th percentile BP for a child's age, sex and height percentile. The severity of the elevation will dictate how many measurements are needed prior to diagnosis and work up.¹ In 2004, pediatrics published updated sex-, age-and height percentile-specific 50th, 90th, 95th and 99th percentile systolic and diastolic BPs for children aged 1 to 17 years and is used to classify children with hypertension.²

Hypertensive emergencies in children are not common and have been mostly due to secondary underlying disease. But because of increase in the incidence of obesity/ metabolic syndrome, the incidence of primary hypertension is been increasing over recent years. There is a strong association of hypertension with obesity and with increase in the prevalence of childhood obesity hypertension is also becoming bigger issue. The association of obesity with insulin resistance and hypertension, otherwise known as metabolic syndrome, predisposes children to the development of cardiovascular disease. Thus, resulting in an increasing

shift to primary hypertension, as important cause of hypertension in the pediatric age group.³

When, how and whom to screen for hypertension

All children three years of age and older should have their blood pressure measured during each physician visit, whether the visit is for well child care, urgent care, or emergency care, at a minimum of once yearly. In addition, children less than three years of age should also have their blood pressure measured at each visit if they have a comorbid condition that places them at increased risk for hypertension. Children with conditions like history of prematurity, LBW/NICU stay, CHD, recurrent UTI, hematuria proteinuria, known renal disease, family history of CKD should be screened properly.

Some children may experience the anxiety during evaluations which may cause elevated blood pressure that are in the hypertensive range, yet when monitored in their home environment are in the normal range. This phenomenon of "white coat" hypertension can be diagnosed with a 24-hour ambulatory blood pressure monitor that obtains many blood pressure measurements taken in the child's home environment. Children with white coat hypertension should also be considered at increased risk for the development of sustained hypertension and as such should be followed for every 6 months.⁴⁻⁶

The primary objective of this study was to determine the incidence of hypertensive emergencies, the clinical presentation and etiological diagnosis at different age groups and to assess the real burden of primary hypertension in causing hypertensive emergencies in children.

METHODS

This was a prospective, descriptive, analytical, and cohort study, done in the emergency department of the pediatrics of government general hospital, a tertiary referral pediatric center attached to Kurnool medical college, Kurnool, serving the population of all four Rayalaseema districts of Andhra Pradesh and neighboring districts of Telangana and Karnataka states. The study was approved by the ethics committee of the hospital (ANO: M150202014). Informed consent was taken.

Inclusion criteria

Children from infancy up to and including 18 years of age presenting to pediatric ED with BP >99th percentile and 5 mmHg in the presence of acute or ongoing target organ lesions or HTN in relation to an immediate life-threatening event requiring immediate intervention to reduce the BP.

Exclusion criteria

Neonates/children with BP <95th percentile/children with BP 95th to 99th percentile and 5 mmHg/children with BP >99th percentile and 5 mmHg in the absence of acute or ongoing target organ lesion. Asymptomatic hypertensive patients, and children with transient hypertension were excluded.

The following data were collected and analyzed

age, gender, weight, height, family history of HTN, BP on arrival to the ED, clinical manifestations of hypertensive crisis (dizziness, headache, nausea/vomiting, visual symptoms, seizure/type, altered consciousness, chest tightness/pain, target-organ damage), reversibility with anti-hypertension drugs, underlying causes (renal disease, cardiovascular (CV), essential HTN, central nervous system (CNS) factors, endocrine/metabolic disorders, oncological disease), recurrent episodes, brain imaging and duration of hospitalization (ward/ intensive care unit (ICU)). In addition, to decrease the influence of age, exact BMI percentile and z score (standard deviation score), and SBP/DBP z score according to the center for disease control (CDC) growth charts were also analyzed. The data was documented in a predetermined proforma and transferred to excel software.

Statistical analysis

All statistical analyses were performed using Fisher's exact test and or Chi-square test as appropriate. The results of the descriptive analyses of independent variables were reported as percentages and mean \pm SD. A p value less than 0.05 were considered statistically significant. Statistical analyses were performed using SPSS software.

RESULTS

A total of 94 patients presented to our pediatric ED with the diagnosis of hypertension. 30 were excluded for asymptomatic hypertension, 29 were excluded due to a final diagnosis of hypertensive urgency and 7 were excluded for transient hypertension. The study group comprised 28 patients with hypertensive emergency. The patients were divided into four age groups: infants (<1 year of age); preschool age (1 to 6 years of age); school going age (6 to 12 years of age); and adolescents (13 to 18 years of age). HTN was defined as a BP between the 95th percentile and 99th percentile plus 5 mmHg (stage 1) and above the 99th percentile plus 5 mmHg (stage 2).

Out of 28 children; 43% (12) children were of 13-18 years of age and had the highest incidence of hypertensive emergencies. 10 children were of 7-12 years age, 5 were of 1-6 years and only 1 child was of <1 year.

Amongst 28 children; 19 (68%) children were having the hypertensive emergency due to the renal causes and in 6 children (21%) essential hypertension caused hypertensive emergency.

Table 1: Etiology of hypertension in hypertensive emergencies.

Etiology (n, %)	Total, (n=28)
Renal (19; 68)	19
Vascular (2; 7)	2
Endocrine (1; 4)	1
Essential HTN (6; 21)	6

Table 2: Renal causes for hypertensive emergencies.

Renal (n=19; 68%)	Total, (n=19)
Glomerulonephritis	13
Obstructive uropathy	3
Reflux nephropathy	2
HUS	1

Among the renal causes the glomerulonephritis was the major cause of hypertensive (n=13).

Table 3: Demographic data and etiologies in hypertensive emergencies.

Etiology (n; %)	Age group (years)				Total, (n=28)
	<1	1-6	7-12	13-18	
Renal (19; 68)					
Glomerulo-nephritis	0	3	6	4	13 (M:F=8:5)
Obstructive uropathy	0	1	1	1	3 (M:F=3:0)
Reflux nephropathy	0	1	0	1	2 (M:F=2:0)
HUS	0	0	1	0	1 (M:F=1:0)
Vascular (2; 7)					
Renal artery stenosis	0	0	0	1	1 (M:F=0:1)
Coarctation of aorta	1	0	0	0	1 (M:F=1:0)
Endocrine (1; 4)					
Pheochromocytoma	0	0	0	1	1 (M:F=0:1)
Essential HTN (6; 21)	0	0	2	4	6 (M:F=5:1)
P=0.009 which is <0.05					

The above table shows that the children with 7-12 years age had the hypertensive emergency due to the renal causes i.e., glomerulonephritis. The males were the most affected due to different etiological variables.

In the present study the encephalopathy (57%) is the major end organ damage followed by retinopathy, LVH and CVA i.e., 22%, 14% and 7% respectively.

Table 4: Age-wise distribution of clinical features.

Clinical features	<1 year	1-6 year	7-12 year	13-18 year
Headache	0	1	3	4
Nausea and vomiting	1	1	2	4
Dizziness	1	2	3	3
Chest discomfort	0	1	2	3
Altered sensorium	0	1	3	2
Visual blurring	0	2	2	2
Convulsions	0	1	1	2
Family history	0	0	2	4
HTN stage 1	0	0	0	0
HTN stage 2	1	5	10	12

Table 5: End organ damage amongst children with hypertensive emergencies.

End organ damage	Percentage (%)
Encephalopathy	57
Retinopathy	22
LVH	14
CVA	7

Table 6: Outcomes of the study.

Condition	Number of subjects
Hypertension	95
Hypertensive crisis	57
Hypertensive urgency	29
Hypertensive emergency	28
Death	0

Table 7: Demographic data of children in hypertensive emergencies.

Age (year)	Percentage (%)
Infancy (<1)	4
Pre-school (1-6)	18
School going (6-12)	32
Adolescence (12-18)	46
Male:female	2.5:1
Family history	21

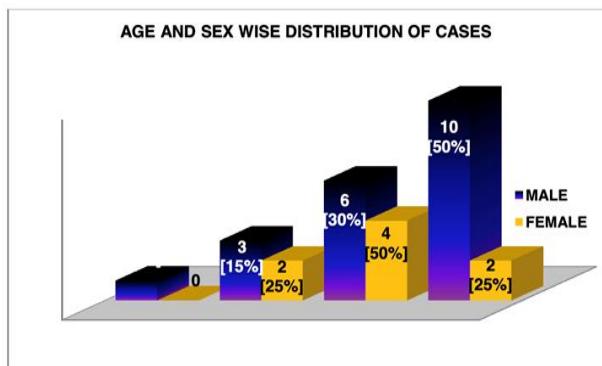


Figure 1: Demographic data.

The outcomes of the study are the patients with hypertension are 95 subjects whereas the hypertensive crisis, hypertensive urgency, and hypertensive emergency are 57 subjects, 29 subjects and 28 subjects respectively.

DISCUSSION

There are very few original pediatric studies published, and most of them are retrospective and limited to a small number of patients. Available data on the incidence causes and clinical presentation of hypertensive emergencies in children is low from India. The exact prevalence of pediatrics hypertension worldwide is not known, based on the use of $\geq 95^{\text{th}}$ percentile to define hypertension, it would be expected that the prevalence of hypertension would be approximately 5%. However, due to the effects of accommodation and regression to the mean with repeated measures, the prevalence of hypertension is lower than 5% and had been expected to be from 1-3% following the recommended three separate measurements in children with an initial BP measurement $\geq 95^{\text{th}}$ percentile.⁷ In the western world, the prevalence of hypertension has been reported to range from 1-5% in children aged 1 to 18 years in 2003.^{4,5} Incidence from India is unclear. Various authors claimed an incidence of 1-11.5% but the true incidence lies between 1-3%.^{8,9} In the present study the incidence of hypertension was 0.9% of total pediatric admissions. This is comparable to most of the studies conducted in India and abroad. Incidence of hypertension as reported by various authors from India was: Hari et al 1.1%, Kota et al 1.1%, Anand et al 0.5% and Pranam et al 1.3%.^{6,8,11,12} Studies from US revealed the prevalence of hypertension to range from 1-5% in children aged 1 to 18 years in 2003.^{4,5} Studies from Taiwan found an incidence of ranging from 0.13% to 0.5% in children aged 6 to 15 years and around 1-3% in children of school age⁶. 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.¹² In retrospective study Han-Ping Wu et al observed 31,400 children over 15 years and detected HTE in 110 patients (0.021%). In the present study the incidence of HTC and HTE was 0.5% and 0.3% of total pediatric admissions respectively. Higher incidence reported in the present study reflects increasing incidence of primary hypertension among children with increasing incidence of obesity presenting with end organ damage at younger age.

A total of 28 children with HTE were studied in the present study. Age wise distribution of cases among four age groups was: infancy (<1 year) 4%, preschool age (1-6 years) 18%; school going age (6-12 years) 32%, adolescent age (12-18 years) 46%. The most common group affected was adolescent group followed by school going age. Wu et al also reported that the most frequently involved age group was from 13 to 18 years (44%), followed by the age group from 7 to 12 years (35%). Findings of Yang et al study on 55 children with HTC

revealed 44% of children were adolescents. Kota et al from their review of medical records from January 1990 to December 2010 of all children aged 18 years and younger with hypertension reported similar incidence of HTC among adolescents (42.9%).⁶

The overall male to female incidence ratio noticed in the present study was 2.5:1. Females were more in school going and preschool age group but no statistically significant disparity among the groups. Sunil K Kota et al⁶ from their study on hypertension on children reported a male to female ratio of 3:1. Yang et al observed increased incidence among males compared to females and reported a male to female ratio of 5:1.¹⁴ Baracco et al also reported male preponderance with M:F ratio of 5:1.¹⁵

Kota et al in their study on clinical analysis of hypertension in children elicited family history of HTN in 26% of cases.⁶ The adolescents were most commonly found to have family history of hypertension. Yang et al reported family history of 15% of their cases presenting with first attack of pediatric hypertensive emergency.¹⁴ Family history of hypertension was only noted in the patients older than preschool age. Overall, 21% of cases had a family history of hypertension in the present study and is similar to the observations of Yang et al (15%) and Kota et al (26%) and it was noticed mostly in patients who are older than preschool age.^{6,14}

The incidence of essential hypertension in children varies from 1% to 45% in various hospital-based studies from developed countries.^{16, 17} Arar et al found primary hypertension in 23% of cases.¹⁸ Hypertension in these patients was usually mild. Screening studies for essential hypertension in school going children in India show a prevalence of 0.46-11.7%.^{11,13}

Amongst pediatric patients with HTE in our study, as the age increased, more related family histories of HTN and more essential hypertensive causes were noted. After seven years of age, essential HTN became the major cause of hypertensive emergencies, whereas before the age of seven, hypertensive emergencies were mostly attributed to secondary HTN. However, even though secondary hypertension was the major cause for the younger patients, there was no statistical correlation between age and different underlying causes of pediatric hypertensive emergencies. Renal diseases were the major underlying cause of hypertensive emergencies, and they could induce hypertensive emergencies at any age.

The study by Yang et al which included children with mostly hypertensive urgency, showed that the most common underlying cause of hypertension was primary in children older than 7 years of age (47%) followed by renal diseases, endocrine and metabolic causes.¹⁴ In our study the incidence of primary hypertension in hypertensive emergencies was 20% among school going children and 33% among adolescent children with overall incidence of 21%. Remaining 79% children with HTE

had secondary hypertension. An infrequent diagnosis of essential hypertension in the present study could be due to selective referral of symptomatic and severe hypertension to the hospital.

Chandar et al in their study on pediatric hypertensive crisis while discussing the etiology of acute severe hypertension in children opined that for hypertensive emergency in children, the underlying cause of hypertension is very likely to be secondary in origin.¹³ Our study results are in concurrence with Chandar et al.¹³ All the school going children and adolescents with primary HTN in our study had family history of hypertension. Kota et al study reported primary hypertension in only 7% of children while Yang et al noticed in 47% of children with hypertensive crisis.^{6,14} In the present study hypertension was associated with underlying cause in 79% of children with HTE while primary HTN was found in 21%. Overall, the most common cause was intrinsic renal disease. However, the most common cause of hypertension in the infant group was coarctation of aorta. In preschool, school going and adolescent age group intrinsic renal disease was the most common cause of hypertensive emergency followed by Reno vascular and endocrine causes. A total of 68% patients had intrinsic renal disease as the cause of HTE. Among the renal causes 68% patients had glomerulonephritis: 16% obstructive uropathy: 11% reflux nephropathy and 5% had HUS. Other than renal causes, overall, 7% had reno vascular (renal artery stenosis and coarctation of aorta): 4% had endocrine/oncological (pheochromocytoma) as the cause of HTE. These findings were in correlation with those observed by Yang et al.¹⁴

All of the patients in this study presented with BP levels higher than the 99th percentile plus 5 mmHg (Stage 2 HTN). Yang et al and Martin et al reported that 98% of their patients had stage 2 HTN.^{12,14} Therefore, the 99th percentile plus 5 mmHg may serve as a critical threshold for a high risk of hypertensive crisis in children.

Major symptoms of HTE observed in the present study were: dizziness (32%) observed in all the age groups followed by head ache (29%), nausea and vomiting (29%), chest discomfort (21%), altered sensorium (21%), visual blurring (21%) and convulsions (14%) apart from disease specific symptoms. Martin et al, Sunil et al and Yang et al all reported similar symptomatology in their patients with hypertensive crisis.^{12,6,14}

In the present study all the patient had end organ damage. 57% presented with hypertensive encephalopathy, 21% with hypertensive retinopathy, 14% with left ventricular hypertrophy and or hypertensive heart failure and 7% presented with intracerebral hemorrhage. Yang et al reported hypertensive encephalopathy in 56%, hypertensive retinopathy in 22% and 22% LVH/CHF. Our results are in concurrence with those of Yang et al.¹⁴ Although the patients with hypertensive emergency in the

current study did not have any mortality or sequelae, permanent neurological damage, blindness, and chronic renal failure have been reported to be long-term consequences of hypertensive emergency.¹³

Limitations

The study was done in a single center, and the patient sample is small as the study was done in the emergency department, it reflected only the hypertensive emergencies in children.

CONCLUSION

With increasing primary hypertension among older children's hypertensive emergencies are increasing. As most of the children with hypertension are asymptomatic; detection of target organ damage is vital.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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