Clinical Profile of Hypertension in Children

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Abstract: Systemic hypertension is an important condition in childhood. It is documented that almost 75% of cases hypertension and 90% of cases of pre hypertension in children and adolescents are undiagnosed [27]. The prevalence of hypertension in children is 1-4%.

Among the 105 (n=105) children included in the study from 2009 to 2011, in a teaching Hospital, Hyderabad, Telangana State, the etiology of hypertension was determined in 97 (92.4%) cases. Renal parenchymal disease was the most common underlying pathology. Acute glmerulonephritis was found the commonest etiological disease. Others include nephrotic syndrome, reflux nephropathy, renal artery stenosis, acute renal failure etc.Hormonal disorders include pheochromocytoma, hypothyroidism. While in 8 cases (7.6%) cause forhypertension was not found. Percentage of essential hypertension was increased in higher age groups.

Keywords: Hypertension, Renal parenchymal disease, Acute glomerulonephritis, Secondary hypertension, Essential hypertension, BMI (Body Mass Index).

I. Introduction

The true incidence of hypertension in the pediatric age group is not known. Large population based studies on hypertension are lacking from India. Smaller studies have suggested incidence between 2-5%.

Review of literature: Said RA, Said SM in 1990 from department of Medicine, Medical School, Jordan University, Amman [38] have noted in a retrospective analysis of 70 patients, aged 1-20 years, over a period of 3 years, that essential hypertension was observed in 6 patients only (8.6%); secondary hypertension 64 (91.4%) was due to renal parenchymal disease in 46 patients (65.7%),reno vascular hypertension in 8 (11.4%),renal transplant in 5 (7.2%), and pheochromocytoma in 1 (1.4%). The etiologies of renal parenchymal disease were acute glomerulo nephritis in 14, idiopathic nephritic syndrome in 10, chronic renal insufficiency in 5 and poly cystic kidney disease in 3 patients.

Other studies include Samboonnanonda A et al. [39], Department of Pediatrics, Faculty of Medicine, Sirraj Hospital, Mahidol University, Bangkok, Thailand from Jan 1999 to Dec 2003; Wyszynska T et al. [29], Department of Nephrology, Child health Centre-Memorial, Warsaw, Poland, between Jan 1982 and Dec 1989; Arar MY et al. [31] in the Southern United States in 1994; Khalil A et al. [33], Department of Pediatrics, Moulana Azad Medical College, New Delhi in 1990; Pankaj Hari et al. [12], Department of Pediatrics, All India Institute of Medical Sciences, New Delhi, between Jan 1983 and Dec 1996. All of these studies have shown secondary hypertension was common in children and the underlying etiology was renal parenchymal disease. (Table 4)

Panja M et al. [42] 1996, Department of Cardiology, Institute of Post Graduate Medical Education & Research, Calcutta evaluated 341 young hypertensives in the age group of 18-30 years over a period of 7 years in Eastern India. Essential hypertension constituted the single largest group (35.8%). Renal pathology was the most common cause of secondary hypertension (26.4%).

In the current study our primary aim is to evaluate the etiology of hypertension in children using variables like age, sex, region (urban or rural), and family history of hypertension and Body Mass Index (BMI).

II. Materials and Methods

The present study is a descriptive study conducted from 2009 to 2011 in a Teaching Hospital, Hyderabad, Telangana State on 105 children with hypertension on the age group of 1-16 yr presenting with various symptoms like facial puffiness, decreased urine output, high colored urine, headache, seizures, sweating, palpitations, pain abdomen. Children who were using drugs like steroids, amphetamines, sympathomimetics. for more than one month were excluded. Before commencing the study the institutional Ethics Committee clearance was taken. Informed consent from the parent or guardian of each and every child enrolled in this study was obtained.

Definition: Hypertension in children and adolescents is defined as systolic or diastolic blood pressure exceeding 95th percentile for age, gender and height.

Staging: Since severity of hypertension influences its management, it should be staged as below.

Pre hypertension: Systolic or diastolic blood pressure between 90th and 95th percentile.

Stage 1 hypertension: Systolic or diastolic blood pressure values exceeding 95th percentile and up to 5mm above the 99th percentile.

Stage 2 hypertension: Systolic or diastolic blood pressure values 5mm or more above 99th percentile.

BMI (Body Mass Index): BMI was calculated by using the following formula.

BMI=weight in kg/height in m²

According to BMI children were classified as normal (5th -85th percentile), underweight (\leq 5th percentile) and overweight and obese ($\geq 85^{\text{th}}$ and $\geq 95^{\text{th}}$ percentile) using the CDC growth charts. WHO Child Growth Charts were used for children below 2 years.

Funding: None.

Study Procedures III.

All children were examined in a separate room under good light in calm and quiet atmosphere. Blood pressure measurements were made in right arm in sitting position by using a standard mercury sphygmomanometer with different sized cuffs as per the recommendation of American Heart Association [4]. Blood pressure was recorded three times and the mean blood pressure was recorded.

Once the child was diagnosed as hypertensive, initially underwent the basic investigations like complete blood picture, blood sugar, blood urea, serum creatinine, serum electrolytes, lipid profile, complete urine examination, 24 hr urinary protein, urine spot protein- creatinine ratio, chest-x-ray, ultra sound abdomen, fundus examination, ECG, 2-D Echo.etc. Based on the clinical manifestations and the basic investigations second line investigations like micturating cysto urethrogram, renal angiogram, Doppler flow studies, CT scan, hormonal studies like T3, T4, TSH, urinary catecholamines, urinary cortisol etc. were performed whenever indicated.

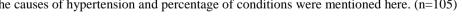
The cause of hypertension was identified in most of the children. Essential hypertension was diagnosed only if detailed evaluation did not show an identifiable etiology.

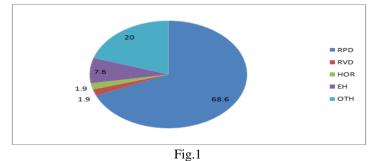
IV. Results

During the study period 105 children with hypertension were observed. Of these 62 were boys and 43 were girls. The age group included in this study was from 1yr to 16 yr. The etiology was determined in 97 (92.4%) cases while 8 (7.6%) cases were diagnosed as essential hypertension. Renal parenchymal disease was the most common underlying pathology found in 72 (68.6%) children with hypertension and acute glomerulonephritis was the commonest etiological disease (Fig.1). Others include nephrotic syndrome, chronic glomerulonephritis, reflux nephropathy, obstructive uropathy and reno vascular hypertension (renal artery stenosis), acute renal failure, multiple cystic diseases of kidney and medullary sponge kidney.

Hormonal disorders include 1case of pheochromocytoma and 1 case of hypothyroidism. Miscellaneous diseases associated with hypertension were IDDM, A-V malformation (vein of Galen), tricuspid regurgitation with pulmonary hypertension with CCF, dilated cardiomyopathy etc.

Most of the patients were presented with renal manifestations like facial puffiness, oliguria, hamaturia and anasarca etc. whereas the rest presented with either non specific symptoms like headache, rashes, loss of weight, loss of appetite or those due to complications of hypertension such as encephalopathy ,CCF etc. There was not much difference between males and females in clinical manifestations and etiology. The causes of hypertension and percentage of conditions were mentioned here. (n=105)





Condition	Percentage	Number of cases
RPD: Renal parenchymal disease	68.6%	72
RVD: Reno vascular disease	1.9%	2
HOR: Hormonal disorders	1.9%	2
EH: Essential hypertension	7.6%	8
OTH: Others	20%	21

Table 1	. Percentag <mark>e</mark>	of cond	<mark>i</mark> tions
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Region wise distribution did not show much difference between rural and urban children. Renal parenchymal disease was found the commonest cause of childhood hypertension in both groups. Family history of hypertension was found in only 2 out of 105 children. One was presented with seizures and the underlying cause of hypertension was not found and second was with CCF and the underlying cause was dilated cardiomyopathy, mild tricuspid regurgitation with pulmonary artery hypertension.

As shown in Fig.2 the percentage of essential hypertension was increased with increasing age and that of secondary hypertension was decreased.

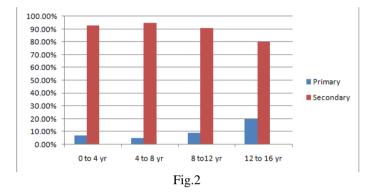


Table 2. Percentage of primary and secondary hypertension with increasing age:

Age in yr	Primary HTN	Secondary HTN
0-4	6.90%	93.10%
4-8	5.30%	94.70%
8-12	9.10%	90.90%
12-16	20%	80%

BMI (Body Mass Index) wise distribution: Out of 105 children with hypertension 16 (15.23%) were overweight/obese. Acute glomerulo nephritis was most common cause in children with hypertension with BMI of normal range i.e. 28 patients (48.3%) and in underweight 9 patients (29%). In overweight and obese children with hypertension nephrotic syndrome was observed in 8 (50%) cases. (Table 3)

Follow-up: All the children with hypertension were treated according to the diagnosis and most of them were hospitalized. Anti hypertensive drugs were prescribed for most of the children. After three months we observed that blood pressure was normalized in almost all the children. Anti hypertensive drugs were being continued for the children in whom essential hypertension was diagnosed. All the children were advised for regular check up and there was no significant rise in blood pressure in those who were attending to our hospital, in six months follow up.

Table 3. BMI v	vise distribution	(n=105)		
Diagnosis	N	0	U	
Acute glomerulo nephritis	28	3	9	
Chronic glomerulo nephritis	4	2	3	
Nephrotic syndrome	13	8	6	
Reflux nephropathy	1	0	1	
Obstructive uropathy	1	0	1	
Renal artery stenosis	2	0	0	
Acute renal failure	2	1	2	
Other renal disorders	0	0	2	
Hormonal disorders	1	0	1	
miscellaneous	2	1	3	
Unknown cause	4	1	3	
Total	58	16	31	

N-Normal range; O-Overweight/Obesity; U-Underweight

V. Discussion

We examined 105 children with hypertension in our hospital. An underlying cause was found in most of our patients with hypertension. Renal parenchymal disease was most common among all age groups. The chief renal disorders were glomerulonephritis, nephrotic syndrome, obstructive uropathy, reflux nephropathy. Our observations were comparable to those from other groups from various parts of the world [12, 29, 30, 31, 33, 38, and 39].

Our study is unique in describing the etiology of hypertension in children and having regular followup. Children were examined in a separate room under good light in calm and quiet atmosphere. Anxiety and fear in children were removed by talking to them and making the child acquainted with the examiner.

Table 4. Com	parative	Data on	Luoiogy	or nyper	tension	m cimar	en.
	Khalil	Pankaj	Said	Samb	Wysz	Arar	Present
Condition	[33]	[12]	[38]	[39]	[29]	[31]	study
	n=23	n=246	n=70	n=66	n=636	n=132	n=105
Renal parenchymal							
disease	47.8%	77.2%	65.7%	62.7%	68%	50%	68.6%
Reno vascular							
disease	13.0%	6.1%	11.4%	7.5%	10%	9.8%	1.9%
Pheochromocytoma							
	4.4%	-	1.4%	1.5%	-	-	0.9%
Essential							
hypertension	8.7%	1.6%	8.6%	7.5%	11%	7%	7.6%
Overweight/							
Obesity	-	-	-	15.1%	-	-	15.23%

Table 4. Comparative Data on Etiology of hypertension in children.

Care was taken while choosing the appropriate sized cuff that would encircle the arm and the inner bladder should go more than half way $(2/3^{rd})$ around the arm and width should go from antecubital fossa to comfortably place the stethoscope at the lower edge of the cuff to prevent the obstruction of axilla. Recording of blood pressure was accurate, as it was recorded 3 times and the mean blood pressure was recorded. Our study is comparable to other studies mentioned above and shows similar findings.

However this study was conducted in children, who were admitted in our hospital. Thus our findings may not represent the etiology of hypertension in the population.

Recommendations: It is known fact that the hypertension slowly establishes itself during the late childhood if there are provocative factors present in the childhood. This onset of hypertension can definitely be prevented if routine blood pressure recording is done in children and interventions made so that the serious complications of hypertension in adult life can be minimized.

Conditions such as stenosis of renal artery or its branches and pheochromocytoma may present with raised blood pressure alone. The diagnosis in these conditions may be difficult and requires detailed evaluation. Surgical treatment is possible in a small number of patients where as others require prolonged anti hypertensive treatment.

VI. Conclusion

Our results suggest that most of the children with hypertension will found to have an underlying etiology. Renal parenchymal disease is the commonest underlying pathology, including acute glomerulonephritis predominantly followed by nephrotic syndrome, reflux nephropathy and obstructive uropathy. Occasionally it is detected incidentally with no clinically obvious renal or cardiovascular cause. As age increases percentage of essential hypertension will be increased.

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Age (yr)	BP percentile			Systoli Heig	e BP (r ht perc)					lic BP (ht perc		3)	
	•	5^{th}	$10^{\rm th}$	25 th	50 th	75 th	$90^{\rm th}$	95 th	$5^{\rm th}$	$10^{\rm th}$	25 th	50 th	75 th	90^{th}	95 th
1	50 th	80	81	83	85	87	88	89	34	35	36	37	38	39	39
	90 th 95 th	94 98	95 99	97 101	99 103	100 104	102 106	103 106	49 54	50 54	51 55	52 56	53 57	53 58	54 58
	99 th	105	106	101	110	112	113	114	61	62	63	64	65	56 66	66
2	50 th	84	85	87	88	90	92	92	39	40	41	42	43	44	44
	90 th	97	99	100	102	104	105	106	54	55	56	57	58	58	59
	95 th 99 th	101 109	102 110	104 111	106 113	108 115	109 117	110 117	59 66	59 67	60 68	61 69	62 70	63 71	63 71
3	50 th	86	87	89	91	93	94	95	44	44	45	46	47	48	48
	90 th	100	101	103	105	107	108	109	59	59	60	61	62	63	63
	95 th 99 th	104	105	107	109	110	112	113	63	63	64	65	66	67	67
4	50 th	111 88	112 89	114 91	116 93	118 95	119 96	120 97	71 47	71 48	72	73 50	74 51	75 51	75 52
	$90^{\rm th}$	102	103	105	107	109	110	111	62	63	64	65	66	66	67
	9.5 th	106	107	109	111	112	114	115	66	67	68	69	70	71	71
5	99 th 50 th	113 90	114 91	116 93	118 95	120 96	121 98	122 98	74 50	75 51	76 52	77 53	78 54	78 55	79 55
5	90 th	104	105	106	108	110	111	112	65	66	67	68	69	69	70
	95 th	108	109	110	112	114	115	116	69	70	71	72	73	74	74
	99 th	115	116	118	120	121	123	123	77	78	79	80	81	81	82
6	50 th 90 th	91 105	92 106	94 108	96 110	98 111	99 113	100 113	53 68	53 68	54 69	55 70	56 71	57 72	57 72
	$95^{\rm th}$	109	110	112	114	115	117	117	72	72	73	74	75	76	76
-	99 th	116	117	119	121	123	124	125	80	80	81	82	83	84	84
7.	50 th 90 th	92 106	94 107	95 109	97 111	99 113	100 114	101 115	55 70	55 70	56 71	57 72	58 73	59 74	59 74
	90" 95 th	110	107	113	115	113	114	115	70	70 74	71	72	73	74 78	74
	99 th	117	118	120	122	124	125	126	82	82	83	84	85	86	86
8	50 th	94	95	97	99	100	102	102	56	57	58	59	60	60	61
	90 th	107	109	110	112	114	115	116	71	72	72	73	74	75	76
	95 th 99 th	111 119	112 120	114 122	116 123	118 125	119 127	120 127	75 83	76 84	77 85	78 86	79 87	79 87	80 88
9	50 th	95	96	98	100		103	104	57	58	59				
9	90 th	95 109	96 110	98 112	114	102 115	103	104 118	72	58 73	59 74	60 75	61 76	61 76	62 77
	95^{th}	113	114	116	118	119	121	121	76	77	78	79	80	81	81
	99 th	120	121	123	125	127	128	129	84	85	86	87	88	88	89
10	50 th	97	98	100	102	103	105	106	58	59	60	61	61	62	63
10	90 th	111	112	114	115	117	109	119	73	73	74	75	76	77	78
	95 th	115			119	121	122	123			79	80	81	81	
	95 99 th		116	117					77	78					82
		122	123	125	127	128	130	130	85	86	86	88	88	89	90
11	50 th	99	100	102	104	105	107	107	59	59	60	61	62	63	63
	90 th	113	114	115	117	119	120	121	74	74	75	76	77	78	78
	95 th	117	118	119	121	123	124	125	78	78	79	80	81	82	82
	99 th	124	125	127	129	130	132	132	86	86	87	88	89	90	90
12	50 th	101	102	104	106	108	109	110	59	60	61	62	63	63	64
	90 th	115	116	118	120	121	123	123	74	75	75	76	77	78	79
	95 th	119	120	122	123	125	127	127	78	79	80	81	82	82	83
	99 th	126	127	129	131	133	134	135	86	87	88	89	90	90	91
13	50 th	104	105	106	108	110	111	112	60	60	61	62	63	64	64
	90 th	117	118	120	122	124	125	126	75	75	76	77	78	79	79
	90 95 th	121						120	79	79		81	82	83	
	95 99 th		122	124	126	128	129				80				83
		128	130	131	133	135	136	137	87	87	88	89	90	91	91
14	50 th	106	107	109	111	113	114	115	60	61	62	63	64	65	65
	90 th	120	121	123	125	126	128	128	75	76	77	78	79	79	80
	95 th	124	125	127	128	130	132	132	80	80	81	82	83	84	84
	99 th	131	132	134	136	138	139	140	87	87	89	90	91	92	92
15	50 th	109	110	112	113	115	117	117	61	62	63	64	65	66	66
	90 th	122	124	125	127	129	130	131	76	77	78	79	80	80	81
	95 th	126	127	129	131	133	134	135	81	81	82	83	84	85	85
	99 th	134	135	136	138	140	142	142	88	89	90	91	92	93	93
16	50 th	111	112	114	116	118	1142	142	63	63	64	65	66	67	67
10	90 th														
	90 95 th	125	126	128	130	131	133	134	78	78	79	80	81	82	82
		129	130	132	134	135	137	137	82	83	83	84	85	86	87
	99 th	136	137	139	141	143	144	145	90	90	91	92	93	94	94
17	50 th	114	115	116	118	120	121	122	65	66	66	67	68	69	70
	90 th	127	128	130	132	134	135	136	80	80	81	82	83	84	84
	os th	131	132	134	136	138	130	140	84	85	86	87	87	88	80

ANNEXURE

 95^{th}

99th

131 132 134 136 138 139 140 84 85

147 92

139 140 141 143 145 146

94 95 96 97

86 87

93 93

88 89

87

-	lge	BP	_		Systoli	e BP (r	nm He')			D	iastolic	BP	(mm l	Hø)		-
	yr)	percentile				ht perc		,			D	Heigh					-
			5 th	10 th	25 th	50 th	75 th	90 th	95 th	5 th	$10^{\rm th}$	25 th	50 th	75 th		95 th	1
	1	50 th	83	84	85	86	88	89	90	38	39	39	40	41	41	42	
		90 th	97	97	98	100	101	102	103	52	53	53	54	55	55	56	
		95 th	100		102	104	105	106	107	56	57	57	58	59	59	60	
	2	99 th 50 th	108		109	111	112	113	114	64	64	65	65	66	67	67	_
	2	90 th	85 98	85 99	87 100	88 101	89 103	91 104	91 105	43 57	44 58	44 58	45 59	46 60	46 61	47 61	
		95 th	102		100	101	105	104	105	61	62	62	63	64	65	65	
		99 th	109		111	112	114	115	116	69	69	70	70	71	72	72	
	3	50 th	86	87	88	89	91	92	93	47	48	48	49	50	50	51	
		90 th	100	100	102	103	104	106	106	61	62	62	63	64	64	65	
		95 th	104		105	107	108	109	110	65	66	66	67	68	68	69	
	4	99 th 50 th	111 88	111 88	<u>113</u> 90	114 91	115 92	116 94	117 94	73 50	73 50	74 51	74 52	75 52	76 53	76 54	_
	+	90 th	101		103	104	106	107	108	64	50 64	65	52 66	67	67	68	
		95 th	105		107	108	110	111	112	68	68	69	70	71	71	72	
		99 th	112	113	114	115	117	118	119	76	76	76	77	78	79	79	_
_	5	50 th	89		91	93	94	95	96	52	53	53	54	55	55	56	
		90 th	103		105	106	107	109	109	66	67	67	68	69	69	70	
		95 th 99 th	107 114		108 116	110 117	111 118	112 120	113 120	70 78	71 78	71 79	72 79	73 80	73 81	74 81	
	6	50 th	91	92	93	94	96	97	98	78 54	78 54	55	79 56	56	57	58	-
	~	90 th	104		106	108	109	110	111	68	68	69	70	70	71	72	
		95 th	108		110	111	113	114	115	72	72	73	74	74	75	76	
_		99 th	115		117	119	120	121	122	80	80	80	81	82	83	83	
	7.	50 th	93	93	95	96	97	99	99	55	56	56	57	58	58	59	
		90 th 95 th	106 110		108 112	109 113	111 115	112 116	113 116	69 73	70 74	70 74	71 75	72 76	72 76	73 77	
		99 th	117		112	120	122	123	124	81	81	82	82	83	84	84	
_	8	50 th	95	95	96	98	99	100	101	57	57	57	58	59	60	60	
		90 th	108	109	110	111	113	114	114	71	71	71	72	73	74	74	
		95 th	112		114	115	116	118	118	75	75	75	76	77	78	78	
_	0	99 th 50 th	119 96		121	122	123	125	125	82	82	83	83	84	85	86	_
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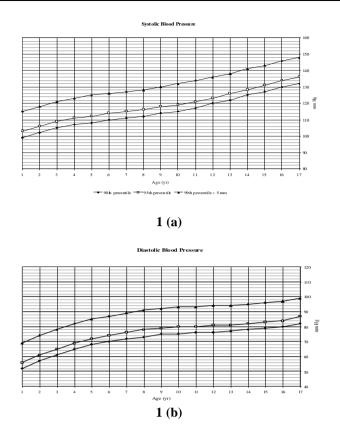
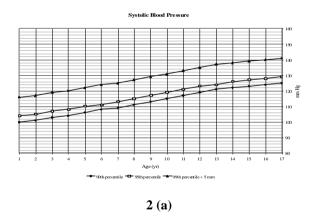


Fig. 1. Blood pressure levels for boys at 50th percentile for height. Chart depicting 90th (closed diamonds), 95th (open circles) and 99th + 5 mm (closed triangles) percentile values for (*a*) systolic and (*b*) diastolic blood pressures, representing cut off values for the diagnosis of pre-hypertension, stage I and stage II hypertension respectively in boys (based on reference 4).



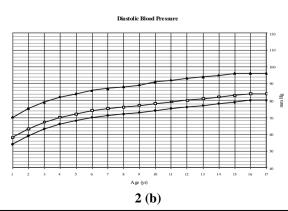


Fig. 2. Blood pressure levels for girls at 50th percentile for height. Chart depicting 90th (closed diamonds), 95th (open circles) and 99th + 5 mm (closed triangles) percentile values for (*a*) systolic and (*b*) diastolic blood pressures, representing cut off values for the diagnosis of pre-hypertension, stage I and stage II hypertension respectively in girls (based on reference 4).

