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MEASUREMENT OF BLOOD PRESSURE IN CHILDREN: A SYSTEMATIC APPROACH

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Summary

Measurement of blood pressure properly is important. Prevalence of hypertension in children is not less. Morbidity and mortality of hypertension cannot be ignored. Blood pressure (BP) should be measured systematically among children over 3 years old who are seen in a medical setting. Among <3 years children, blood pressure should be measured in special circumstances. Various methods of blood pressure measurement are existent. Though ambulatory blood pressure monitoring (ABPM) has some advantages, over all sphygmomanometry is the preferred method. Conventional cuff measurement and ABPM cannot be used interchangeably. For correct recording of BP a cuff that is appropriate to the size of the child's upper arm is needed. Elevated BP must be confirmed on repeated visits before declaring a child as hypertensive. Measures obtained by oscillometric device that exceed the 90th percentile should be repeated by auscultation.

Key words

Blood pressure; children; measurement

Introduction

Hypertension is one of the commonest diseases throughout the globe. Prevalence of this condition in children is reported to be 1-3%. In school-aged children, prevalence appears to be increasing, perhaps due to increased prevalence of childhood obesity[1]. About 4.5% school going children suffers from hypertension[2]. Prevalence of persistent secondary hypertension in children is 0.1%[3]. Morbidity and mortality of hypertension is not less. Risk of cardiovascular diseases increases two fold by each increment of 20 mmHg in systolic or 10 mmHg in diastolic pressure[4]. One-third of peoples in United States, are unaware of this problem and another one-third has blood pressure control below the establish goals[5]. Measurement of blood pressure in children is ignored many times due to paucity of suitable pediatric blood pressure recording instrument. Lack of positive attitude of physician regarding blood pressure measurement in children is another factor.

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But methodical record of blood pressure is definitely important. Before going to record BP every one should look for some basic queries e.g. (i) who is to be measured? (ii) when is to be measured? (iii) how is to be measured? (iv) why is to be measured and (v) what is the criterion of measuring equipment? The clinician is to be updated about case definition of different categories of blood pressure. The article is written to orient health personals specially the clinicians regarding such fundamental aspects of blood pressure recording.

Indications of blood pressure recording

Though recording of blood pressure (BP) in pediatric group is emphasized, special attention is to be given to at-risk children. The Pediatric Nephrology group of Indian Academy of Pediatrics recommends[6] annual measurement of blood pressure in all children more than 3 years old, who are seen in clinics or hospital settings. Blood pressure should also be measured in all at-risk younger children with (i) history of prematurity, very low birth weight or intervention in intensive care unite (NICU). (ii) congenital heart diseases. (iii) Recurrent urinary tract infection, known renal or urological diseases, hamaturia or proteinuria (iv) family history of congenital renal disorders (v) malignancy or post organ transplant (vi) conditions associated with hypertension e.g. neurofibromatosis, tuberous sclerosis and ambiguous genitalia. Blood pressure should be measured in patients who present with features of kidney disease, seizure, altered sensorium, headache or visual complaints.

Blood pressure measurement

Before going to discus the methods of blood pressure recording it is wise to have a concept of definition of hypertension. Hypertension is defined as average systolic blood pressure (SBP) and/or diastolic blood pressure (DBP) that is 95th percentile for age, gender and height on 3 occasions. Prehypertension in children is defined as average SBP or DBP levels that are 90th percentile but <95th percentile. As with adults, adolescents with BP levels 120/80 mm Hg should be considered prehypertensive. A patient with BP levels >95th percentile in a physician's office or clinic, who is normotensive outside a clinical setting, has "white-coat hypertension". If the BP is >90th percentile, the BP should be repeated twice at the same office visit, and an average SBP and DBP should be used.

If the BP is >95th percentile, BP should be staged. Stage-1 hypertension is the BP levels that range from 95th percentile to 5 mmHg above the 99th percentile. Stage-2 hypertension is defined as BP that is >5mmHg above the 99th percentile. Values of BP in children vary depending on parameters like age and sex of the child (Table-1)[7].

Table I : Age and sex wise percentile chart of blood pressure in children

Age (Years)	BP (percentiles)	Boy (50th height %) systolic (mmHg)	Boy (50th height %) diastolic (mmHg)	Girl (50th height %) Systolic (mmHg)	Girl (50th height %) diastolic (mmHg)
5	90th	103	70	101	68
	95th	110	73	105	71
	99th	119	76	111	74
10					
	90th	114	80	110	74
	95th	118	80	118	70
	99th	124	83	124	81
15					
	90th	125	91	122	88
	95th	130	92	127	82
	99th	136	98	131	84

Accurate techniques of blood pressure measurement are necessary for its diagnosis, staging and follow-up. Staging of BP is helpful for planning of evaluation and treatment of hypertension.

Measurement devices

(i) Mercury sphygmomanometer: Normative values of blood pressure are based on sphygmomanometry, which is considered as preferred method for blood pressure estimation. Physicians should remember that mercury is a major environmental pollutant and that accidental spills of it must be managed appropriately[8].

(ii)Oscillometric devices: These devices are increasingly used in infants and in intensive care settings when frequent blood pressure measurements are needed. However, oscillometric devices are neither validated for children, nor normative data are based on its reading[9].Blood pressure which exceed the 90th percentile on oscillometry, must be confirmed by sphygmomanometry[6].

(iii)Android and other devices: These instruments are based on spring based technology, require frequent calibration and validation. The use of android devices and wrist or finger band oscillometry for blood pressure measurement is discuraged[6].

(iv)Ambulatory blood pressure monitoring(ABPM) devices: Continuous blood pressure recording over 12 or 24 hours are believed to reflect true blood pressures accurately[10]. Portable BP device, worn by the patient, records BP which is very useful in the evaluation of hypertension in children[11].By frequent measurement and recording of BP, ABPM enables computation of the mean BP over 24 hours as well as various measures to determine the degree to which BP exceeds the upper limit of normal over a given time period. The ABPM is very helpful in evaluation of white-coat hypertension as well as the risk for hypertensive organ injury, apparent drug resistance and hypotensive symptoms with antihypertensive drugs. It is also useful for evaluating children for whom more information on BP patterns is needed, such as those with episodic hypertension and autonomic dysfunction[12].

Measurement of blood pressure by sphygmomanometer

Blood pressure measurement by sphygmomanometer remains the method of choice till date. The cuff should encircle at least 80-100% of the arm circumference. The bladder width-to-length ratio should be at least 1:2[11]. The bladder length should be >40% of the arm circumference. Choosing of correct cuff size is important (Table-II)[13].Inappropriately small cuffs give aberrantly high reading, whereas large cuffs underestimate the exact reading. If an appropriate sized cuff is not available, the next large size is used[10].

Table II : Dimensions for blood pressure cuffs

Age	Width (cm)	Length (cm)
Newborn, infant	4	8
Child	9	18
Adolescent	10	24
Adult	13	30
Thigh	20	42

Ideally, prior to recording BP any stimulant drugs or foods should not be given to the children. The child should be seated quietly for 5 minutes with his or her back supported, feet on the floor and right arm supported, cubital fossa at heart level[14,15]. The right arm is preferred in repeated measures of BP for consistency and comparison with standard tables and because of the possibility of coarctation of the aorta, which might lead to false (low) readings in the left arm[16]. Blood pressure should be recorded in infant while he (she) is in supine position and in others in sitting position[1].

In children BP should be measured with a standard clinical sphygmomanometer, using a stethoscope placed over the brachial artery pulse, proximal and medial to the cubital fossa, and below the bottom edge of the cuff (ie, 2 cm above the cubital fossa). The use of the bell of the stethoscope may allow softer korotkoff sounds to be heard better[12,13]. The observer's eye should be at the level of the mercury column[6]. The mercury column is lowered slowly (2 mm per second). Systolic blood pressure is the point when korotkoff sounds are first heard (k1) and disappearance of sounds (k5) is the diastolic pressure[17]. If the sounds persist, the measurement is repeated with less pressure on the stethoscope head. If the sounds persists at low intensity, then k4 (muffling of sounds) is recorded as the diastolic pressure[6].

Conventional cuff measurement and ABPM cannot be used interchangeably, because one measurement does not correlate to other. Both types of measurements should be evaluated according to respective standard tables[13].

Conclusions

Prevalence of hypertension in children is not less. Blood pressure related morbidity and mortality are also not uncommon. This may leads to deleterious effect on child health including organ failure if hypertension is unnoticed for a long time. Attention in blood pressure recording is to be given particularly to at-risk children. Blood pressure recording by mercury sphygmomanometer is the preferred method. Choosing of correct sized cuff is crucial because a small cuff might overestimate the readings and vice versa. Emphasis is to be given on correct method of measurement to have a reasonably accurate blood pressure of children. Repetition of recording blood pressure is needed if a child is found hypertensive.

Disclosure

The author declared no competing interestes

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