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缅甸联邦第一特区卫生部

The Union of Myanmar, SR(1) Department of Health

Hypertension

Standard Operating Procedure (SOP)

Contents

Hypertension

Clinically defined as elevated blood pressure if systolic and/or diastolic pressure 2 90: percentile and as hypertension if systolic and/or diastolic pressure ≥95"percentile for age, sex and height percentile on 2 3 separate occasions.

Table 3.4 Definitions of Blood Pressure Categories and Stages

Category	*Aged 1-13 year*	*Aged ≥13 year*
Normal	*<90th percentile*	*<120/<80 mmHg**
Elevated Blood Pressure	*290t to <95th percentile OR 120/80 mmHg to <95th percentile (whichever is lower)*	*120/<80 to 129/<80 mmHg*
Stage 1 Hypertension	*≥95th to <95th percentile +12 mmHg*	*130/80 to 139/89 mmHg*
Stage 2 Hypertension	*≥95th percentile +12 mmHg OR ≥140/90 mmHg (whichever is lower)*	*≥140/90 mmHg*
Hypertensive urgency	• *Raised Blood Pressure but No end-organ damage* • *Symptomatic with complaints such as nausea, headaches and blurred vision.*	
Hypertensive emergency	• *Raised Blood Pressure with end-organ damage such as cerebral infarction, cerebral hemorrhage, encephalopathy (seizures) and pulmonary edema* • *Symptomatic*	

**If systolic and diastolic categories are different, categorize by the higher value.*
Patients with elevated blood pressure are at increased risk for progression to hypertension
Source: Flynn JT, Kaelber DC, Baker-Smith CM, et al. Clinical Practice Guideline for Screening and Management of High Blood Pressure in Children and Adolescents. Pediatrics. 2017; 140 (3)e20171904

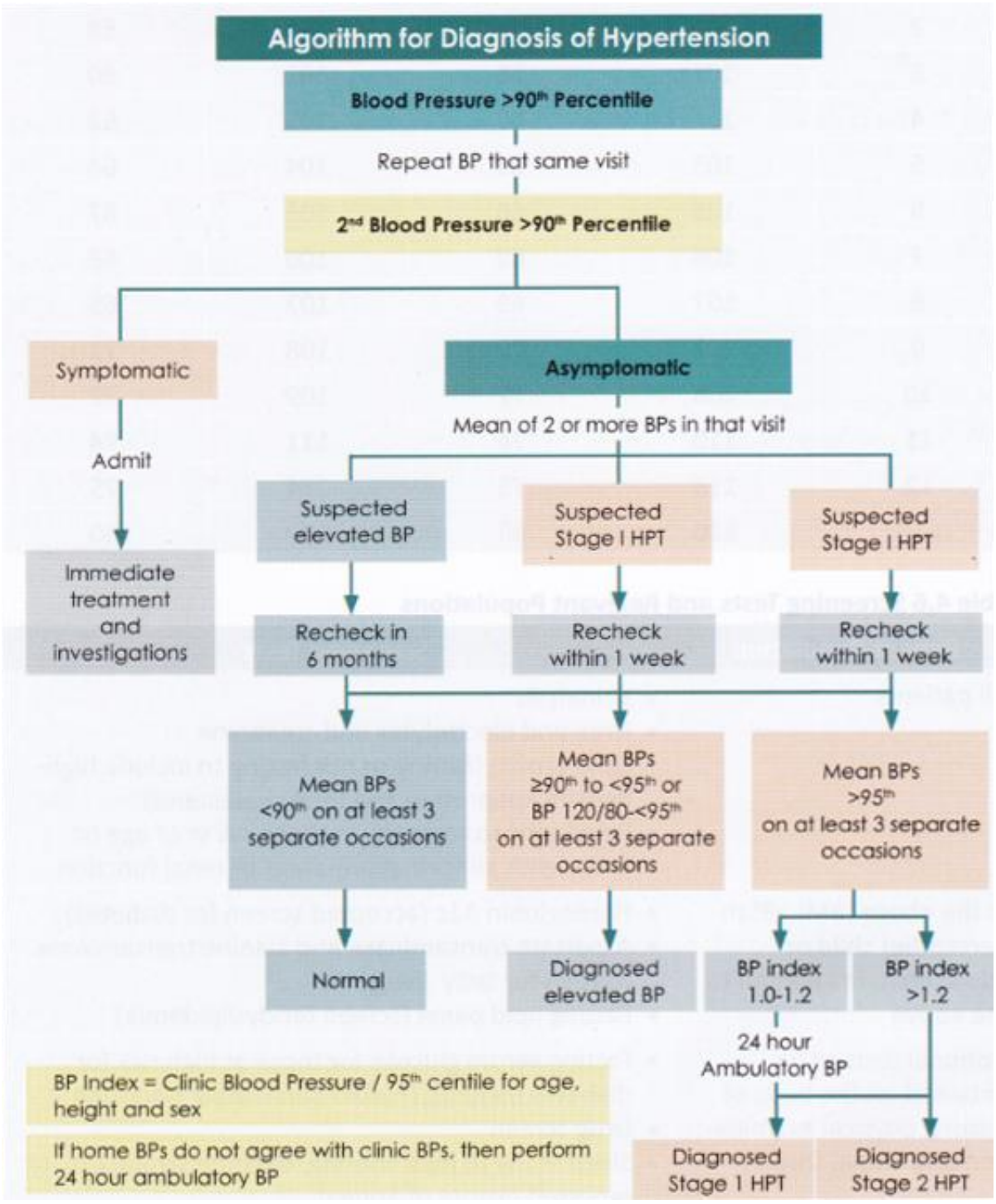
Best Blood Pressure Measurement Practices

- *Blood Pressure in children may vary considerably between visits and even during the same visit. There are many potential etiologies for isolated elevated Blood Pressure in children and adolescents including such factors as anxiety and recent caffeine intake.*

- *Blood Pressure generally decreases with repeated measurements during a single visit, although the variability may not be large enough to affect blood pressure classification.*
- *The child should be seated in a quiet room for 3-5 min before measurement with the back supported and feet uncrossed on the floor.*
- *Blood Pressure should be measured in the right arm for consistency for comparison with standard tables and to avoid a falsely low reading from the left arm in the case of coarctation of the aorta. The arm should be at heart level, supported and uncovered above the cuff, The patient and observer should not speak while the measurement is being taken.*
- *The correct cuff size should be used. The bladder length should be 80%-100%of the circumference of the arm and the width should be at least 40%.*
- *In auscultation, the bell of the stethoscope should be placed over the brachial artery in the antecubital fossa and the lower end of the cuff should be 2-3cm above the antecubital fossa. The cuff should be inflated to 20-30 mm Hg above the point at which the radial pulse disappears. Over inflation should be avoided. The cuff should be deflated at a rate of 2-3 mm Hg per second. The first (Phase l Korotkoff) and last (Phase V Korotkoff) audible sounds should be taken as systolic blood pressure and diastolic blood pressure.*
- *To measure blood pressure in the legs, the patient should be in the prone position, if possible, An appropriately sized cuff should be placed mid thigh and the stethoscope placed over the popliteal artery. The systolic blood pressure in the legs is usually 10%-20% higher than the brachial artery pressure.*

Timing of Blood Pressure Measurements

- *Children ≥3 years should have their blood pressure measured at least once during every health care episode.*
- *Children <3 years should have their blood pressure measured in the following circumstances:*
- *History of prematurity, very low birth weight (VLBW), other problems requiring neonatal intensive care*
    - *Congenital heart disease (repaired or non-repaired)*
    - *Recurrent urinary tract infection, hematuria, or proteinuria*
    - *Known renal or urologic disorders*
    - *Family history of congenital renal disease*
    - *Malignancy or Solid organ transplant or bone marrow transplant*
    - *Treatment with drugs known to raise blood pressure*
    - *Systemic diseases associated with hypertension (neurofibromatosis, tuberous sclerosis)*
    - *Elevated intracranial pressure*



Source: Yap HK, Aragon ET, Ng KH, Approach to diagnosis of Hypertension, Pediatric Nephrology On the Go: second edition 2015:53

Table 3.5 Screening Blood Pressure Values Requiring Further Evaluation

Age (yr)	*Boys*		*Girls*	
	Systolic BP	*Diastolic BP*	*Systolic BP*	*Diastolic BP*
1	*98*	*52*	*98*	*54*
2	*100*	*55*	*101*	*58*
3	*101*	*58*	*102*	*60*
4	*102*	*60*	*103*	*62*
5	*103*	*63*	*104*	*64*
6	*105*	*66*	*105*	*67*
7	*106*	*68*	*106*	*68*
8	*107*	*69*	*107*	*69*
9	*107*	*70*	*108*	*71*
10	*108*	*72*	*109*	*72*
11	*110*	*74*	*111*	*74*
12	*113*	*75*	*114*	*75*
≥13	*120*	*80*	*120*	*80*

Table 3.6 Screening Tests and Relevant Populations

Patient Population	*Screening Tests*
All patients	• *Urinalysis* • *Urea and electrolytes and creatinine* • *Lipid profile (fasting or nonfasting to include high. density lipoprotein and total cholesterol)* • *Renal ultrasonography in those < 6 yr of age or those with abnormal urinalysis or renal function*
In the obese (BMI >95thpercentile) child or adolescent, in addition to the above	• *Hemoglobin A1c (accepted screen for diabetes)* • *Aspartate transaminase and alanine transaminase (screen for fatty liver)* • *Fasting lipid panel (screen for dyslipidemia)*
Optional tests to be obtained on the basis of history, physical examination and initial studies	• *Fasting serum glucose for those at high risk for diabetes mellitus, Thyroid-stimulating hormone* • *Drug screen*

	• *Sleep study (if loud snoring, daytime sleepiness, or reported history of apnea)* • *Complete blood count especially in those with growth delay or abnormal renal function*

Diagnosis

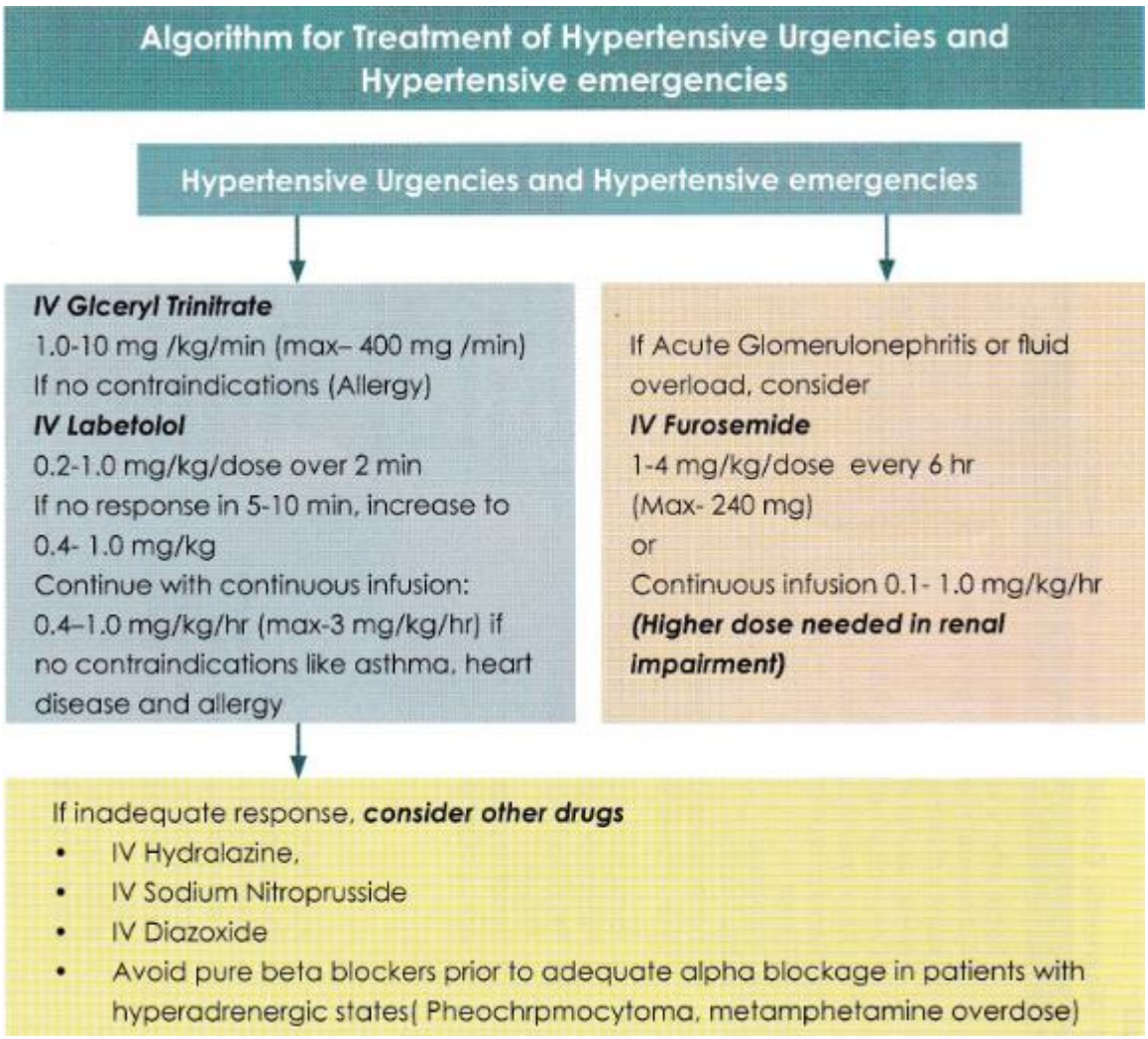
Table 3.7 Diagnostic Considerations in Hypertension

Age (yr)	*Etiology*	*History*	*Physical examination*
0-1	• *Renal artery and venous thrombosis* • *Autosomal recessive polycystic kidney disease* • *Aortic coarctation* • *Congenital nephritic syndrome* • *Other renal parenchymal disease* • *Renal artery stenosis* • *Tumor* • *Iatrogenic* • *Mydriatics* • *Theophylline overdose* • *Caffeine overdose*	• *Umbilical artery catheterization* • *Oligohydramnios* • *Prolonged mechanical ventilation* • *Family history of renal disease* • *Medications*	• *Pulse quality and blood pressure in four oligohydramnios extremities* • *Signs of congestive heart failure* • *Abdominal mass and bruit* • *Ambiguous genitalia*
1-12	• *Renal parenchymal disease* • *Polycystic kidney disease* • *Renovascular disease* • *Tumor* • *Endocrine causes* • *Aortic coarctation*	• *Poor feeding* • *Failure to gain weight* • *History of urinary tract infection* • *History of low birth weight* • *Family history of renal disease* • *Headache, palpitations, blurred vision* • *Medications* • *Accidental ingestion*	• *Heart rate, body mass index, pulse quality and blood pressure in four extremities* • *Cardiovascular/pulmonary examination* • *Abdominal mass and bruit* • *Rash* • *Peripheral edema* • *Retinal examination* • *Ambiguous genitalia*
13-18	• *Poor feeding* • *Failure to gain weight* • *History of urinary tract infection* • *History of low birth weight*	• *Excessive weight gain* • *History of fever and/or joint pain* • *History of urinary tract infection*	• *Heart rate, body mass index, pulse quality and blood pressure in four extremities* • *Cardiovascular/pulmonary examination* • *Thyroid examination*

	• *Family history of renal disease* • *Headache, palpitations, blurred vision* • *Medications* • *Accidental ingestion*	• *History of low birth weight* • *Family history of hypertension or renal disease* • *Medications* • *Drug overdose* • *Headache, palpitation, blurred vision*	• *Abdominal mass and bruit* • *Rash* • *Peripheral edema* • *Retinalexamination*

Management Strategy in Hypertensive Crisis

- *Select an agent with rapid and predictable onset of action*
- *Agents with minimal CNS side effects should be chosen (To prevent masking of signs related to hypertensive encephalopathy)*
- *IV route is preferred as fall in pressure can be carefully titrated*
- *Conditions that may mimic hypertensive emergency e.g Intracranial pathology, seizures must be excluded*
- *Stepwise reduction should be planned as too rapid reduction may interfere with adequate organ perfusion*
- *In general - Blood pressure should be reduced by about ⅓ of total planned reduction during 1st 12 hours and next y over ⅓ hours and final ⅓ over 24hours*



Source: Yap HK, Aragon ET, Ng KH, Approach to diagnosis of Hypertension, Pediatric Nephrology on the Go; second edition 2015;91

Table 3.8 Antihypertensive drugs for management of severe hypertension in children

Drug	*Class*	*Dose*	*Route*	*Comments*
Hydralazine	*Vasodilator*	*0.2-0.6 mg/kg/dose*	*IV/IMM*	*Should be given every 4 hours when given IV bolus. It is contraindicated in high ICP, cerebrovascular diseases severe renal impairment, mitral valvular heart diseases and HOCM.*
Giceryl Trinitrate	*Vasodilator*	*Start 1.0 mg/kg/ min and titrate1.0- 10 mg /kg/min (maximum400mg/min)*	*IV infusion*	*Predominantly venodilator and may be useful in reducing preload and afterload and ma also improve coronary blood flow.*
Labetalol	*α- and β blocker*	*Bolus:0.2-1.0 mg/kg/ dose (up to 40 mg/dose) infusion: 0.25-3.0 mg/kg/hr*	*IV bolus or infusion*	*Asthma and overt heart failure are relative contra-indications.*
Furosemide	*Diuretic*	*1-4 mg/kg 0.1-1.0mg/kg/hr*	*IV infusion*	*Most children with hypertension have chronic or acute renal disease and IV Furosemide is a drug of choice in acute glomerulonephritis with fluid overload.*
Nicardipine	*Calcium channel blocker*	*1.0 -3.0 mg /kg/min (Max-250 mg/min)*	*IV infusion*	*similar to Nifedipine without the deleterious risk of depressing myocardial function.*

Sublingual Nifedipine is no longer recommended for the treatment of acute hypertension because it may cause a precipitous drop in blood pressure particularly in those with long standing hypertension (or uncertain duration) and reports of death from hypotension in the adult population.

Other alternatives

- *IV Diazoxide (arterial vasodilator) 1-3 mg/kg dose*
- *Sodium Nitroprusside (arterial vasodilator) 0,53-10 mcg/kg/min, IV infusion*

Selecting for Long Term Use

To use drugs that preferably can be used once daily, maximizing treatment dosage before adding a further drug. The agents used will come from the following 'ABCD'
ACE-Inhibitor and (Angiotensin-II receptor blockers) ARBS

- *Beta blocker*
- *Calcium channel blocker*
- *Diuretic*
- *The children generally respond better to drugs that block the renin system. These include 'A' drugs and 'B' drugs*
- *High renin essential hypertension and high renin due to renal or renovascular diseases-ACEI*
- *For volume dependent hypertension-Diuretics*
- *If more than one drug is required, to combine 'A' or 'B' with 'C' or 'D' It is not logical to combine A with B or C with D*
- *If hypertension is still not well controlled, triple therapy; A+C+D or B+C+D should be given.*
- *For infants: Use shorter acting agents for flexibility of dosage; propranolol instead of atenolol, captopril instead of enalapril. Once stable, patient may be changed to the longer acting antihypertensives*

Table 3.9 Dosing Recommendations for the initial Prescription of Antihypertensive

Drugs for Outpatient Management of Chronic Hypertension

Drug	*Age*	*Initial Dose*	*Maximal Dose*	*Dosing interval*
ACE inhibitors *Contraindications: pregnancy, angioedema,* *Common adverse effects: cough, headache, dizziness, asthenia* *Severe adverse effects: hyperkalemia, acute kidney injury, angioedema, fetal toxicity*				
Captopril	*Infants*	*0.05 mg/kg/dose*	*6 mg/kg/day*	*Daily to 4 times a day*
	Children	*0.5 mg/kg/dose*	*6 mg/kg/day*	*Three times a day*
Enalapril	*≥1 month*	*0.08 mg/kg/day (up to 5 mg/d)*	*0.6 mg/kg/day (up to 40 mg/day)*	*Daily to twice a day*
Lisinopril	*≥6 yr*	*0.07 mg/kg/d (up to 5 mg/d)*	*0.6 mg/kg/day (up to 40 mg/day)*	*Daily*
ARBS *Contraindications: pregnancy* *Common adverse effects: headache, dizziness* *Severe adverse effects: hyperkalemia, acute kidney injury, fetal toxicity*				
Losartan	*≥6 yr*	*0.7 mg/kg (up to 50 mg)*	*1.4 mg/kg (up to 100 mg)*	*Daily*
Diuretics *Common adverse effects: dizziness, hypokalemia* *Severe adverse effects: cardiac dysrhythmias, Cholestatic jaundice, new onset diabetes mellitus, pancreatitis*				
Furosemide	*Child*	*1-4 mg/kg/day*		*Daily to 4 times a day*
Chlorothiazide	*Child*	*10 mg/kg/day*	*20 mg/kg/day (up to 375 mg/day)*	*Daily to twice a day*
Hydro-chlorothiazide	*Child*	*1 mg/kg/day*	*2 mg/kg/day (up to 37.5 mg/day)*	*Daily to twice a day*
Calcium channel blockers *Contraindications: hypersensitivity to CCBs,* *Common adverse effects: flushing, peripheral edema, dizziness* *Severe adverse effects: angioedema*				
Amlodipine	*1-5 yr*	*0.1 mg/kg*	*0.6 mg/kg (up to 5 mg/'day)*	*Daily*
	26 yr	*2.5 mg*	*10 mg*	

Nifedipine extended release	*Child*	*0.2-0.5 mg/kg/ day*	*3 mg/kg/day (up to 120 mg/day)*	*Daily to twice a day*

Table 3.10 Treatment of choice for selected causes of hypertension

Suspected Aetiology	*Treatment of choice*
Acute glomerulonephritis	*Diuretics, standard oral antihypertensives*
Reflux nephropathy/Obstructive uropathy	*Relieve obstruction if present standard oral anti-hypertensives-ACE inhibitor*
Renovascular disease	*Standard oral antihypertensives (ACE inhibitor is contraindicated in bilateral renal artery stenosis) Angioplasty surgery*
Phaeochromocytoma	*Phenoxybenzamine and β blocker (Propranolol) Nifedipine Surgery (after adequate α and β blockage)*
Endocrine (this category is complicated and generally has low renin hypertension)	*Depends on the specific disorder and may include; Spironolactone Triamterene/ amiloride Dexamethasone, Thiazide*
Coarctation	*Surgery, standard oral antihypertensives*

Source: Rees L, Webb NIA, Brogan PA; Paediatric Nephrology, Oxford University Press.1s Edition, 2007;334-341

Non-pharmacologic therapy if hypertension is mild

- *Weight reduction*
- *Physical exercise (effective and long term)*
- *Reducing dietary sodium*
- *Avoid tobacco and alcohol*
- *High intake of fruits, vegetables and legumes*
- *Stress reduction (Breath awareness meditation)*