Sudan Hypertension Guideline

Non-Communicable Diseases Directorate

Federal Ministry of Health

&

Sudan Society of hypertension (SSH)

2012

Report of the First Working Party of Federal Ministry of Health Non-Communicable Diseases department, the Sudan Hypertension Society and the Cardiology/ Medicine/ Pediatrics Consultative Councils.

Adopted, with modifications, from:

1-the JNC7 the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure"

2-"WHO/ISH (international society of hypertension) Clinical Guidelines for the Management of Hypertension"

3-"British Hypertension Society Guidelines"

4- "ESC (European society of cardiology) and ESH(European society of hypertension) 2007 Guidelines for the Management of Arterial Hypertension"

5-international society of hypertension in black guidelines for management of hypertension

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PREFACE

Sudan aspires to establish a sustainable systematic health development process to all citizens including prevention of non communicable diseases and their complications to ensure a public well being. As a result, the Ministry of Health has adopted many health policies and programs one of which is establishing local guidelines for the Management of systemic Hypertension. This disease affects 20 percent of the population in Sudan, children and adults alike, and is a leading cause of cardiovascular, cerebrovascular and renal diseases.

The NCDs Directorate and the Sudan Society of Hypertension has an important role in translating guidelines and programs into practical plans of actions, unified in a protocol for early diagnosis and proper management of this health dilemma and its complications. These guidelines were prepared by the First Working Party of the Federal Ministry of Health Non-Communicable Diseases Directorate, the Sudan Hypertension Society and the Cardiology/ Medicine and Pediatrics Consultative Councils.

They have to develop, in collaboration with interested groups, research and evidence based knowledge database specific for issues related to our culture and heritage. These scientific resources should be made readily accessible online, and provide brochures and pamphlets for health care providers.

In this regard, we would like to express our deep appreciation to the members of the Sudan society of Hypertension (SSH) and the NCDs for their efforts in developing these guidelines for the direct use by healthcare providers.

May all of us pray to Allah, the almighty for more success

Prof .Hassan Abuaisha

Contents

ABREVIATIONS

AAFP ----------**American Academy of Family Physicians**
ACE---------- **Angiotensin Converting Enzyme**
ACEIs---------- **Angiotensin Converting Enzyme Inhibitors**
ARBs ---------- **Angiotensin II Receptor Blockers**
BMI----------**Body Mass Index**
BP ----------**Blood Pressure**
CABG----------**Coronary Artery Bypass Graft**
CBC ----------**Complete Blood Count**
CCBs----------**Calcium Channel Blockers**
CHD ----------**Coronary Heart Disease**
CKD---------- **Chronic Kidney Disease**
CO----------**Cardiac Output**
COPD----------**Chronic Obstructive Pulmonary Disease**
CRF----------**Chronic Renal Failure**
CV----------**Cardiovascular**
CVD----------**Cardiovascular Disease**
CVP----------**Central Venous Pressure**
CXR ---------- **Chest X-Ray**
DASH ---------- **Dietary Approach to Stop Hypertension**
DBP ---------- **Diastolic Blood Pressure**
DM ---------- **Diabetes Mellitus**
ECG ---------- **Electrocardiogram**
EMAN----------**East Mediterranean Approach to Non-Communicable Diseases**
ESC---------- **European Society of Cardiology**
ESH ---------- **European Society of Hypertension**
FBS----------**Fasting Blood Sugar**
FEC----------**Final Editing Committee**
FMOH----------**Federal Ministry of Health**
GDP----------**Gross Domestic Product**
HDL---------- **High Density Lipoprotein**
HF----------**Heart Failure**
HPT----------**Hypertension**
ICU---------- **Intensive Care Unit**
IV----------**Intravenous**
IHD---------- **Ischaemic Heart Disease**
ISA ---------- **Intrinsic Sympathomymetic Activity**
JNC----------**Joint National Committee**
K----------**Kortkoff**
LDL---------- **Low Density Lipoprotein**
LV----------**Left Ventricle**
LVH ---------- **Left Ventricular Hypertrophy**
NCDs ---------- **Non-Communicable Diseases**
NSAIDs ----------**Non Steroidal Anti-Inflammatory Drugs**
MAP----------**Mean Arterial Blood Pressure**
MI----------**Myocardial Infarction**

MRI----------Magnetic Resonant Imaging
OCP----------Oral Contraceptive PILLS
PHC----------Primary Health Care
PP----------Pulse Pressure
PPP----------Power Parity per Head
RF----------Risk Factor
RFT----------Renal Function Test
RAA----------Renin Angiotensin
SBP ---------- Systolic Blood Pressure
SHTN---------- Systolic Hypertension
SSH----------Sudan Society of Hypertension
SLE----------Systemic Lupus Erythrymatosus
SVR----------Systemic Vascular Resistance
SR---------- slow release
TIA ----------Transient Ischemic Attack
TOD----------Target Organ Damage
TPA----------Tissue Plasminogen Activator
WHO ---------- World Health Organization
3D CT----------3 Dimensions Computed Scan

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This document was the fruitful outcome of the dedicated efforts of a multitude of persons and institutions. It would not have been possible to produce these guidelines without the contributions, support and encouragement of a group of national consultants in the fields of internal medicine, cardiology, pediatric and public health. The Sudan Society of hypertension and the Consultative Councils in the Federal Ministry of Health were instrumental in leading the efforts which culminated in the production of this manual.

The Non-Communicable Diseases Directorate at the Federal Ministry of Health, the policy making body, extends its special gratitude and deep thanks to the Sudan Hypertension Society and the Cardiology/ Medicine/ Pediatrics Consultative Councils whose without their outstanding efforts and extensive deliberations over a long period of time, this outcome would not have been possible.

Director/NCDs/FMoH

Introduction

Sudan health care system:

The official health care system of the Sudan is a three-tier system. In addition to governmental health services provided by the Federal Ministry of Health ,state ministry of health and armed forces, health services are also provided through different partners including, universities, private sector (both for profit and non-profit), civil society and a newly established health insurance system.

Accessibility to services varies considerably between areas with the rural parts of the country suffering from inadequate coverage.

According to the 25 year strategy for the health sector, Sudan 2002 -2027, rigidity of the organizational structure in the governmental health services at different levels and poor coordination between departments are some of the main problems facing the health care system of the country.

WHO estimates of national health accounts suggest that the percentage of the gross domestic product (GDP) for expenditure on health has been increasing over the 5 years (2000-2005) up to an estimated 4.7% in 2005, composed of both public and private expenditure, thus giving purchasing power parity per head (PPP) of about US$ 48.

Hypertension in Sudan:

Hypertension is the third leading killer in the world. There are one billion hypertensive globally, and four million people die annually as a direct result of hypertension. In the Eastern Mediterranean Region, the prevalence of hypertension averages 26% and it affects approximately 125 million individuals (1).
Hypertension has the highest prevalence among the major NCDs in Sudan (prevalence of 23.6 in Khartoum state) (2) Hypertension accounts for 1.3% of the outpatient visits; it is represented as one of the 10 leading diseases treated in health facilities (outpatients)and also one of the 10 leading causes of deaths in Sudan (3)

The high prevalence of hypertension and its definite role in the development of cardiovascular disease puts hypertension control and prevention as one of the top priorities of the NCDs directorate in Sudan. The development of Sudan guideline for the management of hypertension is a corner stone for the control and prevention of hypertension. These guidelines are intended to standardize the care and to provide all health care providers with practical and up to date information regarding the management of hypertension

Regarding the threshold of intervention the committee adopted a modified approach that is regarded most appropriate for Sudan. The threshold for intervention we present here is relatively lower than the above mentioned guidelines: lack of routine check up and late presentation to health facilities which is commonly observed by the doctors were the reasons behind adopting shorter interval for intervention

1-General issues

1.1 *Target of the guidelines*

To provide accessible, and comprehensive resource document for management of hypertension for health care professionals (Doctors, Nurses, pharmacists and all paramedical) at public and private sectors.

The guideline is aimed to be simple, practical and educational, based on concise protocol, it will distributed to all health workers in primary, secondary and tertiary levels

1.2 Objectives of the guidelines

1. **To promote the primary prevention of hypertension and its cardiovascular diseases by life style modification of high risk groups.**
2. **To increase the detection of under diagnosed hypertension by routine screening and increase awareness of hypertension among the public**
3. **To improve the treatment and control of hypertension to optimal levels <140/90 for all patients and <130/80 for patient with DM,CKD or CVD**
4. **To reduce the risk of cardiovascular disease of treated hypertensive patients by pharmacological and non- pharmacological measures**

1.3 Summary of the Recommendations

1- Measure BP regularly in all persons above 20 years of age even if they are normotensive

2- Diagnosis of hypertension should be confirmed by the mean of two or more appropriate measured blood pressure readings, on two or more visits using a validated machine except in emergency

3- Asses by quick history and examination to rule out secondary cause and to asses for TOD.

4- Baseline investigations: CBC, RFT, urinalysis , FBS and Lipid profile

5- The risk of developing CVD can be estimated using either the categorical classification or the WHO risk prediction charts (if available).

6- Goal of BP level is <140/90 for all people and <130/80 for patients with Dm , CKD or CVD

7- Life-style modifications recommended for all people with high BP and pre-hypertension.

8- If persistent SBP 130-139 and/or DBP 8o--89 mmHg (pre hypertension) Initiate antihypertensive drug therapy according to the presence or absence of

DM , CKD , or an estimated (CVD) risk of ≥20% over 10 years.

9- If persistent SBP 140 --159 and /or DBP90--99mmHg (stage 1)Initiate antihypertensive drug therapy after one month follow up, treat immediately if there is DM or TOD

10- If persistent SBP >160 and/or DBP>100mmHg mmHg.(stage 2) Initiate antihypertensive drug therapy after two weeks of follow up, treat immediately if DM or TOD.

11- The guidelines recommended the use of CCBs or Thiazide diuretics as first line therapy unless there are compelling indications or contraindications for specific classes of antihypertensive drugs.

12- The combination therapy should be used when blood pressure is >20/10 mmHg above the goals.

13- Unless contraindicated, low-dose aspirin (75-100 mg/ day) is recommended for all people needing secondary prevention of ischemic CVD, and primary prevention in people with hypertension over the age of 50 years or who have a 10-year CVD risk ≥30% by using the WHO charts or moderate risk by using the categorical classification

14- Statin therapy is recommended for all people with high BP complicated by CVD, irrespective of baseline total cholesterol or low-density lipoprotein (LDL) levels. Similarly, statin therapy is also recommended for primary prevention in people with high BP who have a 10-year CVD risk ≥20% or moderate risk. Or age more than 65 years

15- Advice is provided on the clinical management of hypertension in specific patient groups, that is, the elderly, diabetes mellitus, chronic renal disease, and in pregnancy and hypertension and surgery

16- Guidelines on the management of hypertension in pediatrics are mentioned separately.

17- A policy for follow-up care at primary and specialist care level is provided in these guidelines.

2-Definitions and classification of Hypertension

2.1 What is Blood pressure?

Blood pressure is the lateral force applied by the blood on the walls of the arteries. It's recorded in two numbers; the higher systolic pressure followed by the lower diastolic pressure. The units are mm of mercury; both figures represent the force of blood against the wall of the arteries.

The higher systolic figure reflects the force of the left ventricle as it contracts in systole. The lower figure reflects the pressure of the blood during the brief time between "beats," the ventricular diastole. While the pressure in the left ventricle at this time drops essentially to 0, the pressure in the aorta normally drops to about 80 mmHg in an adult. This pressure keeps the blood moving even between beats. (4, 5)

2.2 Definition of hypertension:

Hypertension is defined as that level of arterial blood pressure associated with doubling of long-term cardiovascular risk. The diagnosis of hypertension is made when the SBP is ≥ 140 mmHg and or DBP ≥90 mmHg

2.3 Classification

Provided that the readings are taken as the mean of two or more properly measured blood pressure readings, on two or more visits.(1)

- **Normal blood pressure: is defined as level ≤ 120/80 mmHg,** (1)
- **Pre hypertension: is SBP of 120 – 139 and or DBP 80 – 89 mmHg. This group of patients is at increased risk for progression to hypertension and has significantly greater risk to develop future cardiovascular events than those with normal blood pressure. Therefore, they should be identified and managed separately. Clustering of cardiovascular risk factors (e.g., diabetes, dyslipideamia, obesity, and impaired glucose tolerance) is more prevalent in this group than in individuals with normal blood pressure.** (1)
- **Isolated systolic pressure is defined as high systolic pressure with normal diastolic pressure.** (1)
- **Hypertension is two stages according to level of the blood pressure (Table 1).**(6)

Table 1 Classification of hypertension

Classification	Systolic BP (mmHg)	Diastolic BP(mmHg)
Normal	<120	And <80
Pre hypertension	130---139	And /Or 80---89
Stage 1	140---159	And /or 90—99
Stage 2	>160	And /or>100

Simplified from JNC7

2.4 Types of hypertension: (1, 6)

2.4.1 Primary hypertension: it is defined as a systemic hypertension of unknown cause that affects more than 95% of patients

2.4.2 Secondary hypertension: it affects less than 5%.of the patients' It is due to underlying disorder

2.4.2.1 Causes of secondary hypertension (table 2)

Table 2 Causes of secondary hypertension		
Causes of Systolic and diastolic hypertension	1-Renal	➢ Acute Glomerulonephritis, - chronic nephritis- polycystic kidney disease- diabetic nephropathy- hydronephrosis- renal artery stenosis - Intrarenal vasculitis- renin-producing tumours- renoprival-primary sodium retention (Liddle syndrome, Gordon syndrome).
	2-Endocrine	➢ Acromegaly-Hypothyroidism-Hyperthyroidism-Hypercalcaemia (hyperparathyroidism)-adrenal syndromes -Cushing syndrome-primary aldosteronism-congenital adrenal hyperplasia-apparent Mineralocorticoid excess (liquorice)-Pheochromocytoma-Extra-adrenal chromaffin tumours, Carcinoid
	3-Exogenous hormones	➢ Estrogen, Glucocorticoids, Mineralocorticoids,, sympathomimetics, Tyramine containing food, Monoamine oxidase inhibitors
	4- Pregnancy-induced hypertension	
	5-Neurological disorders	➢ Increased intracranial pressure (brain tumours, encephalitis, and respiratory acidosis) Sleep apnoea, Quadriplegia, Familial dysautonomia.
	6-Drugs	➢ NSAID- OCP- Steroids
Causes of Systolic hypertension	1-Increased Cardiac output	➢ Aortic valve insufficiency, Arteriovenous fistula ,Patent ductus arteriosus, Thyrotoxicosis, Paget's disease of bone-Beri-beri, hyperkinetic circulation
	Rigidity of the aorta	
	Iatrogenic hypertension	

3-Prevention of hypertension

3.1 Introduction

WHO Expert Committee on Hypertension Control has stressed the importance of primary prevention of hypertension by preventing the blood pressure rise, lowering blood pressure levels in the population and addressing modifiable risk factors in order to decrease cardiovascular morbidity and mortality. Applying these recommended measures are among the priorities of the Non-Communicable Diseases Directorate of Sudan FMoH. These prevention policies are planned to take place at primary health care and community levels. (1)

3.2 lifestyle modifications

To decrease the incidence of hypertension in the population, the following lifestyle modifications are needed:

- **Weight control**
- **Increased physical activity**
- **Adopting the DASH eating plan**

This can be achieved by improving providers and patient's communication which depend on the provider's confidence and their ability to teach patients the necessary skills to follow the recommendations within the time available for preventive services. This can be achieved by training of the providers and support of patients' education and counseling.

3.3 Target groups for primary prevention:

- **Pre-hypertensive patients.**
- **Individuals with family history of hypertension.**
- **Diabetic patients.**
- **Females with history of hypertension with pregnancy or toxemia of pregnancy.**
- **Individual with risk factors (e.g. smokers, overweight, sedentary life, unhealthy diet).**

The approach should be directed also to: communities, schools, work sites, and food industries.

3.4 Primary prevention of hypertension at PHC settings

The PHC facilities play a major role in early detection and treatment of hypertension. PHC providers should:

Measure BP regularly in all persons above 20 years of age even, if they are normotensive, at least once a year.

Advise patients with mild hypertension on lifestyle modifications, such as reduction of salt intake to 3g per day, which reduces strokes by 33% and coronary heart disease by 25%. Patients can achieve significant reduction in blood pressure by making appropriate changes to their lifestyle.

3.5 Community approach to hypertension prevention

The community approach to hypertension prevention has high degree of generalization and cost- effectiveness.The objectives of Sudan community approach for hypertension prevention goes in line with the East Mediterranean Approach to Non-communicable diseases (EMAN)

for primary hypertension prevention which aims at reducing the major risk factors for cardiovascular disease and their social and economic determinants. This could be achieved through launching community based programs that target both prevention and control of hypertension besides development of standards of care and cost effective case managements. This approach also emphasizes the importance of establishing effective collaboration between those implementing the community approach and the health authorities to sustain primary prevention.

4-Diagnosis and evaluation

4.1 Diagnosis of hypertension

Early **Diagnose and manage of hypertension is important to prevent its complications (1)**

Uncomplicated hypertension is usually asymptomatic or gives rise to minimal symptoms. Therefore, it usually goes unrecognized for several years and when obvious symptoms and signs develop this usually indicates the onset of target organ damage (TOD).

Anticipate hypertension in adults when the average of two or more DBP is ≥90 and/or SBP is ≥140 mmHg on at least two subsequent visits

Inform patients clearly that a single elevated reading does not constitute a diagnosis of hypertension but is a sign that further observation is required. (1)

4.2 BP measurement technique and devices:

The Person should be seated quietly for at least 5 minutes in a chair with the arm supported at heart level. Caffeine, exercise, and smoking should be avoided for at least 30 minutes prior to measurement. No exogenous adrenergic stimulants e.g. nasal decongestants should be administered before measuring the blood pressure. (1)

- **Use An appropriately sized cuff (cuff bladder encircling at least 80 percent of the arm) and the length should be one and half time the arm circumference to ensure accuracy , the examiner should have a larger and a smaller bladder available for fat and thin arms, respectively table(3)**

Table (3) Correct cuff sizes based on mid-arm* circumferences

Arm circumference (cm)	Bladder size (cm)
<33	13 X 24 (regular cuff)
33- 42	17 X 32 (large cuff)
>42	20 X 42 (thigh cuff)

- **Inflate by 20 mmHg above the systolic BP (determined by the pulse) and deflate by 3 mmHg every second, Korotkoff sounds should be heard at least every 2 mmHg gradation of the mercury column.**

- **Take the mean of at least two measurements spaced by 1–2 minutes. Additional measurements might be needed if the first two are quite different (more than 5 mm Hg difference) until two readings are close.(8)**
- **Measure BP in both arms at first visit and take the higher value as the reference one.**
- **Take multiple measurements routinely in patients with irregular pulse (e.g. atrial fibrillation) and in older patients with systolic hypertension.**
- **Use phase I and V (disappearance) Korotkoff sounds 1 (8) to identify systolic and diastolic BP, respectively. If the phase V goes to zero, phase IV should be used to identify the diastolic blood pressure.**
- **Use a mercury sphygmomanometer or validated aneroid device. Make sure various parts e.g. rubber tubes, valves, amount of mercury, are kept in proper order. (1)**
- **Measure BP regularly in all persons above 20 years of age even if they are normotensive.**
- **Encourage the patients to monitor their BP at home and record the readings.**

4.3 Recommended response when hypertension is suspected during the first visit

Table (4) recommended response during first visit

Initial BP measurement (mmHg)	Recommended response
Normal or optimal	Recheck every year if the age above 40 years
Pre hypertension	Recheck every 6 months (treat if DM or CKD)
Stage 1 SBP 140-159 and/or DBP 90-99	Check every week for one month (treat if DM or CKD)
Stage 2 SBP>160- and/or DBP>100	Confirm with two readings every week for two week(treat if DM or CKD)

` **Korotkoff Phase I:** begins with the sudden appearance of a faint, clear, tapping or thumping sound that gradually increases in intensity .**Phase II***:* phase II begins when the sounds change to a loud "swishing" murmur. **Phase III**: the beginning of Phase III occurs when the sounds assume a loud, distinct, knocking quality. These sounds are less intense than those of Phase I. **Phase IV**: begins when the sounds suddenly become muffled and have a faint murmur-like or "swishing" quality. **Phase V:** begins when silence develops."

(7) Modified by the FEC

***Ambulatory BP monitor should be used by senior health care providers. if indicated**

1- suspected white coat hypertension
2-suspected episodic hypertension
3-hypertension resistant to increased medication
4-symtoms while having antihypertensive medication
5-autonomic dysfunction
6- to evaluate whether antihypertensive therapy is moderating early morning B.P. surge
7- large variation in B.P. values
8- elevated office B.P. in pregnant women with suspected pre-eclampsia
9-to establish non dipper status or nocturnal

4.4 Initial assessment of newly diagnosed hypertensive patient

Assess every new patient with hypertension through history taking, examination and investigations for:

1. **Secondary causes.**
2. **Risk factors for cardiovascular diseases.**
3. **Contributory factors.**
4. **Target organs damage.**
5. **Associated clinical conditions.**
6. **Drug contraindications.**

Table (5) Initial assessment of newly diagnosed hypertensive patient

1)Assessment f causes (Most common causes) (7)	**Drugs: e.g.NSAID's,oral contraceptive and steroids Renal disease - Reno - vascular disease (abdominal or loin bruit) Endocrine disease: pheochromocytoma, Conn's syndrome, Cushing syndrome Coarctation of the aorta (radio-femoral delay or weak femoral pulses)**
2)Assessment of risk factors for	**Systolic and diastolic BP levels Levels of pulse pressure (in the elderly) Age (M . 55 years; W . 65 years)**

ovascular diseases (10)	Smoking Dyslipideamia Total cholesterol 5.0 mmol/l (190 mg/dl) 1. LDL-C: 3.0 mmol/l (115 mg/dl) 2. HDL-C: a. Male: 1.0 mmol/l (40mg/dl), b. Female: 1.2 mmol/ (46 mg/dl) 3. TG: 1.7 mmol/l (150 mg/dl) Fasting plasma glucose 5.6–6.9 mmol/L (102–125 mg/dl) Abnormal glucose tolerance test Abdominal obesity (Waist circumference .102 cm (M), .88 cm (W)) Family history of premature CVD: Male at age , 55 years; Female at age ,65 years) (2)
Assessment of contributory factors (1)	Overweight, Lack of exercise Excess alcohol intake (>3 units/day) - Excess salt intake Environmental stress
Target Organ Damage	Stroke, TIA, dementia, carotid bruits LVH and/or LV strain on ECG, heart failure Myocardial infarction, angina, CABG or angioplasty, Peripheral vascular disease Fundal hemorrhages or exudates, papillodema Proteinuria, Renal impairment (raised serum creatinine)
Associated clinical conditions	Diabetes- CVD –CHD- Chronic heart failure-CKD Aortic disease-Peripheral arterial disease Hypercholesterolaemia
Drug contraindications	The treatment of hypertension will be tailored to each patients according to the initial assessment.(1)

The treatment of hypertension will be tailored to each patient according to the initial assessment. (1)

4.5 Patient evaluation

4.5.1 Clinical history:

Ask about:

1. Duration of high blood pressure
2. Symptoms indicating presence of secondary hypertension.
3. Family history of cardiovascular disease, hypertension and/ or Hyperlipidemia.
4. Drug intake: oral contraceptives, steroids, non-steroidal anti-inflammatory drugs .
5. Symptoms of target organ damage:
   - Eye: impaired vision
   - Brain: headache, vertigo, transient ischemic attacks, sensory or motor deficits.
   - Heart: palpitation, chest pain, shortness of breath, swollen ankles
   - Kidney: dysuria, haematuria
   - Peripheral arteries: cold extremities, intermittent claudication
6. Environmental factors that influence hypertension.
7. Tobacco use
8. Diet

9. **Exercise**
10. **Stress**

4.5.2 Physical examination:

Check for:

1. **Evidence of visceral obesity:**
   - **Body Weight ,BMI,waist circumference (wcc),Hip circumference (HCC),WCC/HCC, mid arm circumference**
2. **Signs of secondary hypertension.**
   - **General features of Cushing syndrome.**
   - **Pulse for diminished and delayed femoral pulse and reduced femoral blood pressure (coarctation of the aorta)**
   - **Palpation of enlarged kidneys (e.g. polycystic kidney)**
   - **Auscultation of precordial or back murmurs (aortic disease) or abdominal murmurs (renovascular hypertension)**
3. **Signs of target organ damage**
   - **Brain: Murmurs over neck arteries, motor or sensory defects**
   - **Eyes: fundoscopic abnormalities**
   - **Heart: Cardiac enlargement, arrhythmias, gallop sound, pulmonary crackles, dependent edema.**
   - **Peripheral arteries: Absence, reduction, or asymmetry of pulses, cold extremities, ischemic skin lesions .**

4.5.3 Investigations:

1. **Urine strip test for Albumin and blood.**
2. **Serum creatinine and electrolytes.**
3. **Fasting blood glucose.**
4. **Fasting lipid profile.**
5. **Haemoglobin and haematocrit**
6. **Electrocardiogram (ECG).**

4.6 Assessment of CVD risk

4.6.1 Methods:

The risk of developing CVD can be estimated using either the categorical classification or the WHO risk prediction charts annex (2).

The two methods of calculating the risk could estimate approximately the risk of cardiovascular disease morbidity and mortality in the coming 10 years.

On these guidelines we highly recommend the use of WHO risk chart since it can give more precise assessment of the risk. However, the categorical method can be used when the risk assessment charts are not available.

4.6.2 Categorical classification: According to the level of the blood pressure and the presence or absence of the risk factors of cardiovascular disease hypertensive patients can be classified into three categories: low risk, medium risk, high risk. (see table below)

Table (6): Stratification of risk to quantify prognosis in hypertensive patient

Risk factor and disease history	Stage 1 : SBP 140-159 and/or DBP 90-99	Stage 2: SBP >160 and/or DBP >100
No risk factors, no TOD	Low risk	Medium risk
1-2 risk factors or TOD	Medium risk	High risk
3 or more risk factors or TOD	High risk	High risk

SBP, systolic blood pressure; DBP, diastolic blood pressure, TOD, target organ damage; *modified from the who and JNC

4.6.3 WHO Risk chart

The WHO/ISH risk prediction charts indicate 10-year risk of a fatal or nonfatal major cardiovascular event (myocardial infarction or stroke), according to age, sex, blood pressure, smoking status, total blood cholesterol and presence or absence of diabetes mellitus for WHO epidemiological sub-regions D annex (2).

There are two sets of charts one can be used in settings where blood cholesterol can be measured and the other set is for settings in which blood cholesterol cannot be measured.

Each chart can only be used in countries of the specific WHO epidemiological sub-region, in Sudan the recommended chart is the East Mediterranean region chart (EMRO)(1).

4.6.3.1 How to use the WHO risk prediction chart

Calculate a score based on several risk factors as a % chance, for example, if the score is 30% this means that there is a 30% chance of developing a cardiovascular disease within the next 10 years.

- **High risk - if the score is 20% or more. (That is, a 2 in 10 chance or more of developing a cardiovascular disease within the next 10 years.)**
- **Moderate risk - if the score is 10-20% (between 1 in 10 and 2 in 10 chance).**

- **Low risk - if the score is less than 10% (less than a 1 in 10 chance)**

(Risk assessment chart annex (2).

4.7 Mean arterial pressure

4.7.1 Clinical significance

***MAP* is considered to be the perfusion pressure seen by organs in the body. It is believed that a *MAP* that is greater than 60 mmHg is enough to sustain the organs of the average person.**

***MAP* is normally between 70 to 110 mmHg**

If the *MAP* falls significantly below this number for an appreciable time, the end organ will not get enough blood flow, and will become ischemic

Mean arterial pressure can be determined from:

$$\mathbf{MAP = (CO \times SVR) + CVP}$$

Where:

- ***CO* is cardiac output**
- ***SVR* is systemic vascular resistance**
- ***CVP* is central venous pressure and usually small enough to be neglected in this formula.**

At normal resting heart rates *MAP* can be approximated using the more easily measured systolic and diastolic pressures, *SP* and *DP*:

$$MAP \simeq DP + \frac{1}{3}(SP - DP)$$

or equivalently

$$MAP \simeq \frac{2}{3}(DP) + \frac{1}{3}(SP)$$

or equivalently

$$MAP \simeq \frac{(2 \times DP) + SP}{3}$$

or equivalently

$$MAP \simeq DP + \frac{1}{3}PP$$

Where *PP* is the pulse pressure, *SP – DP*

At high heart rates *MAP* is more closely approximated by the arithmetic mean of systolic and diastolic pressures because of the change in shape of the arterial pressure pulse. (9, 10)

5-Treatment of hypertension

5.1 Goals of treatment:

The goal in the treatment of hypertension is to reduce the long term risk of cardiovascular morbidity and mortality. This requires: (1)

- **Treatment of modifiable risk factors , such as; smoking, dyslipideamia, obesity, diabetes mellitus**
- **Proper management of associated clinical conditions, such as; congestive heart failure, coronary artery disease, transient ischemic attacks**
- **Achievement of blood pressure value ≤140/90 for patients with no diabetes or chronic renal disease.**
- **Achievement of blood pressure value ≤ 130/80 mmHg for patients with diabetes mellitus, or chronic renal disease.**

5.2 Patient involvement:

Hypertension is a lifelong disease and its treatment requires commitment to lifestyle change and taking regular medication besides regularly attending follow–up appointments.

Patient involvement in the treatment makes it more likely that the patient will adhere to the medication, thus achieving good control.

Effective involvement starts with adequate explanation of the nature of the disease, discussion of the risk factors that might lead to its development, and where appropriate the patients should be involved in the decision as to whether they should take lifestyle action or start drug therapy, and in particular decisions about which individual drugs they should take, possible side-effects and the likelihood that they may need to take at least two, or even three.

Adequate explanation of the all relevant information should be carried out in a simple language. Special attention should be paid to people with low reading skills and the elderly since they may have difficulty in recalling the information. Moreover, a written plan should be provided to all patients in order to improve their adherence to treatment.(8)

5.3 General guidance

- **Patients with isolated systolic hypertension have the same risk for developing cardiovascular events as those with high diastolic pressure. Therefore, they should be treated when the diagnosis is confirmed.**
- **Treating hypertension is associated with decrease in cardiovascular complications, including 35%-40% reduction in stroke incidence, 20%-25% reduction in myocardial infarction and≥ 50% reduction in heart failure.**
- **Establish a partnership with the patient and involve him adequately in formulating the management plan so as to encourage, trust and adherence to treatment**
- **Consider cultural beliefs and individual attitude in formulating treatment plan**
- **Involve the whole family to facilitate the adoption of healthy lifestyle and to increase adherence to the medication**

5.4 Plan of management after confirmation of pre hypertension and hypertension *: table (3)*

1. **Lifestyle modifications**
2. **Pharmacological therapy**

(Table 7) Plan of management after confirmation of pre hypertension and hypertension			
Presence or absence of CVD risk factors and diseases	Pre hypertension SBP 130-139 And/ Or DBP 80-89	Stage 1 HTN SBP 140-159 And /Or DBP 90-99	Stage 2 HTN SBP >160 And/ Or DBP >100
No risk factors (Low risk) or (score less than 10%)	Life style change Check BP every 6 months	Lifestyle change + Treatment if persistently high over 2 months	Lifestyle change + Drug treatment if persistently high over one month
1-2 risk factors (moderate risk) or (score 10-20%)	Lifestyle change + Check BP every 2months + consider treatment if persistently high for 6 months	Lifestyle change + Treatment if persistently high over one month	Lifestyle change + Immediate Drug treatment (consider combination therapy)
≥3 risk factors or High risk (score is ≥ 20%) Or DM or established CKD or CVD	Life style change + Immediate drug treatment	Life style change + Immediate drug treatment	Life style change + Immediate Drug treatment

5.5 Lifestyle modifications:

Lifestyle modification prevents hypertension, decrease blood pressure, enhance antihypertensive drug efficacy and decrease cardiovascular risk. (1)

The life style measures that should be considered in all patients are:

- **Cessation of smoking :This the most important lifestyle measure for prevention of cardiovascular and non-cardiovascular diseases, including stroke and coronary heart disease.**
- **Weight reduction and physical exercise :Weight reduction reduces blood pressure in overweight patients by 1.6/1.1 mmHg for every kilogram of weight loss, and also has positive effects on associated risk factors such as diabetes, Hyperlipidemia and left ventricular failure.Weight reduction may be achieved by increase in physical exercise such as brisk walking for at least 30 minutes per day, most days of the week.**
  NB:For poorly controlled hypertensive patients heavy physical exercise should be discouraged.
- **Reduction of salt intake and other dietary changes :Reducing sodium intake to 2.4 g sodium or 6 g sodium chloride reduces SBP by 4-6 mmHg. Patients should be advised to avoid salted food, to eat more fish, potassium, fruit and vegetables and to reduce intake of saturated fat. This is achieved by adoption of Dietary Approach to Stop Hypertension (DASH) that is rich in fruits, vegetables and low-fat dairy foods (whole grains, poultry, fish and nuts) and increased amount of potassium, calcium, magnesium, dietary fiber and protein, and is reduced in fats, red meat, sweets and sugar. The combination of low sodium intake and DASH diet is more effective than either alone.**

Table 4: Summary of the recommended lifestyle modifications

Modification	Recommendation	Approximate SBP reduction
Weight reduction	Maintain normal body weight	5–20 mmHg/10kg
Adopt DASH	Consume a diet rich in vegetables, fruits, and eating plan low-fat dairy products with a reduced content of saturated and total fat	8–14 mm Hg
Dietary sodium	Reduce dietary sodium intake to no more than sodium chloride 2.4 g sodium or 6 g restriction	2–8 mmHg
Physical activity	Engage in regular aerobic physical activity at least 30 minutes daily, most days of the week	4–9 mmHg

5.6 Pharmacological therapy:

5.6.1 General Guidelines (1)

- **Once the selection of the most appropriate agent for initial therapy has been made .a relatively low dose of a single drug should be started, aiming for a reduction of 5 to 10 mm Hg in blood pressure at each step.**
- **Thus, there should be a gradual approach to antihypertensive therapy in order to avoid symptoms related to overly aggressive blood pressure reduction.**
- **Individualized therapy. Perhaps the most crucial factor in the selection process is the presence of one or more concomitant conditions, some that could be worsened by the drug chosen, others that could be improved**
- **Drug combinations. Combinations of smaller doses of two drugs from different classes is better to take advantage of the differences in the dose-response curves for therapeutic and toxic (side) effects**
- **Better to choose long acting preparations providing effective, 24-hour control of hypertension in a manner that encourages adherence to the regimen.**

5.6.2 Initiation of drug treatment

Is determined by presence or absence of compelling indications for the use of specific drug:

- **In patients without compelling indications, the drug therapy must be initiated by thiazide diuretic or long acting Calcium channel blocker.**
- **In patients with compelling indications, initial drug is based on outcome data- from clinical trials- for specific anti-hypertensive drugs in treatment of special groups according to benefits of drugs on the associated condition.**

5.6.3 Compelling indication:

- **Ischemic heart disease**
  - **In patients with stable angina, the drug of choice is β-blocker, alternatively calcium channel blockers (CCBs) can be used.**
  - **In patients with unstable angina or myocardial infarction initial drug therapy should be β-blockers and angiotensen converting enzyme inhibiters (ACEI)**
  - **In post myocardial infarction angiotensen converting enzyme inhibiters (ACEI), β-blockers and aldosterone antagonists are recommended.**

- **Heart failure**
  - **For patients with asymptomatic ventricular failure, ACE inhibitors and β-blockers are recommended**
  - **For patient with clinical heart failure, ACE inhibitors, β-blockers, angiotensen receptor blockers (ARBs), aldosterone blockers and loop diuretics are recommended**

- **Diabetes mellitus**

  - **Combination of two or more drugs are needed to achieve blood pressure of ≤ 130⁄80 mmHg**
  - **ACE inhibitors and ARB- treatments decrease the progression of diabetic nephropathy and reduce albuminuria.**
  - **Thiazide diuretic, ACE inhibitors, β-blockers, angiotensen receptor blockers (ARBs), and calcium channel blockers (CCBs) are beneficial decreasing cardiovascular diseases and stroke incidence.**

- **Chronic renal disease**
  - **Patients with chronic renal disease should receive aggressive blood pressure management to delay impairment of renal function and prevent cardiovascular complications. Three or more drugs are needed to reach target blood pressure of ≤ 130⁄80mmHg.**
  - **ACE inhibitors and ARBs have good effects on the prognosis of renal disease**
  - **With advanced renal disease increased doses of loop diuretic combined with other drugs are needed.**

- **Cerebrovascular disease**

  To prevent intracerebral bleeding in patients with recent ischemic stroke whose blood pressures are very high, cautious reduction of blood pressure by about 10%-15% is needed and this can be achieved by carefully monitored infusion therapy.

Table 5: Indications and contraindications of antihypertensive drugs

Class of drug	Compelling indications	Possible indications	Caution	Compelling Contraindications
Alpha-blockers	Benign prostatic Hypertrophy		Postural Hypotension Heart failure	Urinary incontinence
ACE inhibitors	Heart failure, LV dysfunction post MI Established CHD type I diabetic nephropathy secondary stroke prevention	Chronic renal disease type II diabetic nephropathy, proteinuric renal disease	Renal impairment PVD	Pregnancy Reno vascular Disease
ARBs	ACE inhibitor intolerance Type II diabetic Nephropathy Hypertension with LVH Heart failure in ACE-intolérant patients post MI	LV dysfunction post MI Intolerance of other antihypertensive drugs proteinuric renal disease Chronic renal disease, Heart failure	Renal impairment PVD	Pregnancy, Reno vascular Disease
Beta-blockers	MI Angina	Heart failure	Heart failure, PVD Diabetes (except with CHD)	Asthma/COPD, heart block
CCBs (dihydropy-	Elderly	Elderly, Angina		

ridine)	Isolated systolic hypertension			
CCBs (rate limiting)	Angina	MI	Combination with beta-blockade	Heart block, heart failure
Thiazide/thiazide-like diuretics	Elderly, Isolated systolic hypertension Heart failure, Stroke prevention			Gout

5.6.4 Other drugs in the management of hypertensive patient

- **Aspirin: Unless contraindicated, low-dose aspirin (75 --100mg/ day) is recommended for all people needing secondary prevention of ischemic CVD, and primary prevention in people with hypertension over the age of 50 years or who have a 10-year CVD risk ≥30%**
- **Statin: therapy is recommended for all people with high BP complicated by CVD, irrespective of baseline total cholesterol or low-density lipoprotein (LDL)-cholesterol levels. Similarly, statin therapy is also recommended for primary prevention in people with high BP who have a 10-year CVD risk ≥20%. The target is to achieve optimal cholesterol lowering and that implies reduction of the total cholesterol by 25% or LDL-cholesterol by 30% or achieves total cholesterol of 4.0 mmol/l or LDL-cholesterol of 2.0 mmol/l, whichever is the greatest reduction**

5.6.5 Selection of antihypertensive drugs

The selection on antihypertensive drug is based on the presence or absence of compelling indication as indicated on the table above.

- **Use of a single drug**

The use of a single antihypertensive drug increases the adherence to the medication. However the response to the anti-hypertensive drugs is substantially different between the patients and the use of single drug will reduce the BP by no more than 7-8%. Therefore, the use of single drug is indicated mainly for patients with mild hypertension (8).

When single drug is chosen to treat hypertension it is recommended to start with a low dose and build up the dose until adequate blood pressure control is achieved. If the patient developed persistent side effects or the control is not achieved try another drug from another class and if no response then two or three drugs should be combined (1)

- **Use of combined therapy**

Most of the patients will need to use more than one drug due to the heterogeneity in the pathogenesis of BP elevations and the multiplicity of pathophysiological mechanisms responsible for high levels of BP.

The combined therapy should be considered when blood pressure is >20/10 mmHg above the goal and it is generally recommended to use drugs with different mode of action when com-

bined therapy is indicated, fixed drug combinations are recommended to reduce the number of medications, which may enhance adherence to treatment (1)

The policy of combining therapy we are recommending here is modified from the British Hypertension Society Algorithm (ABCD). The algorithm is developed to improve the control of hypertension and it is based on the notion that the renin levels are different among different groups of people (Caucasian have high renin / African have low renin) (8).

In these guidelines we recommend starting the treatment with diuretics or long acting calcium channel blockers (drugs with minimal effect on the rennin- angiotensin system) and then to add a drug with strong effect on the rennin- angiotensin system e.g. Angiotensin converting enzyme inhibitors, or angiotensin receptor blocker.

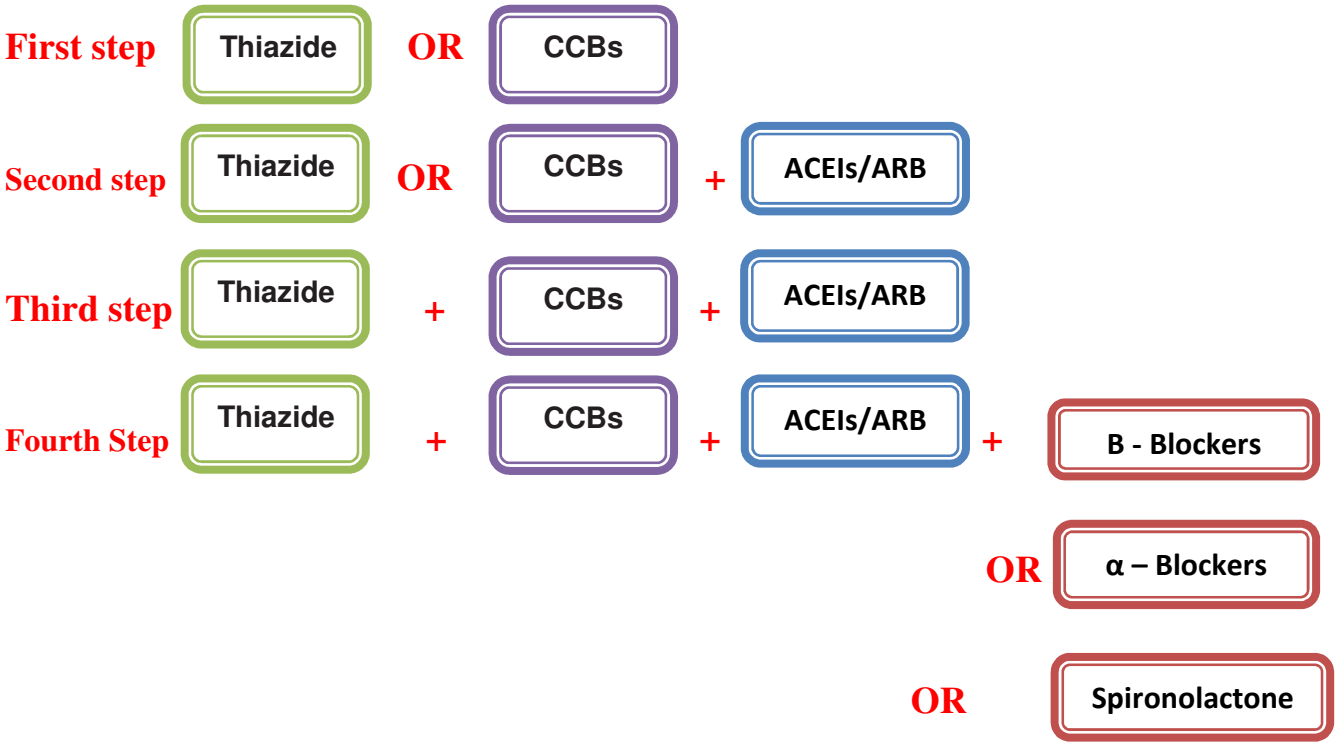
NB: diuretics enhance the effects of beta blockers and ACE inhibitors in African

5.6.6 Steps of combining the drugs are (6)

1. **Use of two drugs at low dose**
2. **Use of the two drugs at full dose**
3. **Use previous combination at full dose in addition to a third drug on low dose**
4. **Use of the three drug combination of full dose.**

The diagram below illustrates the recommended drugs in combination therapy: (If there is any compelling indication that prevent following these steps, the patient should be treated accordingly)

Combining antihypertensive therapy[٢]:



This approach of combined therapy is modified from the British Hypertension Society Guidelines [٢]

OR

Other diuretics or centrally acting

6-Follow-up for patients with hypertension

6.1 Level of follow up

All the patients with essential hypertension can receive the medical care at primary care level (non-specialist care)

Refer patient to specialist care if any of the below criteria is present

- **Secondary hypertension**
- **Age less than 40 years (younger patients may have secondary hypertension which need to be treated under specialist care)**
- **Presence of co morbidity: DM, heart disease, stroke, TIA, Kidney disease.**
- **Blood pressure not controlled with the use of single drugs or two drugs**
- **Albuminuria.**
- **Hyperlpidaemia (cholesterol more than 8 mmol/l).**

6.2 Frequency of the follow-up visits at PHC level

All patients with hypertension should be provide with regular follow-up, the follow up intervals can vary from one week to one year according to patient's condition.

Arrange follow- up visits as follows:

- **Grade 1: Monthly until goal blood pressure is achieved, then every 3 to 6 months.**
- **Grade 2: every 2 weeks until goal blood pressure achieved then every 3 months.**
- **Grade 3: weekly until the goal blood pressure achieved then every 3 months**
- **In the presence of co-morbidity as DM or heart disease might increase the follow up frequency.**

6.3 What to do during the follow-up visit

1. **Check the blood pressure**
2. **Check adherence to medication**
3. **Advice and educate `on life style modification**
4. **Inquire about symptoms that indicate the presence of target organ damage (complication) e.g. breathlessness, chest pain**
5. **Examine for signs of target organ damage**
6. **Investigate as required;**
    - **One week after initiating ACEIs : Serum creatinine and electrolytes**
    - **Annual routine investigations: Lipid profile. renal function test and electrolytes**
    - **Other investigation is requested according to the symptoms of target organ damage and the presence of concomitant disease e.g. DM**
7. **Decides whether to continue the same management plan or to modify it.**

6.4 Modifying the management plan: (13)

Increase the dose of antihypertensive drugs if adequate response is not achieved.
The increment of the antihypertensive dose depends on the maximum drug effect,
Plan the increment in the doses follow:

- **Diuretics: after one month**
- **ACEIs: 2 weeks to 1 month**
- **CCBs: 2 weeks to 1 month**
- **ARBs: 2 weeks to 1 month**

Consider reduction or discontinuation of antihypertensive drugs if the targeted blood pressure achieved and maintained for a period at least of one year, features in favor of withdrawal are: (1)

- **Low blood pressure before and after therapy.**
- **Control of the blood pressure with a low dose of medicine.**
- **Patient's willingness to maintain healthy lifestyle.**

In above cases decrease the dose first and then stop it if a good response has been maintained.

Keep the patient on regular follow even after discontinuing the medication to maintain the blood pressure under control.

7-MANAGEMENT OF HYPERTENSION CRISES

7.1 Frequency:

Approximately 1% of hypertensive patients will develop acute elevations in blood pressure at some point in their life.

7.2 Types:

1. **Hypertensive emergencies: These conditions are characterized by severe elevations in BP (>180/120 mmHg) complicated by target organ dysfunction (11)**
2. **Hypertensive urgencies: This term is used for patients with severely elevated blood pressure without acute end-organ damage.**

7.3 Aims of Treatment

1. **To reduce the BP safely to non morbid levels.**
2. **To prevent end organ damage.**
3. **To tackle co morbidities.**
4. **To prevent precipitating ischemic attack.**

7.4 Hypertensive emergencies:

7.4.1 Clinical conditions that meet the diagnostic criteria for hypertensive emergency:

1. **Hypertensive encephalopathy**
2. **Dissecting aortic aneurysm**
3. **Acute left ventricular failure with pulmonary edema**
4. **Acute myocardial ischemia**
5. **Eclampsia**
6. **Acute renal failure**
7. **Symptomatic microangiopathic hemolytic anemia**

7.4.2 The Clinical manifestations of hypertensive emergencies

- **The clinical manifestations are those associated with end-organ dysfunction. Organ dysfunction is uncommon with diastolic blood pressures less than 130 mmHg except in children and in pregnant women [the absolute level of blood pressure may not be as important as the rate of increase].**
- **In patients with longstanding hypertension a systolic blood pressure of 200 mmHg or elevations in diastolic pressure up to 150 mmHg may be well tolerated without the development of hypertensive encephalopathy, whereas children or pregnant women may develop encephalopathy with a diastolic blood pressure of only 100 mmHg.**
- **Hypertensive encephalopathy gives rise to headache, altered level of consciousness, and/or focal neurologic sign. On physical examination, these patients may have retinopathy with arteriolar changes, hemorrhages and exudates as well as papilledema.**
- **Cardiovascular manifestations may predominate, with angina, acute myocardial infarction, or acute left ventricular failure**
- **Renal manifestation: in some patients, severe injury to the kidneys may lead to acute renal failure with oliguria and/or haematuria.**
- **In pregnant patients, the clinical features vary but may include visual field defects, severe headaches, seizures, altered mental status, acute cerebro- vascular accidents, severe right upper quadrant abdominal pain, congestive heart failure, and oliguria. In the vast majority of cases, this process can only be terminated by delivery. The decision to continue the pregnancy or to deliver the baby should be made following consultation between medical and obstetric personnel**
- **Aortic dissection should be considered a likely diagnostic possibility in patients presenting with acute chest pain and elevated blood pressure. Left untreated, about three-quarters of patients with type A dissection die within 2 weeks of an acute episode, but with successful initial therapy the 5-year survival rate increases to 75%.**

7.4.3 Evaluation and management of hypertensive emergencies

- **Distinct between a hypertensive emergency which involve TOD and hypertensive urgency on the basis of the clinical evaluation.**
- **Measure the blood pressure in both arms by Physician.**
- **Use appropriately sized cuffs in obese patients**

- **Physical examination should include palpation of pulses in all extremities, auscultation for renal bruits, focused neurologic examination, and a fundoscopic examination.**
- **Investigate :**
    1) **Complete blood count**
    2) **Blood smear (to exclude a microangiopathic anemia),**
    3) **Electrolytes, blood urea, creatinine,**
    4) **urinalysis**
    5) **Electrocardiogram.**
    6) **Chest radiograph should be obtained in patients with shortness of breath or chest pain,**
    7) **Head computed tomography (CT) scan should be obtained in patients**
    8) **Chest CT scan or magnetic resonance imaging scan should be considered in patients with unequal pulses and/or evidence of widened mediastinum on the chest radiograph.**

Remember patients in whom an aortic dissection is considered should not undergo transesophageal echocardiography until the blood pressure has been adequately controlled.

7.4.4 Initial Therapeutic Approach (11)

- **Treat patients with hypertensive emergencies in intensive care unit for continuous monitoring of BP and intravenous administration of an appropriate drug (table 1).**
- **Reduce mean arterial BP by no more than 25 percent (within minutes to 1 hour), then if stable, to 160/100–110 mmHg within the next 2–6 hours, this is the initial goal therapy.**
- **Avoid excessive fall in pressure that may precipitate renal, cerebral, or coronary ischemia. Therefore, short-acting Nifidipine is no longer considered acceptable in the initial treatment of hypertensive emergencies or urgencies.**
- **If this level of BP is well tolerated and the patient is clinically stable, implement further gradual reductions toward a normal BP in the next 24–48 hours.**
- **Exceptions to the above recommendations are:**
    - **Patients with an ischemic stroke in which there is no clear evidence from clinical trials to support the use of immediate antihypertensive treatment;**
    - **Patients with aortic dissection who should have their SBP lowered to <100 mmHg if tolerated, and**
    - **Patients in whom BP is lowered to enable the use of thrombolytic agents.**

7.4.5 Recommended antihypertensive agents for hypertensive crises table (8)

Table (8) antihypertensive agents for hypertensive crises	
Condition	**Preferred antihypertensive agent**
Acute pulmonary edema	nitroglycerin (up to 60 µg/min) and a loop diuretic if needed IV CCBs
Acute myocardial ischemia	Labetalol or Esmolol in combination with nitroglycerin (up to 60 µg/min)
Hypertensive encephalopathy	Labetalol, Nicardipine, or Fenoldopam
Acute aortic dissection	Labetalol or combination of Nicardipine or Fenoldopam and Esmolol or combination of Nitroprusside with either Esmolol or intravenous Metoprolol
Eclampsia	Labetalol or CCBs, Hydralazine may be used in a non-ICU setting
Acute renal failure, microangiopathic anemia	Hydralazine or CCBs
Sympathetic crisis/cocaine overdose	Verapamil, Diltiazem, or Nicardipine in combination with a benzodiazepine

7.5 Hypertensive urgency:

This term is used for patients with severely elevated blood pressure without acute end-organ damage

- **Patients with hypertensive urgencies may benefit from treatment with an oral, short-acting agent such as captopril, (other drugs) followed by several hours of observation.**
- **Use alternative approach adjustment in their antihypertensive therapy, particularly the of combination drugs, or reinstitution of medications if noncompliance is a problem**
- **Check patient with hypertensive urgency in the refer clinic in a week time**
- **Reduce blood pressure gradually, the term urgency led to over treatment which is not without risk therefore.**

Figure ١ Management of severe hypertension (11)

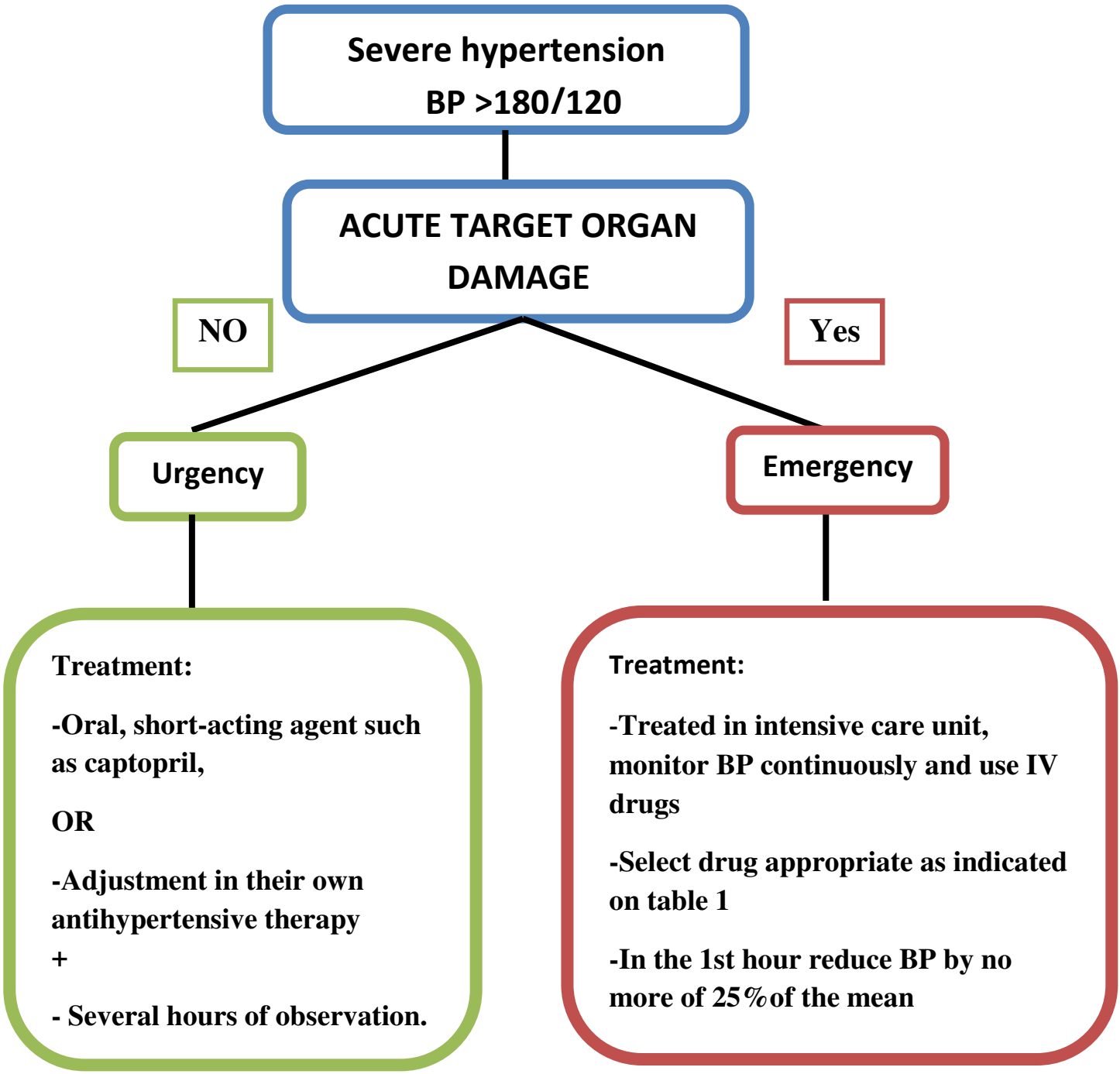


Table (9) Hypertensive emergency drugs					
Drug	**Dosage**	**Onset of action**	**Duration of action**	**Special indications**	**Adverse effects**
Nitroprusside	0.25–10 µg/kg per min	Instanta-neous	1-2 min	Most hypertensive emergency, caution with high and intracranial pressure, cyanide intoxication or azotemia	Nausea, vomiting, twitching, thiocyanate toxicity (AVOID its use for more than 48 to prevent the side effects)
Hydralazine	10–20 mg/ IV 10–50 mg/ IM	10–20 min 20–30 min	1–4 hrs 4–6 hrs	Eclampsia	Tachycardia, flushing, headache, or aggravation of angina
Labetalol	20–80 mg IV Bolus every 10 min, infusion 2 mg/min IV	5–10 min	min 3–6 hrs	Most hypertensive except acute heart failure	Vomiting, burning throat, postural hypotension scalp tingling
Esmolol	250-500 µg/kg per min bolus then 50–100 µg/ kg per min IV infusion may repeat bolus after 5 min or increase infusion to 300 µg/min	1–2 min	10-30 min	Aortic dissection preoperative	Hypotension, nausea, asthma, first degree heart block, heart failure
Nitroglycerin	5–100 µg/min	2–5 min	5–10 min	Coronary ischemia	Tachycardia, flushing, headache IV infusion methaemog-lobinoemia
Nicardipine	5–15 mg/h IV	5–10 min	15-30 May exceed 4 hrs	Most hypertensive emergencies except acute heart failure; caution with coronary ischemia	Tachycardia, headache, flushing, local phlebitis
Enalapril	1.25–5 mg every 6 hours	15-30 min	6–12 hrs	Acute left ventricu-lar failure, avoid in acute myocardial	Abrupt fall in BP in high renin states. Variable response
Fenoldopam	0.1–0.3 µg/kg per min	<5 min	30min	Most hypertensive emergency; caution with glaucoma	Tachycardia, headache, flushing Adrenergic inhibitors
Phentolamine	5–15 mg IV bolus	1–2 min	10-30 min	Catecholamine excess	Tachycardia, flushing, headache

7.6 Special consideration: Management of hypertension with acute stroke:

The management of BP during an acute stroke remains controversial. BP is often elevated in the immediate post-stroke period and is thought by some to be a compensatory physiologic response to improve cerebral perfusion to ischemic brain tissue. As a result, it has been common practice after acute cerebral infarction to reduce or withhold BP treatment until the clinical condition has stabilized. There still are no large clinical studies upon which to base definitive recommendations.

Nevertheless, it is recommended that: in patients with recent ischemic stroke whose SBP is >220 mmHg or DBP 120–140 mmHg, cautious reduction of BP by about 10–15 percent is suggested, while carefully monitoring the patient for neurologic deterioration related to the lower pressure. If the DBP is >140 mmHg, carefully monitored infusion of sodium Nitroprusside should be used to reduce the BP by 10–15 percent (11).

The use of thrombolytic agents in ischemic stroke is affected by the BP level. SBP >185 mmHg or diastolic pressures >110 mmHg are contraindications to the use of tissue plasminogen activator (TPA) within the first 3 hours of an ischemic stroke. Once a thrombolytic agent has been initiated, BP should be monitored closely, especially in the first 24 hrs (11).

7.7 Summary of hypertensive emergencies treatment

- **The treatment should be established at intensive care unit.**
- **In hypertensive urgency the recommended action is to reduce the BP within 24 to 48 hours by oral route.**
- **In patients with end organ damage rapid but controlled lowering of blood pressure is indicated to limit and prevent further organ damage. The type of antihypertensive should be selected according to the organ involved.**
- **Hypertension in the setting of acute ischemic stroke the blood pressure should be reduced by no more than 10–15% in the first 24 hours.**
- **In patients with intra cerebral hematomas lowering blood pressure is currently recommended only when the systolic blood pressure is greater than 200 mmHg or the diastolic pressure is greater than 110 mmHg.**

Pregnant patients with systolic blood pressure greater than 180 mmHg or diastolic blood pressure greater than 110 mm Hg, should be treated by the intravenous route marinating the diastolic blood pressure over 90 to avoid fetal distress

8
Special Groups

8.1 Hypertension in the elderly:

Older people show greater BP variability, so multiple measurements on several occasions are mandatory to confirm diagnosis, also it is worth that seated and standing measurements during initial assessment and after initiating therapy should be noted because of high prevalence of orthostatic hypotension (SBP pals ≥20 mmHg). Treatment may need to be titrated to the standing value. Lifestyle measures should be offered to all older people as far as they are effective in younger people.

Thiazide/thiazide-like diuretics are especially effective at lowering BP in older people as are dihydropyridine CCBs.

ARB-based therapy was shown to be more effective than beta blockers based therapy at reducing the risk of stroke and CVS mortality in people with ISH, so beta-blockers should be used when indicated, e.g. post MI, angina or HF, more than one drug can be used and logical combination are out lined in the ABCD algorithm. (8)

8.2 Hypertension and pregnancy:

There is consensus for initiating treatment at BP level 150 – 160 mmHg SBP or 100-110 mmHg DBP or in the presence of target organ damage. There is concern that excessive lowering of BP leads to intrauterine growth restriction. Regarding the choice of anti-hypertensive therapy methyldopa remains the drug of choice. CCBs (esp. long acting form of Nifidipine) and the vasodilator Hydralazine are commonly used as second line drugs. Also true for Labetalol as second line and esp. for resistant hypertension in third trimester. Beta-blockers less often used as it inhibits fetal growth. ACE-inhibitors and ARBs should be avoided, Thiazide/thiazide-like diuretics should be used little, as theoretically, they have the potential of reducing circulatory blood volume.(8)

8.3 Hypertension and diabetes:

The targeted blood pressure for diabetic with hypertension is <130/80 mmHg and combined therapy is usually needed to achieve this target. ACE-inhibitor or ARBs is the first line therapy, other drugs will be required to achieve targeted blood pressure are long acting CCBs, beta blockers and alpha blockers. In patients with renal impairment and/or edema, a loop diuretic may be required as an alternative to, or in addition to, thiazide and thiazide-like diuretics precaution is hyperglycemia. (10)

8.4.Diabetic nephropathy:

Type I diabetes and diabetic nephropathy:

The target B.P is <130/80 mmHg .BP reduction and ACE-inhibitors treatment slow the rate of decline of renal function in overt diabetic nephropathy and delay progression from the microalbuminric phase to overt nephropathy. ACE-inhibitors have specific renoprotection in patients with incipient or overt type I diabetic nephropathy and are recommended as initial therapy, ARBs as an alternative if patients had persistent cough. The ACE-inhibitors / ARBs

should be titrated to the maximum dose and if the goal is not achieved, combined therapy is required, example for drug used in combined therapy are low dose thiazide/thiazide-like, CCBs, beta blockers and alpha blockers.(8)

type II diabetes and diabetic nephropathy:

anti-hypertensive therapy slows the progression of nephropathy in patients with type II DM.

ACE-inhibitors have similar action as in type I in preventing the progressing from microalbuminuria to overt nephropathy, but it is less clear whether they have specific renoprotection beyond BP reduction in overt nephropathy. There is now good evidence that ARBs-based antihypertensive can delay progression of microalbuminuria to overt nephropathy and progression of overt nephropathy to end stage renal disease, so this benefit is complementary to the more substantial benefit achieved by improved BP control.(8)

8.5 Orthostatic hypotension:

Diagnosed by measuring standing and supine blood pressure; normally there is slight difference between the two measures but the presence of >20 mmHg difference in systolic or >10 mmHg diastolic blood pressure confirm the diagnosis of orthostatic hypotension.

The patient presents with faint on standing, eating or hot bathing and it is associated with the presence of impaired vasomotor reflexes which are present in elderly, autonomic neuropathy e.g. DM, antihypertensive medication and over diuresis. (1, 8)

Orthostatic hypotension is a real obstacle to good blood pressure control and its severity is strongly related to premature death, increased numbers of falls and fractures.

The presence of orthostatic hypotension necessitates slow-dose titration of antihypertensive drugs. Moreover, volume depletion should be avoided and a clear warning should be given to patients. (1, 8)

Resistant hypertension

9.1 Definition (14)

Office blood pressure >140/90 or 130/90 in patients with diabetes or chronic kidney disease
And
Patient prescribed 3 or more antihypertensive in full doses including diuretics if possible
Or
Office blood pressure at goal but patient requiring 4 or more antihypertensive drugs

9.2 Causes of resistant hypertension (15)

1) **Improper blood pressure measurements.**
2) **Volume over load:**
   - **Excess sodium intake.**
   - **Volume retention from kidney disease.**
   - **Inadequate diuretic therapy.**
3) **Drug induced or other causes:**

-Drugs: NSAIDs use, sympathomimetic (decongestants), oral contraceptive pills, corticosteroids, cyclosporine, erythropoietin

- **Cocaine/amphetamine + illicit drugs**
- **Non-adherence to antihypertensive medication.**
- **Inadequate antihypertensive doses.**
- **Inappropriate drug combination.**

4) **Associated conditions:**
   - **Obesity.**
   - **Excess alcohol.**
   - **Obstructive sleep apnea (present in 50% of hypertensive patients)**

9.3 Management approach (14):

1. **Confirm resistant hypertension diagnosis and check for the following:**
   - **If adequate treatment is prescribed**
   - **If it is the appropriate treatment**
   - **If the patient is taking the pills or not**
   - **If BP measured correctly**
2. **Exclude pseudo-resistance through the following:**
   - **Check adherence with prescribed medication**
   - **Obtain home, work or ambulatory BP readings to exclude white coat effect**
   - **Identify and reverse contributing lifestyle factors**
3. **Increase patients compliance with the medication: this can be achieved through:**
   - **Do proper education**
   - **Increase the frequency of the follow-up visits**
   - **Encourage self measurement of BP**
   - **prescribe of drugs that least likely to cause adverse effect**
   - **Prescribe a once day regimen**
   - **Use of fixed dose combination**
   - **Use of less costly regimen**
   - **Acknowledge progress towards goals and the exclusion of other the drugs that can interfere with BP control.**
4. **Exclude secondary causes of hypertension**
5. **Adjust the pharmacological treatment:**

- **Studies suggest that change in diuretics therapy (adding a diuretic, increasing the dose, or changing the diuretics class based on kidney function) will help 60% of these patients achieve BP goals.**
- **The rationale behind the use of diuretics is that volume expansion seems to be the most frequent pathogenic finding in this group of patients**
- **Fixed dose antihypertensive are very useful for patients with resistant hypertension, especially those with adherence problem.**

10

Hypertension in children and adolescents:

10.1 Introduction:

The prevalence and rate of diagnosis of hypertension in children and adolescents appear to be increasing. This is due in part to the increasing prevalence of childhood obesity as well as growing awareness of this disease. With age, the blood pressure increases gradually. Therefore, standard nomograms are necessary for interpretation of blood pressure values. Transient rise in blood pressure, which can be mistaken for hypertension, is seen with caffeine use and certain psychological disorders (e.g., anxiety, stress). (١٦,١٧)

There is evidence shows that breast feeding in infancy may be associated with a lower blood pressure in childhood. (18)

Children with blood pressure >90th percentile have a 2.4-3 fold greater risk of having hypertension as adults. Similarly, nearly half of hypertensive adults had a blood pressure >90th percentile as children. (22)

10.2 Definition of hypertension in children

Based on statistics for children > one year old hypertension is defined as average systolic and/or diastolic blood pressure (BP) > 95th percentile for gender, age, and height found in 3 or more different occasions (16,17,19,27)

10.3 Classifications of BP in Children One Year of Age and Older and Adolescents (16, 19, 21, 22)

1. **Normal blood pressure, SBP and DBP less than the 90th percentile**
2. **Pre hypertension, SBP or DBP greater than or equal to 90th percentile but less than 95th percentile. Any adolescent whose BP is equal or greater than 120/80 mm Hg is also given this diagnosis, even if their reading is less than the 90th percentile**
3. **Stage 1 hypertension SBP or DBP from 95th percentile to 99th percentile plus 5 mm Hg**
4. **Stage 2 hypertension SBP or DBP greater than 99th percentile plus 5 mm Hg**

Table (10) hypertension classification

Blood Pressure Category	Definition
Normal	< 90^{th} percentile
Pre hypertension	90^{th} -95^{th} percentile or ≥ 120/80 mm Hg
Stage 1	95^{th} - 99^{th} percentile + 5 mm Hg
Stage 2	> 99th percentile + 5 mm Hg

10.4 Causes of childhood hypertension (16, 22, 24, 25, 28)

Most childhood hypertension, particularly in preadolescents, is secondary to an underlying disorder. Kidney disease is the most common cause of hypertension in children. (16)

Hypertension in the newborn is most often associated with umbilical artery catheterization and renal artery thrombosis.

Table (11) Causes of hypertension

Infant	Children		Adolescents
	1-6 y	7-12 y	
1) Thrombosis of renal artery or vein 2) Congenital renal anomalies 3) Co arctation of the aorta 4) Bronchopulmonary dysplasia	1) Renal artery stenosis 2) Renal parenchymal disease 3) Wilms tumor 4) Neuroblastoma 5) Coarctation of the aorta	1) Renal parenchymal disease 2) Renovascular abnormalities 3) Endocrine causes 4) Essential hypertension	1) Essential hypertension 2) Renal parenchymal disease 3) Endocrine causes

10.5 How to measure the blood pressure in children (18, 19, 21, 22, 24,)

- **Identification:**
  - ❖ **Accurate blood pressure measurements should be part of the routine annual physical examination of all children 3 years or older.**
  - ❖ **A wide variety of cuffs should be available in any medical office where children are routinely seen.**
- **Measure BP at normal room temperature more than 60 minutes after meals, ingestion of caffeine, strenuous exercise, or smoking.**
- **Measure BP with the patient either seated (child's feet on the floor and his back supported) or supine; infants may be held in the lap of their parent. After the patient has been sitting quietly for 5-10 minutes, BP should be measured with the arm supported at heart level.**
- **Take subsequent measurements for comparison with the patient in the same position.**
- **Monitor BP in both upper &lower extremities to detect coarctation of the aorta.**
- **To measure the BP in the lower limb place the child in a supine position, put a cuff on the calf. The cuff should be wide enough to cover at least two thirds of the distance from knee to ankle.**
- **Use first palpatory, then auscultatory technique. Palpation is useful for rapid assessment of systolic blood pressure, although the palpated pressure is generally about 10 mm Hg less than that obtained via auscultation.**
- **Inflate the cuff at a pressure approximately 20 mmHg greater than that at which the radial pulse disappears and then allowed to deflate at a rate of 2-3 mm Hg/s.**

- **Define the systolic pressure by first Kortkoff of sound (i.e., appearance of a clear tapping sound) and define diastolic whereas Kortkoff 5 (i.e., disappearance of all sounds) define the diastolic.**
- **Define the diastolic pressure by Kortkoff 4 when K4 (low-pitched, muffled) and 5 frequently occur simultaneously or K5 not occur at all**
- **Repeat BP measurement with less pressure applied to the head of the stethoscope, when the diastolic pressure heard down to 0 mm the**
- **Define hypertension in infant by considering the systolic BP alone if the heart sound did not disappear**
- **Decrease patient anxiety usually by making the patient more comfortable & familiar with the procedure, some level of anxiety associated with measurement of blood pressure that may lead to a false diagnosis of hypertension (white-coat hypertension).**
- **Careful attention to cuff size is necessary. The cuff should completely encircle the arm to ensure uniform compression. The inflatable bladder should cover 2/3 (at least 40%) of the upper arm length and 80–100% of its circumference at its midpoint. A cuff that is too short or narrow artificially increases blood pressure readings.**
- **Roughly to evaluate the blood pressure for different age groups (Annex 3), an approximate rule of thumb is 80 + (2 x age) for 50th centile, and 100 + (2 x age) for 95th centile. (23)**
- **In absent of severe hypertension or end-organ damage, document elevated BP three times during each of at least three clinic visits spaced over a period of 6 wks to make the diagnosis of hypertension**

10.6 Interpretation of BPs:

- **Categorize according to the higher value. if there is discrepancy between systolic and diastolic BP, the BP should be**
- **Provide immediate medical attention to patients with severe hypertension and target-organ damage require**
- **Confirm HTN in patients with stage two in a period of one week or less.**
- **Confirm HTN in patients with stage one over one to two weeks (17).**
- **Monitor pre-hypertensive patients for 6 months & follow every 6 months**
- **Diagnose white-coat hypertension for a patient with BP above the 95th percentile when measured in the clinic but who is normotensive outside the clinical setting. Ambulatory monitoring of BP is necessary to diagnose white-coat hypertension**

10.7 Evaluation (19, 20, 21, 23, 24, 25)

Evaluate to:

- **Identify underlying causes of the elevated blood pressure and/or**
- **Detect any end-organ damage.**

In Contrary to adult, children with hypertension usually have symptoms; Corix et al-in his some study found that Headache was the most common (42%) reported symptom (7).

10.7.1 History :

Children and adolescents with essential hypertension are usually asymptomatic; the blood pressure elevation is usually mild and is detected during a routine examination or check up evaluation

Ask for:

In neonates: Failure to thrive, seizure, irritability or lethargy, respiratory distress & congestive heart failure.

In children: (The findings observed in neonates) + Headache, fatigue, blurred vision, epistaxis & bell palsy

Table (12) history in child with high BP	
History	**Suggestion**
Age	Secondary hypertension is more likely in a younger child.
Chronic illness, hospitalization	
Seizures, focal neurological symptoms, blurred vision.	Hypertension symptoms
Recurrent rashes, Joint pain or swelling ,Myalgias	Rheumatologic disorders
Chest pain , palpitations or dyspnea on exertion	Cardiovascular disease
Growth failure	Endocrinopathies or CRF
Endocrine problems (e.g., diabetes, thyroid, adrenal)	Familial Endocrinopathies
Umbilical artery catheterization Neonatal or hypovolemia	Renovascular disease, renal scarring
Urinary tract infections Recurrent, Haematuria or Enuresis	Renovascular disease, renal scarring
Weight or appetite changes, Diaphoresis (abnormal) or Heat or cold intolerance	Endocrinopathies
Headache Cardiovascular disease (e.g., myocardial infarction, stroke) Dyslipideamia Sleep-disordered breathing (from snoring to obstructive sleep apnea)	Suggest Primary hypertension
Kidney disease or deafness	Congenital or familial renal disease
Medication history (oral contraceptives, steroids, caffeine,)	Medications and drugs can elevate blood pressure.
Substance abuse ethanol, tobacco,	Can elevate blood pressure.

amphetamines or cocaine)	

10.7.2 Physical Examination:

- **In the majority of children with hypertension the physical examination will be normal**
- **Regardless of the cause, end-organ (cardiac and renal) dysfunction and fundal changes occur in the face of marked, chronic, severe hypertension.**

Table (13)Examination in child with high BP

Signs	Association
Growth parameters and body mass index (BMI > 25 implies overweight, > 30 implies obese)	Primary hypertension
Adenotonsillar hypertrophy	Sleep disorder associated with hypertension
Thinness	Pheochromocytoma, renal disease, hyperthyroidism
Tachycardia	Hyperthyroidism, pheochromocytoma, and Neuroblastoma
Growth retardation, rickets, anemia and edema	suggest chronic renal disease
Abdominal mass	Wilm's tumor, Neuroblastoma, pheochromocytoma, polycystic kidneys or hydronephrosis
Epigastric and/or abdominal bruit	Co arctation of the abdominal aorta or renal artery stenosis
Absent of diminished femoral pulses & BP difference between upper and lower extremities	Co arctation of the aorta
Pericardial Rub	Secondary to chronic renal disease
Goiter or Proptosis	Hyperthyroidism
Virilization or ambiguity	Adrenal hyperplasia
Café au lait spots, neurofibromas	Neurofibromatosis, Pheochromocytoma
Acanthosis nigricans	Metabolic syndrome
Bruises, striae, acne and central obesity	Cushing syndrome
Needle tracks	Illicit drug use
Rashes	SLE, Henoch Schonlien purpura
Impetigo	suggest acute nephritis
Neurologic deficits , Muscle weakness	Chronic or severe acute hypertension with stroke or Hyperaldosteronism
Epistaxis, visual changes, and seizures	Substantial hypertension headache,
Vomiting, temperature elevation, ataxia, stupor and seizures.	Hypertensive encephalopathy

Stigmata of clinical Bardet-Biedl, von Hippel-Landau, Williams, or Turner syndromes	

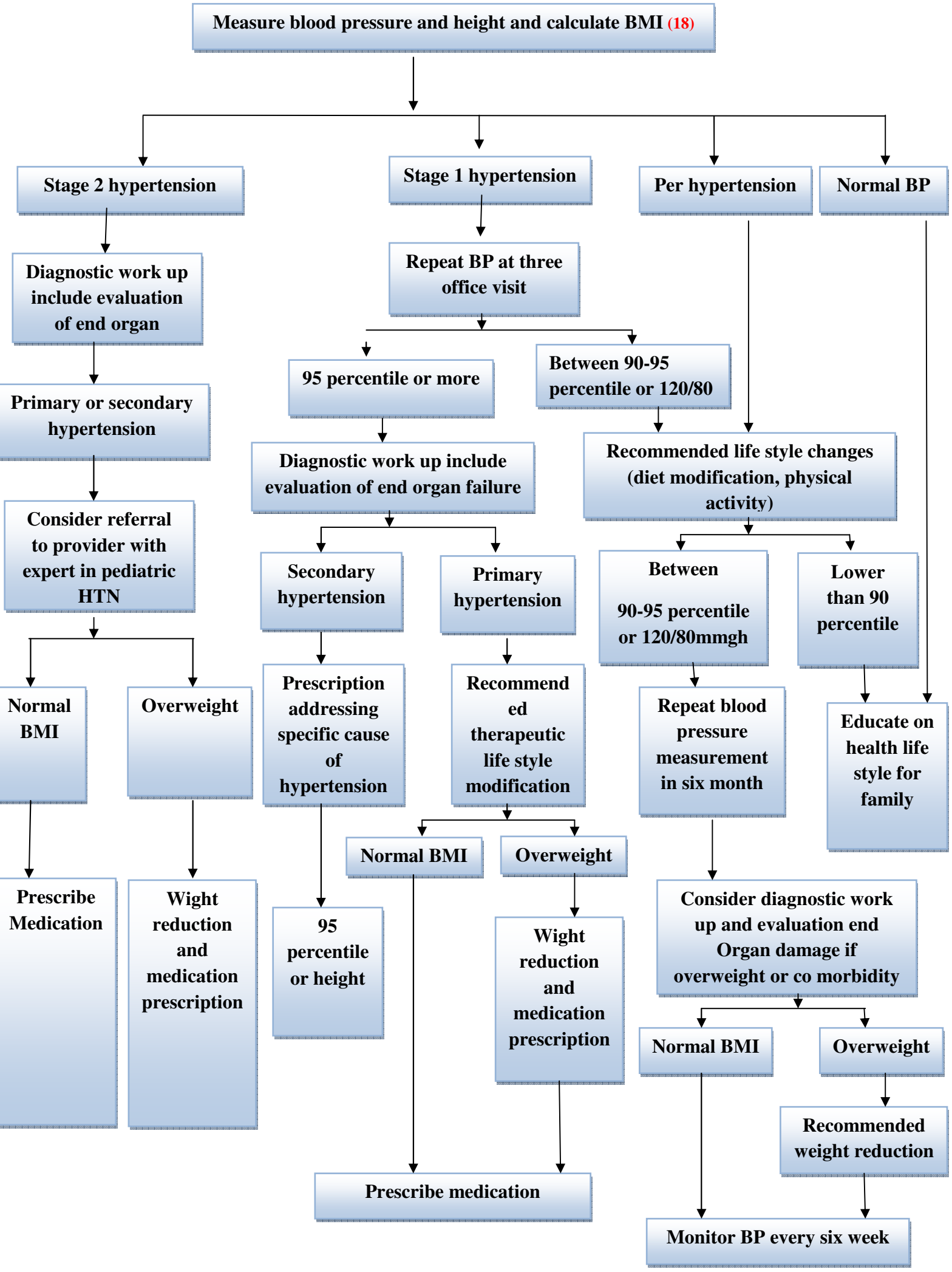
10.7.3 Laboratory and imaging tests (19,20,23,24,25)

- In patients with hypertension, proceed from simple tests that can be performed in an ambulatory setting to complex non invasive tests and finally to invasive tests.
- Screening tests should be performed on all children with a confirmed diagnosis of hypertension. Decisions about additional testing are based on individual and family histories, the presence of risk factors, and the results of the screening tests

Table (14) Investigation for child with high BP

Aim of the test	Tests	Possible diagnosis
To identify the cause	CBC with differential and platelet	Anemia of chronic disease e.g. chronic renal disease
	Blood urea, creatinine, Electrolytes (Ca,K,Po4) and uric acid	Renal disease; chronic nephritis and calculi
	Renal ultrasound	Renal scaring, congenital renal anomaly, unequal renal size
	Urine analysis/ culture	Infection haematuria, proteinuria
To identify co-morbidities	Fasting glucose, fasting lipid	Diabetes and Hyperlipidemia
	Drug screen	Identify drug-induced hypertension
To identify organ damage	Echocardiography	Left ventricular hypertrophy
	Retinal examination	Identify retinal vascular damage
Additional testing	24 hour urine protein and creatinine clearance	Chronic Kidney disease
	Plasma rennin level	Mineralocorticoid related disease
	Duplex Doppler flow study, MRI, 3 D CTscan, arteriography	Reno-vascular disease
	Ambulatory blood pressure monitoring	Anxiety induced hypertension (white coat hypertension)
	Hormone levels (thyroid, adrenal)	Hyperthyroidism and adrenal dysfunction
	Urine and Plasma	Catecholamine mediated hypertension

	catecholamine	


Measure blood pressure and height and calculate BMI (18)
Stage 2 hypertension
Stage 1 hypertension
Per hypertension
Normal BP
Diagnostic work up include evaluation of end organ
Repeat BP at three office visit
Primary or secondary hypertension
95 percentile or more
Between 90-95 percentile or 120/80
Diagnostic work up include evaluation of end organ failure
Recommended life style changes (diet modification, physical activity)
Consider referral to provider with expert in pediatric HTN
Secondary hypertension
Primary hypertension
Between 90-95 percentile or 120/80mmgh
Lower than 90 percentile
Normal BMI
Overweight
Prescription addressing specific cause of hypertension
Recommended therapeutic life style modification
Repeat blood pressure measurement in six month
Educate on health life style for family
Normal BMI
Overweight
Prescribe Medication
Wight reduction and medication prescription
95 percentile or height
Wight reduction and medication prescription
Consider diagnostic work up and evaluation end Organ damage if overweight or co morbidity
Normal BMI
Overweight
Recommended weight reduction
Prescribe medication
Monitor BP every six week

10. 8 Management (16, 19, 20, 21, 23, 24, 25, 26)

10.8.1 Lifestyle modification

These include:

- **weight control**
- **regular exercise**
- **low-fat and low-sodium diet**

• Refer to nutritionists, weight-loss programs, and exercise programs can be productive.
• Data regarding dietary changes in children with hypertension are limited.
• A no-salt-added diet with more fresh fruits and vegetables combined with low-fat dairy and protein like to the DASH (Dietary Approaches to Stop Hypertension)
• Exercise combined with diet in adolescents had a greater antihypertensive effect than diet alone.
• Whatever lifestyle changes are recommended, a family-centered rather than patient-oriented approach usually is more effective
• A well-supervised program of non-pharmacologic therapy should be prescribed for most young patients with essential hypertension.
• When the patient is unable to cooperate with the non-pharmacologic approach or the reduction in blood pressure is insufficient, antihypertensive agents should be considered.

10.8.2 Pharmacologic Therapy

- **Pharmacologic therapy is required for many children with secondary hypertension and for selected patients with essential hypertension.**
- **Antihypertensive drug are recommended on the following conditions:**
    1. **Presence of symptomatic hypertension**
    2. **Evidence of end-organ damage,{ left ventricular hypertrophy (LVH) , retinopathy, proteinuria}**
    3. **Stage 2 hypertension**
    4. **Stage 1 hypertension unresponsive to lifestyle modifications and hypertension with diabetes.**
    5. **Hypertension with CV risk factors**
- **According to the National High Blood Pressure Education Program/ United States (NHBPEP), pharmacotherapy should follow a step-up plan,**
- **Introduce one medication at a time at the lowest dose, and then increase the dose until therapeutic effects are seen, side effects are seen, or the maximal dose is reached. Only then should a second agent can be initiated.**
- **Long-acting medication is useful in improving compliance.**
- **BP is considered controlled when it is less than the 95th percentile in children with uncomplicated primary hypertension.**
    - **When patients have chronic renal disease, diabetes, or hypertensive target-organ damage, the goal should be less than the 90th percentile**

- **Add a drug from another class if BP is not controlled, if control is not achieved with 2 drugs, reconsider the possibility of secondary hypertension before adding a third drug.**
- **In patients with long-standing or poorly controlled hypertension, the underlying pathophysiology is often complex. Such patients frequently require trials of combinations of antihypertensive agents to gain control of markedly elevated or labile pressure.**
- **Refer patients to specialist is advisable, since the treatment of chronic hypertension requires expertise.**
- **Choice drug based on the mode of action and the potential for adverse effects as follow:**

  - **Patients with volume-dependent hypertension usually have an adequate response to diuretics;**
  - **ACE inhibitors and calcium channel blockers may be considered for initial therapy in an adolescent with significant hypertension. They have been shown to be safe and effective in children and are commonly prescribed.**
  - **An alternative to a calcium-channel blocker or ACE inhibitor may be hydrochlorothiazide & β-Blocking agents.**
  - **Preferential use of specific classes of medications for certain underlying or coexisting pathology has led to the prescribing of ACE inhibitors or ARBs in children with diabetes or proteinuria or renal disease.**
  - **α-adrenergic blocking agents (Phentolamine, phenoxybenzamine) are beneficial in patients with neural crest tumors who have high circulating levels of catecholamine. In such patients, β-blocking drugs are also needed to control the heart rate, or an agent with dual blocking action (labetalol) may be used.**
  - **Sympathetic blockade with labetalol is likewise efficacious in patients who experience marked stimulation of the cardiovascular system from high doses of cocaine.**

10.9 Hypertensive crisis (23, 24, 27, 29, 30, 31,32)

10.9.1 Definitions:

HTN Emergency: it is defined as elevation in systolic and Diastolic BP associated with acute end organ damage (brain, heart, kidney, eye,)

The clinical manifestations include HPT encephalopathy, congestive heart failure, pulmonary edema, stroke, myocardial infarction, severe proteinuria, adrenergic crises, head trauma and blurring of vision (30).

HTN urgencies: it is a situation in which the possibility exists for progression to hypertensive emergency requiring a decrease within 12 to 24 hours.Itis define as a BP that more than 99th percentile plus 5 mm Hg, based on sex, age and height without end organ damage(31) .

Hypertensive urgencies are accompanied by less serious symptoms, such as severe headache or vomiting (27)

10.9.2 Management

In response to a hypertensive crisis, it is important to select an agent with a rapid and predictable onset of action and to monitor blood pressure carefully as it is being reduced.

- **Chose antihypertensive agents with minimal central nervous system side effects to avoid confusion between symptoms of disease and adverse effects of the drug, because hypertensive encephalopathy is a possible complication of hypertensive emergencies.**
- **Plan a stepwise reduction in pressure because too rapid a reduction in blood pressure may interfere with adequate organ perfusion,.**
- **Use Intravenous administration so that the fall in blood pressure can be carefully titrated.**
- **Reduce the pressure by about 1/3 of the total planned reduction during the 1st 6 hr and the remaining amount over the following 48–72 hr.**

10.9.2.1 Management of hypertensive urgencies (16):

- **Treat by either intravenous or oral antihypertensive, depending on the child's symptomatology**
- **Give intravenous bolus antihypertensive e.g.hydrazine, labetalol if the rise in the blood pressure is rapid e.g post Glomerulonephritis,**
- **Give oral medication e.g. short acting CCBs if the rise is gradual (CKD)**

10.9.2.2 Management of hypertensive emergencies (table 15 below)

Table (15)Management of hypertensive emergencies

Clinical condition	Recommended drug
HPT encephalopathy	Nitroprusside or labetalol
Sudden and severe HPT	Nitroprusside or labetalol
HPT with intracranial hemorrhage	Nitroprusside or labetalol
HPT with intracranial hemorrhage	Nitroprusside or labetalol (avoid Hydralazine and Nicardipine)
catecholamine production tumor (e.g pheochromcytoma)	Phentolamine

- **Most children with hypertensive crisis have chronic or acute renal disease; in these pa-**

tients, management of blood pressure also requires careful attention to fluid balance, as well as diuresis.

- Intravenous furosemide is usually effective, even though glomerular filtration may be impaired.
- In patients with renal artery stenosis secondary to fibromuscular dysplasia, percutaneous balloon angioplasty may cure as many as 50%. Of cases. Angioplasty is not successful for renal artery stenosis because of atherosclerotic plaques. If angioplasty is unsuccessful, placement of an intravascular stent or surgery may be indicated

Table (16) Medications in hypertensive emergencies (16,31)

Drug	Dose	Recommendation
Labetalol	(0.2-1mg/kg bolus push over 2 minutes followed by 0.4-1 mg/kg/h IV) (0.25 to 3mg/kg/hr infusion (if available) max. dose 40mg.	Is not recommended in patients with asthma and heart failure
Hydralazine	(0.1-0.8 mg/kg IV dose qid or 4 hourly), max. dose 3.5mg/kg/day	
Esmolol	(load of 100-500 µg/kg IV infusion followed by 25-100 µg/kg/min) (if available) load over 1 to 2 mints	
Nifidipine,	swallow or bite and swallow, given in a dose of 2.5 _10 mg(0.25 t0 0.50 mg /kg/dose. Initial dose can be repeated once within 30 mints	contraindicated in patients with heart diseases (pediatric Nephrology 6th
Nitroprusside	(0.53-0.10 µg/kg/min IV) (if available) max. dose 8 microgram /kg/min ,in continuous infusion	
Phentolamine	(0.1 mg/kg IV).(catecholamine production tumor)	
Nicardipine	1-3 mcg/kg/min IV infusion.	

10.10 Follow-up:

- As with any chronic health issue, medical follow-up and appropriate monitoring are important to long-term success.
- Drug calendars, parental supervision, and close patient-physician communication also

help ensure compliance.

- As-needed basis follow up laboratory testing for medication side effects, lipid panels and echocardiograms. Follow up fundoscopic examinations,
- Gradual discontinuation of drug therapy can be attempted in patients with initially mild hypertension who are well-controlled on a single drug and who are compliant with lifestyle modification.

10.11 Course and prognosis (19, 20, 23)

- Many of these children continue to have essential hypertension as adults.
- Severe cases of childhood hypertension are also at increased risk of developing hypertensive encephalopathy, seizures, cerebrovascular accidents, and congestive heart failure.
- Children with chronic hypertension are likely to have learning disabilities and deficiencies in executive function, which are potentially reversible with antihypertensive treatment. These cognitive defects may be secondary to abnormal regulation of cerebral blood flow.
- Raised blood pressure in childhood could also contribute to the early development of atherosclerosis, which can have both short-term and long-term adverse effects on vasculature
- The prognosis of a child with secondary hypertension is primarily determined by the nature of the underlying disease and its responsiveness to specific therapy.
- Survival in patients with underlying chronic renal disease is determined by the patient's response to dialysis and the success of renal transplantation.
- In patients with renovascular disease, the degree of elevation in renal vein renin activity may help predict response to therapy.
- A discrepancy in renin secretion between the 2 kidneys of more than 1.5:1 suggests that the kidney producing the higher level is primarily responsible for the hypertension. Surgical correction yields a high probability of marked improvement or resolution of the hypertension.
- The prognosis after surgical repair of coarctation of the aorta is variable and partly dependent on the age at which the correction is performed. Most patients operated on during infancy and childhood, established normal systemic blood pressure after surgery unless the coarctation recurs; patients in whom the diagnosis is made during adolescence, however, are at risk for persistently elevated pressure.
- The long-term outcome is favorable for neonates who experience hypertension as a complication of umbilical artery catheterization. Few of these infants require therapy beyond 12 month of age, and most show marked improvement in renal perfusion.

10.12 Prevention

- Prevention of high blood pressure may be viewed as part of the prevention of cardiovascular disease and stroke.
- Control risk factors for cardiovascular disease include obesity, elevated serum cholesterol levels, high dietary sodium intake and tobacco use. The components of tobacco

may cause or exacerbate hypertension.

ANNEXES

Annex 1 : Anti hypertensive drugs

Drug	Dose/mg/day	Doses/day	Mechanism of action	Special consideration
Diuretics				
Thiazides and related drugs			They initially lower BP by reducing plasma extracellular fluid volume and cardiac output. Within 6–8 weeks, these parameters return toward normal and the lower BP is related to fall in peripheral resistance	•Thiazides are more effective antihypertensives than loop diuretics, unless serum creatinine is 2.0 mg/ml or creatinine clearance 50 ml/min •Without concomitant diuretics, antihypertensive drugs which do not block the RAA mechanism may cause sodium retention •Week diuretics may cause hyperkalaemia particularly when combined with ACE inhibitors, K supplements or NSAIDS
• Hydrochlorothiazid	12.5-25	1		
• Chlorothalidone	12.5-25	1		
• Indapamide	2.5	1		
Loop diuretics				
• Furosemide	20-320	2		
• Bumetanide	0.5-5	2		
• Ethacrynic acid	24-100	2		
• Torsemide	50-100	1		
K sparing diuretics				
• Spironolactone	25-100	2-3		
• Triamterene	50-100	2		
Calcium antagonists				•May cause initial natriuresis, resulting in vasodilatation. •Effect not blunt by NSAID •Short acting agents may increase risk of ischaemic heart disease
Nondihydropyridine			Block entry of calcium into smooth muscle cell Deltiazem and Verapamil blunt increases in exercise rate	
• Verapamil	80-480	2-3		
• Verapamil SR	120-480	1-2		
• Verapamil- covera HS	180-240	1 (bed time)		
• Diltiazem	90-360	3-4		•Liquid nifedipine reduces BP quickly but may precipitate cerebral and myocardial ischaemia
• Diltiazem CD	180-360	1		
Dihydropyridines				
• Nifedipine	30-120	3		
• Nifedipine GTS	30-120	1		
• Amlodipine	2.5-10	1		
• Felodipine	43952	1		
• Isradipine	2.51	2		

ACE inhibitors			Block conversion of angiotensin I to angiotensin II, thus removing the effects of the latter as a vasoconstrictor and as a stimulant of aldosterone synthesis. They inhibit break down of bradykinin, incease levels of vasodilatory prostaglandins decrease level of endothelins, and inhibit RAA system within the heart and other tissues.	• First dose may precipitate dramatic fall in BP but full effect may not appear for 7 to 10 days. • Renal function test and K should be measured one week after starting the treatment to detect the presence of side effects • Effect is potentiated by diuretics. • May cause hyperkalaemia in patients with renal failure,hypoaldosteronism and those receiving K-sparing diuretics or NSAID. • Particularly effective in patients with diabetic vasculopathy, heart failure or systolic dysfunction after myocardial infarction.
• Captopril	12.5-100	2-3		
• Enalapril	2.5-4	1-2		
• Fusinopril	10-40	1		
• Lisinopril	5-40	1		
• Perindopril	1-16	1-2		
• Ramipri	1.25-20	1		
• Trandolapril	1-4	1		
Angiotensin II receptor blockers				
• Losartan	25-100	1-2	Block the angiotensin II receptors	• Recommended only if ACE inhibitors cannot be tolerated because
• Valsartan	80-320	1		
• Candesartan	8-32	1		
• Irbesartan	150-30	1		
•A-Adrenergic receptors antagonists			Selective antagonists of postsynaptic α-1 receptors because presynaptic α – adrenergic receptors is left unblocked, the feedback inhibiton of NE release is intact	• Inhibition of NE release may lead to first- dose hypotension • Useful for prostatic hypertrophy • In older patients, doxazocin may increase the risk of stroke and heart failure
• Prazocin	2-20	1-2		
• Doxazocin	2-16	1		
• Terazocin	1-20	1		
B- adrenergic receptor antagonists			These cause decrease in cardiac output, rennin release and sympathetic discharge. Intially, vasoconstriction develops by overtime, vascular resistance is normalized	• The three most important differences in clinical use are cardio-selectivity. ISA and lipid solubility • Cardio-selectivity disappears when higher doses are given. • Cardio-selectivity results in less metabolic side effects. • ISA causes less decrease in heart rate, rennin release and cardiac out put and less metabolic side effects. • Less Lipid soluble agents do not enter brain readily and thus cause less nervous side effects.
Cardioselctive				
• Atenolol	25-100	1		
• Metoprolo	50-200	1-2		
Non-cardioselective				
• Propranolol	40-240	1-2		
• Nadolol	20-240	1		

With intrinsic sympathetic activity				
• Acebutolol	200-1200	2		
• Pindolol	22190	2		
A-/B- blocker			Fall in blood pressure results mainly from decrease in peripheral resistance. α-/B- blocker is 10-1 for Labetalol and 4:1 for Carvedilol	•B-blocker are well suited for younger and middle-aged hypertensive particularly in patients with myocardial ischaemia and high level of stress. They may interfere with athletic performance.
• lLabetalol	200-800	2-3		
• CCarvedilol	3.75-25	2		
Acting within neurons				•Frequently cause orthostatic hypotension and sexual dysfunction
• Reserpine	0.05-.25	1	Depletes postganglionic adrenergic neurons of NE by inhibiting its reuptake in storage vesicles	
• Guenfancine	0.5-2.0	1	Inhibits release of NE from adrenergic neurons	
Central α-agonists				•May cause inflammatory disorders in various organs commonly the liver. •Haemolytic anemia rarely occurs
• Methyle dopa	250-1500	2	α methyl NE, derived from methyldopa stimulates central α- adrenergic receptors reducing sympathetic outflow.	
• Clonidine	0.1-0.6	2	Same action as Methyldopa but also inhibits NE release from pre-synaptic α –neurons	•Central α – agonists have short half life, so when discontinued, the inhibition of NE release disappears and rebound hypertension occurs.
• Clonidine TTS	0.1-0.3	once /week		
Direct vasodilatation				
• Hydralazine combined	50-200	2-4	Direct relaxation of smooth muscle cells	•Limited efficacy if given alone due to fluid retention and reflex sympathetic activation, so they should be given with a diuretics and B- blockers
• Minoxidil	2.5-80	1		•Hydralazine may cause lupus – like syndrome if dose >200 mg/day and in in slow acetylators of the drug

Annex 2: East Mediterranean risk assessment chart

WHO/ISH Risk prediction charts
for 14 WHO epidemiological sub-regions

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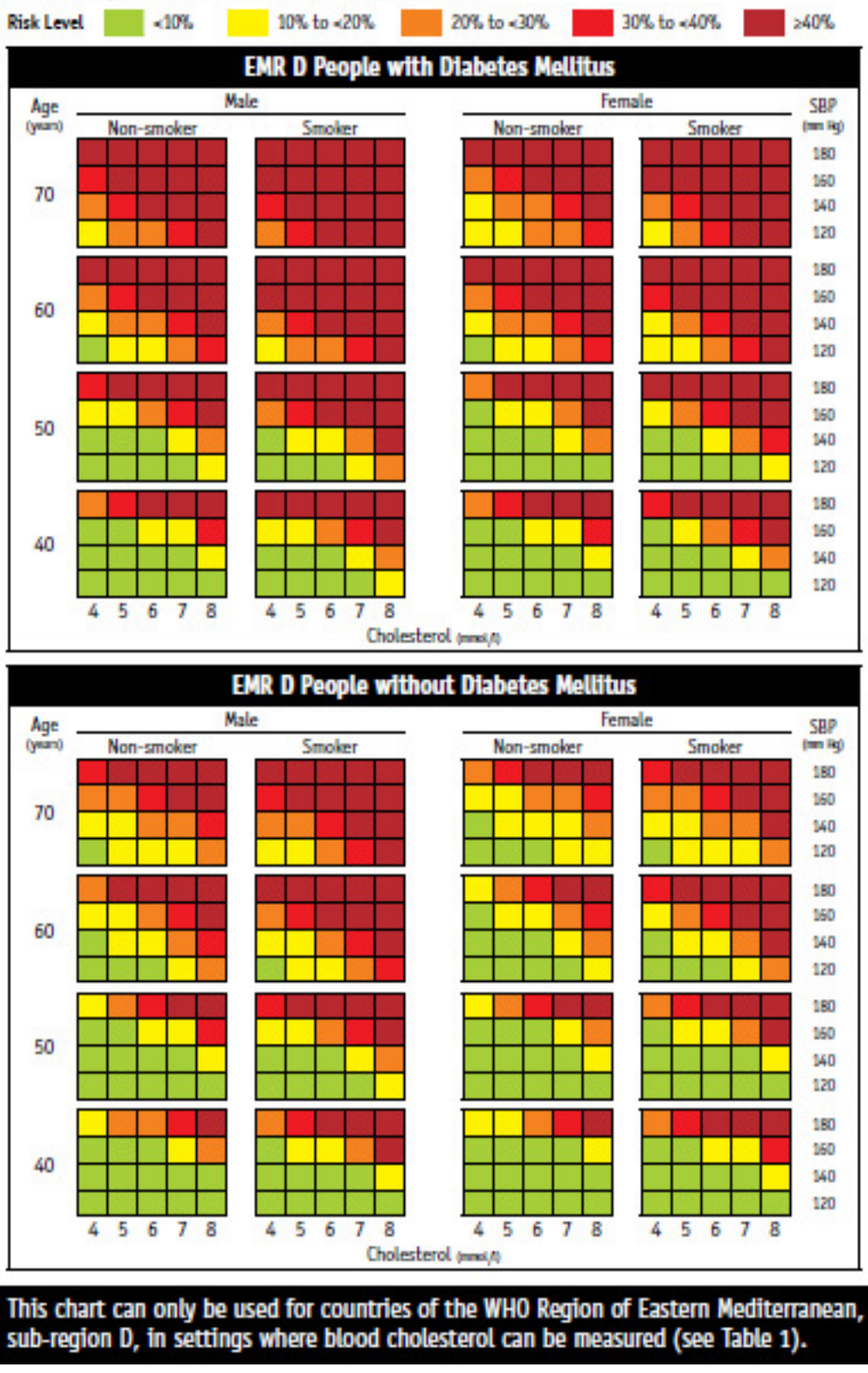
Figure 12. WHO/ISH risk prediction chart for EMR D. 10-year risk of a fatal or non-fatal cardiovascular event by gender, age, systolic blood pressure, total blood cholesterol, smoking status and presence or absence of diabetes mellitus.



This chart can only be used for countries of the WHO Region of Eastern Mediterranean, sub-region D, in settings where blood cholesterol can be measured (see Table 1).

WHO/ISH Risk prediction charts

for 14 WHO epidemiological sub-regions

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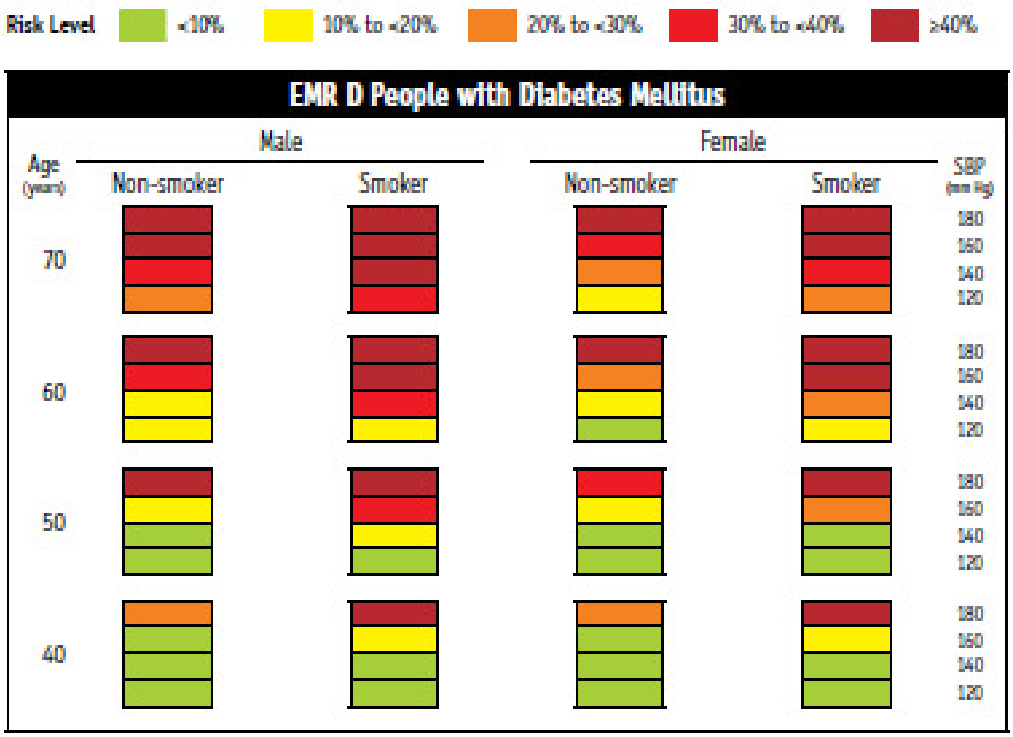
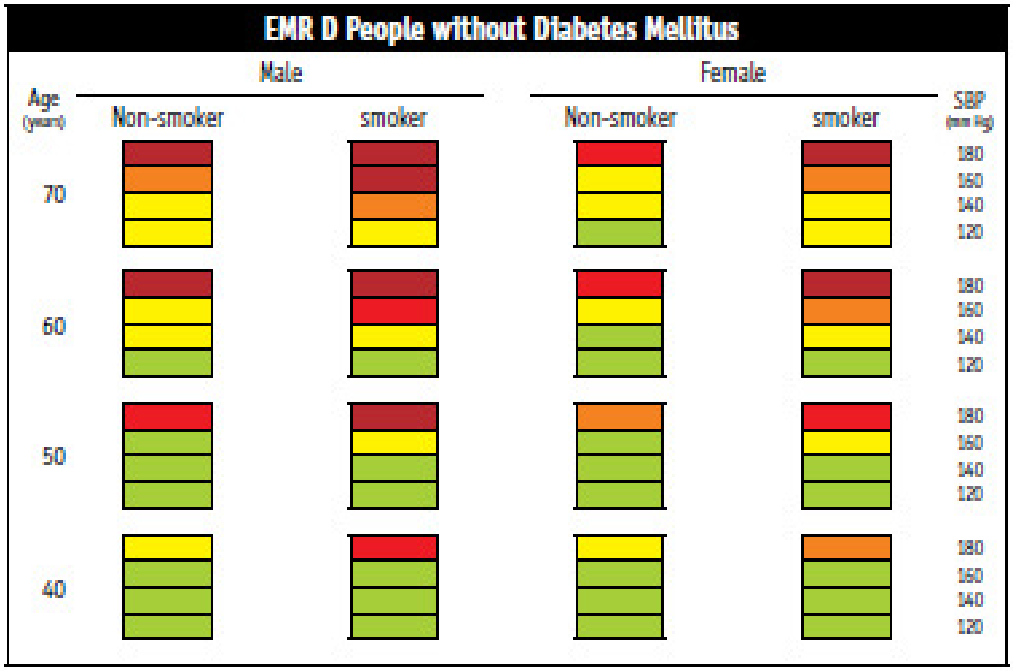
Figure 14. WHO/ISH risk prediction chart for EMR D. 10-year risk of a fatal or non-fatal cardiovascular event by gender, age, systolic blood pressure, smoking status and presence or absence of diabetes mellitus.





This chart can only be used for countries of the WHO Region of Eastern Mediterranean, sub-region D, in settings where blood cholesterol CANNOT be measured (see Table 1).

Annex 3: Percentiles of BP for height in children 1-17 years (18)

Blood Pressure Levels for Boys by Age and Height Percentile

Age (Year)	BP Percentile ↓	Systolic BP (mmHg) ← Percentile of Height →							Diastolic BP (mmHg) ← Percentile of Height →						
		5th	10th	25th	50th	75th	90th	95th	5th	10th	25th	50th	75th	90th	95th
1	50th	80	81	83	85	87	88	89	34	35	36	37	38	39	39
	90th	94	95	97	99	100	102	103	49	50	51	52	53	53	54
	95th	98	99	101	103	104	106	106	54	54	55	56	57	58	58
	99th	105	106	108	110	112	113	114	61	62	63	64	65	66	66
2	50th	84	85	87	88	90	92	92	39	40	41	42	43	44	44
	90th	97	99	100	102	104	105	106	54	55	56	57	58	58	59
	95th	101	102	104	106	108	109	110	59	59	60	61	62	63	63
	99th	109	110	111	113	115	117	117	66	67	68	69	70	71	71
3	50th	86	87	89	91	93	94	95	44	44	45	46	47	48	48
	90th	100	101	103	105	107	108	109	59	59	60	61	62	63	63
	95th	104	105	107	109	110	112	113	63	63	64	65	66	67	67
	99th	111	112	114	116	118	119	120	71	71	72	73	74	75	75
4	50th	88	89	91	93	95	96	97	47	48	49	50	51	51	52
	90th	102	103	105	107	109	110	111	62	63	64	65	66	66	67
	95th	106	107	109	111	112	114	115	66	67	68	69	70	71	71
	99th	113	114	116	118	120	121	122	74	75	76	77	78	78	79
5	50th	90	91	93	95	96	98	98	50	51	52	53	54	55	55
	90th	104	105	106	108	110	111	112	65	66	67	68	69	69	70
	95th	108	109	110	112	114	115	116	69	70	71	72	73	74	74
	99th	115	116	118	120	121	123	123	77	78	79	80	81	81	82
6	50th	91	92	94	96	98	99	100	53	53	54	55	56	57	57
	90th	105	106	108	110	111	113	113	68	68	69	70	71	72	72
	95th	109	110	112	114	115	117	117	72	72	73	74	75	76	76
	99th	116	117	119	121	123	124	125	80	80	81	82	83	84	84
7	50th	92	94	95	97	99	100	101	55	55	56	57	58	59	59
	90th	106	107	109	111	113	114	115	70	70	71	72	73	74	74
	95th	110	111	113	115	117	118	119	74	74	75	76	77	78	78
	99th	117	118	120	122	124	125	126	82	82	83	84	85	86	86
8	50th	94	95	97	99	100	102	102	56	57	58	59	60	60	61
	90th	107	109	110	112	114	115	116	71	72	72	73	74	75	76
	95th	111	112	114	116	118	119	120	75	76	77	78	79	79	80
	99th	119	120	122	123	125	127	127	83	84	85	86	87	87	88
9	50th	95	96	98	100	102	103	104	57	58	59	60	61	61	62
	90th	109	110	112	114	115	117	118	72	73	74	75	76	76	77
	95th	113	114	116	118	119	121	121	76	77	78	79	80	81	81
	99th	120	121	123	125	127	128	129	84	85	86	87	88	88	89
10	50th	97	98	100	102	103	105	106	58	59	60	61	61	62	63
	90th	111	112	114	115	117	119	119	73	73	74	75	76	77	78
	95th	115	116	117	119	121	122	123	77	78	79	80	81	81	82
	99th	122	123	125	127	128	130	130	85	86	86	88	88	89	90

Blood Pressure Levels for Boys by Age and Height Percentile (Continued)

Age (Year)	BP Percentile ↓	Systolic BP (mmHg) ← Percentile of Height →							Diastolic BP (mmHg) ← Percentile of Height →						
		5th	10th	25th	50th	75th	90th	95th	5th	10th	25th	50th	75th	90th	95th
11	50th	99	100	102	104	105	107	107	59	59	60	61	62	63	63
	90th	113	114	115	117	119	120	121	74	74	75	76	77	78	78
	95th	117	118	119	121	123	124	125	78	78	79	80	81	82	82
	99th	124	125	127	129	130	132	132	86	86	87	88	89	90	90
12	50th	101	102	104	106	108	109	110	59	60	61	62	63	63	64
	90th	115	116	118	120	121	123	123	74	75	75	76	77	78	79
	95th	119	120	122	123	125	127	127	78	79	80	81	82	82	83
	99th	126	127	129	131	133	134	135	86	87	88	89	90	90	91
13	50th	104	105	106	108	110	111	112	60	60	61	62	63	64	64
	90th	117	118	120	122	124	125	126	75	75	76	77	78	79	79
	95th	121	122	124	126	128	129	130	79	79	80	81	82	83	83
	99th	128	130	131	133	135	136	137	87	87	88	89	90	91	91
14	50th	106	107	109	111	113	114	115	60	61	62	63	64	65	65
	90th	120	121	123	125	126	128	128	75	76	77	78	79	79	80
	95th	124	125	127	128	130	132	132	80	80	81	82	83	84	84
	99th	131	132	134	136	138	139	140	87	88	89	90	91	92	92
15	50th	109	110	112	113	115	117	117	61	62	63	64	65	66	66
	90th	122	124	125	127	129	130	131	76	77	78	79	80	80	81
	95th	126	127	129	131	133	134	135	81	81	82	83	84	85	85
	99th	134	135	136	138	140	142	142	88	89	90	91	92	93	93
16	50th	111	112	114	116	118	119	120	63	63	64	65	66	67	67
	90th	125	126	128	130	131	133	134	78	78	79	80	81	82	82
	95th	129	130	132	134	135	137	137	82	83	83	84	85	86	87
	99th	136	137	139	141	143	144	145	90	90	91	92	93	94	94
17	50th	114	115	116	118	120	121	122	65	66	66	67	68	69	70
	90th	127	128	130	132	134	135	136	80	80	81	82	83	84	84
	95th	131	132	134	136	138	139	140	84	85	86	87	87	88	89
	99th	139	140	141	143	145	146	147	92	93	93	94	95	96	97

BP, blood pressure

* The 90th percentile is 1.28 SD, 95th percentile is 1.645 SD, and the 99th percentile is 2.326 SD over the mean.

For research purposes, the standard deviations in Appendix Table B–1 allow one to compute BP Z-scores and percentiles for boys with height percentiles given in Table 3 (i.e., the 5th,10th, 25th, 50th, 75th, 90th, and 95th percentiles). These height percentiles must be converted to height Z-scores given by (5% = -1.645; 10% = -1.28; 25% = -0.68; 50% = 0; 75% = 0.68; 90% = 1.28%; 95% = 1.645) and then computed according to the methodology in steps 2–4 described in Appendix B. For children with height percentiles other than these, follow steps 1–4 as described in Appendix B.

Blood Pressure Levels for Girls by Age and Height Percentile

Age (Year)	BP Percentile ↓	Systolic BP (mmHg)							Diastolic BP (mmHg)						
		← Percentile of Height →							← Percentile of Height →						
		5th	10th	25th	50th	75th	90th	95th	5th	10th	25th	50th	75th	90th	95th
1	50th	83	84	85	86	88	89	90	38	39	39	40	41	41	42
	90th	97	97	98	100	101	102	103	52	53	53	54	55	55	56
	95th	100	101	102	104	105	106	107	56	57	57	58	59	59	60
	99th	108	108	109	111	112	113	114	64	64	65	65	66	67	67
2	50th	85	85	87	88	89	91	91	43	44	44	45	46	46	47
	90th	98	99	100	101	103	104	105	57	58	58	59	60	61	61
	95th	102	103	104	105	107	108	109	61	62	62	63	64	65	65
	99th	109	110	111	112	114	115	116	69	69	70	70	71	72	72
3	50th	86	87	88	89	91	92	93	47	48	48	49	50	50	51
	90th	100	100	102	103	104	106	106	61	62	62	63	64	64	65
	95th	104	104	105	107	108	109	110	65	66	66	67	68	68	69
	99th	111	111	113	114	115	116	117	73	73	74	74	75	76	76
4	50th	88	88	90	91	92	94	94	50	50	51	52	52	53	54
	90th	101	102	103	104	106	107	108	64	64	65	66	67	67	68
	95th	105	106	107	108	110	111	112	68	68	69	70	71	71	72
	99th	112	113	114	115	117	118	119	76	76	76	77	78	79	79
5	50th	89	90	91	93	94	95	96	52	53	53	54	55	55	56
	90th	103	103	105	106	107	109	109	66	67	67	68	69	69	70
	95th	107	107	108	110	111	112	113	70	71	71	72	73	73	74
	99th	114	114	116	117	118	120	120	78	78	79	79	80	81	81
6	50th	91	92	93	94	96	97	98	54	54	55	56	56	57	58
	90th	104	105	106	108	109	110	111	68	68	69	70	70	71	72
	95th	108	109	110	111	113	114	115	72	72	73	74	74	75	76
	99th	115	116	117	119	120	121	122	80	80	80	81	82	83	83
7	50th	93	93	95	96	97	99	99	55	56	56	57	58	58	59
	90th	106	107	108	109	111	112	113	69	70	70	71	72	72	73
	95th	110	111	112	113	115	116	116	73	74	74	75	76	76	77
	99th	117	118	119	120	122	123	124	81	81	82	82	83	84	84
8	50th	95	95	96	98	99	100	101	57	57	57	58	59	60	60
	90th	108	109	110	111	113	114	114	71	71	71	72	73	74	74
	95th	112	112	114	115	116	118	118	75	75	75	76	77	78	78
	99th	119	120	121	122	123	125	125	82	82	83	83	84	85	86
9	50th	96	97	98	100	101	102	103	58	58	58	59	60	61	61
	90th	110	110	112	113	114	116	116	72	72	72	73	74	75	75
	95th	114	114	115	117	118	119	120	76	76	76	77	78	79	79
	99th	121	121	123	124	125	127	127	83	83	84	84	85	86	87
10	50th	98	99	100	102	103	104	105	59	59	59	60	61	62	62
	90th	112	112	114	115	116	118	118	73	73	73	74	75	76	76
	95th	116	116	117	119	120	121	122	77	77	77	78	79	80	80
	99th	123	123	125	126	127	129	129	84	84	85	86	86	87	88

Blood Pressure Levels for Girls by Age and Height Percentile (Continued)

Age (Year)	BP Percentile ↓	Systolic BP (mmHg)							Diastolic BP (mmHg)						
		← Percentile of Height →							← Percentile of Height →						
		5th	10th	25th	50th	75th	90th	95th	5th	10th	25th	50th	75th	90th	95th
11	50th	100	101	102	103	105	106	107	60	60	60	61	62	63	63
	90th	114	114	116	117	118	119	120	74	74	74	75	76	77	77
	95th	118	118	119	121	122	123	124	78	78	78	79	80	81	81
	99th	125	125	126	128	129	130	131	85	85	86	87	87	88	89
12	50th	102	103	104	105	107	108	109	61	61	61	62	63	64	64
	90th	116	116	117	119	120	121	122	75	75	75	76	77	78	78
	95th	119	120	121	123	124	125	126	79	79	79	80	81	82	82
	99th	127	127	128	130	131	132	133	86	86	87	88	88	89	90
13	50th	104	105	106	107	109	110	110	62	62	62	63	64	65	65
	90th	117	118	119	121	122	123	124	76	76	76	77	78	79	79
	95th	121	122	123	124	126	127	128	80	80	80	81	82	83	83
	99th	128	129	130	132	133	134	135	87	87	88	89	89	90	91
14	50th	106	106	107	109	110	111	112	63	63	63	64	65	66	66
	90th	119	120	121	122	124	125	125	77	77	77	78	79	80	80
	95th	123	123	125	126	127	129	129	81	81	81	82	83	84	84
	99th	130	131	132	133	135	136	136	88	88	89	90	90	91	92
15	50th	107	108	109	110	111	113	113	64	64	64	65	66	67	67
	90th	120	121	122	123	125	126	127	78	78	78	79	80	81	81
	95th	124	125	126	127	129	130	131	82	82	82	83	84	85	85
	99th	131	132	133	134	136	137	138	89	89	90	91	91	92	93
16	50th	108	108	110	111	112	114	114	64	64	65	66	66	67	68
	90th	121	122	123	124	126	127	128	78	78	79	80	81	81	82
	95th	125	126	127	128	130	131	132	82	82	83	84	85	85	86
	99th	132	133	134	135	137	138	139	90	90	90	91	92	93	93
17	50th	108	109	110	111	113	114	115	64	65	65	66	67	67	68
	90th	122	122	123	125	126	127	128	78	79	79	80	81	81	82
	95th	125	126	127	129	130	131	132	82	83	83	84	85	85	86
	99th	133	133	134	136	137	138	139	90	90	91	91	92	93	93

BP, blood pressure

* The 90th percentile is 1.28 SD, 95th percentile is 1.645 SD, and the 99th percentile is 2.326 SD over the mean.

For research purposes, the standard deviations in Appendix Table B–1 allow one to compute BP Z-scores and percentiles for girls with height percentiles given in Table 4 (i.e., the 5th,10th, 25th, 50th, 75th, 90th, and 95th percentiles). These height percentiles must be converted to height Z-scores given by (5% = -1.645; 10% = -1.28; 25% = -0.68; 50% = 0; 75% = 0.68; 90% = 1.28%; 95% = 1.645) and then computed according to the methodology in steps 2–4 described in Appendix B. For children with height percentiles other than these, follow steps 1–4 as described in Appendix B.

Annex 4: Anti-hypertensive drug classes for hypertensive children

Drug	Dose	Comments
ACE inhibitors		- FDA approval is limited to children six years of age or older with creatinine clearance of at least 30 ml per min per 1.73 m2. -ACE inhibitors are effective and well-tolerated drugs with no adverse effects on plasma lipid levels or glucose tolerance. But it might be less effective in black. -They prevent the progression of diabetic nephropathy and other forms of glomerulopathies. - Patients with high plasma renin activity may have an excessive hypotensive response to ACE inhibitors. -Patients with bilateral renal vascular disease or with single kidneys, whose renal perfusion is maintained by high levels of angiotensin II, may develop irreversible acute renal failure when treated with ACE inhibitors. -side effects: hyperkalemia, Cough and angioedema are less common with newer members of this class than with captopril. -Serum potassium and serum creatinine concentrations should be monitored.
Captopril	1-17 years: 0.15-0.5 mg/kg/dose PO tid to 6 mg/kg/day. Older children and adolescents: 6.25–25 mg/dose up to450mg/day	
Enalapril	1-17 years initial dose 0.08 mg/kg/d PO qd or divided bid not to exceed 5 mg/d; may gradually increase to 0.6 mg/kg/d not to exceed mg/d	
Lisinopril	1-17 years 0.07 mg/kg/d PO qd; not to exceed 5 mg/d initially, may gradually increase to 0.6 mg/kg/d; not to exceed 40mg/d	
Losartan	Initial dose, 0.7 mg per kg per day up to 50 mg per day Maximum dose 1.4 mg per kg per day up to 100 mg per day	
Beta blockers		-They were among the first and most widely used antihypertensive drugs for children. - There use is highBp treatrment is limited now -They are especially useful in the concurrent treatment of hypertension and migraine disorder .
Selective beta 1-adrenergic blockers 1-Atenolol	1-17 years: 0.5-1 mg/kg/d PO qd or divided bid initially, may gradually increase to 2 mg/kg/d; not to exceed 100 mg/day	
2-Metoprolol	1-17 years: 1-2 mg/kg/d PO divided bid initially; may gradually increase to 6 mg/kg/d; not to exceed 200 mg/d	
Nonselective beta-blocker 1-Propranolol	1-17 years: 0.5-2 mg/kg/d PO divided bid/tid initially; may gradually increase to 4 mg/kg/d	
2-Labetalol	1-17 years: 1-3 mg/kg/d PO divided bid initially; may gradually increase to 10-12 mg/kg/d; not to exceed 1200 mg/d	

Calcium-channel blockers		
Amlodipine	<6 years: Not established 6-17 years: 0.1-0.6 mg/kg/day or 2.5-5 mg PO qd(once/day)	
Isradipine	1-17 years: 0.15-0.2 mg/kg/d PO divided tid/qid initially; may gradually increase to 0.8 mg/kg/d; not to exceed 20 mg/d	
Nifedipine, extended-release	1-17 years: 0.25 -0.5 mg/kg/d PO divided qd/bid may gradually increase, not to exceed daily dose of 3 mg/kg/d (up to 120 mg/d	
Thiazide diuretics		Thiazide diuretics are safe and effective in children, but metabolic complications (hypokalemia, glucose intolerance, adverse lipid effects) associated with previously recommended high doses have limited their use. They should have electrolytes monitored shortly after initiation of therapy and periodically thereafter.
Hydrochlorothiazide	1-17 years: mg/kg PO qd initially; may gradually increase to 3 mg/kg/d; not to exceed 50 mg/d	
Chlorthalidone	1-17 years: 0.3 mg/kg PO qd initially; may gradually increase to 2 mg/kg/d; not to exceed 50 mg/d	
Loop diuretics		
Furosemide	1-17 years 0.5-2 mg/kg /dose PO initially; may gradually increase to 6 mg/kg/d divided for 2-4 doses	
Bumetanide	1-17 years: 0.015-0.1 mg/kg/dose PO q6-24h; not to exceed 10 mg/d	
Potassium-sparing diuretics		
Spironolactone (Aldactone)	1-17 years: 1 mg/kg/d PO qd or divided bid initially; may gradually increase to 3.3 mg/kg/d; not to exceed 100 mg/d	
Amiloride	1-17 years: 0.4-0.625 mg/kg PO qd initially; may gradually increase to 20 mg/d	
Direct Vasodilator		
Minoxidil	1-11 years: 0.1-0.2 mg/kg/d PO qd or divided tid; not to exceed 50 mg/d . 12-17 years: Administer as in adults 5 mg PO qd initially; may gradually increased to 10-40 mg/d qd or divided bid; not to exceed 100 mg/d	
Peripheral alpha-antagonists		These agents causes vasodilation of veins and arterioles and decreasing total peripheral resistance and BP. They often cause marked hypotension after the first dose.
Doxazosin	1-17 years: 1 mg PO qd initially; may gradually increase to 4 mg/d	
Prazosi	1-17 years: .05-0.1 mg/ 0.05-0.1 mg/kg/d PO divided tid initially	

REFERENCES

1. World Health Organization, Regional Office for Eastern Mediterranean, Clinical guideline for management of hypertension. EMRO technical publication series, Cairo 2005.
2. Khartoum RF survey ٢٠٠٥--2006.
3. (annual health statistical report 2008)
4. Hypertension Research Group*Clinical Epidemiology Unit, Department of Community Health Sciences,
5. Aga Khan University, Karachi Modified from JNC 7 and the Fourth Working Party of the British Hypertension Society guidelines (last updated in 2007):
6. Jnc 7 guidelines for management of hypertension 2
7. 2003 European Society of Hypertension/European Society of Cardiology Guidelines for the management of arterial hypertension. Journal of Hypertension, 2003, 21:1011–1053.
8. British Hypertension Society Guidelines, Guidelines for management of hypertension: report for the forth working party of the British hypertension society 2004.
9. Zheng L, Sun Z, Li J, *et al.* (July 2008). "Pulse pressure and mean arterial pressure in relation to ischemic stroke among patients with uncontrolled hypertension in rural areas of China". *Stroke* 39 (7): 1932–7. doi:10.1161/STROKEAHA.107.510677. PMID 18451345. http://stroke.ahajournals.org/cgi/pmidlookup?view=long&pmid=18451345.
10. impactEDnurse (May 31, 2007). "mean arterial pressure". impactednurse.com. http://www.impactednurse.com/?p=329. Retrieved 2010-12-25.
11. B William et al, guidelines of management of hypertension, Journal of Human Hypertension
12. WHO Flow charts for prevention and management of major NCDs (for physicians and non-physician health workers), Year
13. British National Formulary, September 2009
14. Edger Lerma, Jeffrey Berns, Allen Nissenson CURRENT Diagnosis & Treatment Nephrology & Hypertension, McGraw-Hill Professional, Dec 17 2008
15. Murray Longmore, Ian Wilkinson, Estee Torok, Oxford Handbook of Clinical Medicine, Oxford university press fifth edition, 2001
16. National High Blood Pressure Education Program (NHBPEP) Working Group on High Blood Pressure in Children and Adolescents. Fourth Report on the Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents* Fourth Report
17. Linda Brookes, MSc , New US Guidelines for Hypertension in Children and Adolescents ,Posted: 05/27/2004; Updated: 05/28/2004
18. AAFP (American Academy of Family Physicians) May-2006, Annual Clinical Focus on Caring for Children and Adolescents
19. 2009 California Pacific Medical Center - Paediatrics page- Evaluation &Management of Hypertension in Children and Adolescents
20. Assessment and Management of Hypertension in Children and Adolescents CME Brian W. McCrindl, Medscape CME Released: 2010;
21. e.Medicine Paediatrics text book update April 2010
22. Nelson Text Book of Paediatrics-18th edition
23. Saudi *Hypertension Management* Guidelines 2007
24. Sarah Zarbock 2005, From Medscape Paediatrics Hypertension in Children
25. Madhu Sharma MD ,et al The effects of Hypertension on the Paediatric Brain: A Justifiable Concern - The Lancet Neurology, Volume 9, Issue 9, Pages 933 - 940, September 2010
26. The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure - U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES Publication No. 04-5230 ,August 2004
27. *Hypertension* in Childhood | Doctor | Patient UK 1 Mar 2010 - There are no consensus UK *guidelines* on the management of *hypertension in children*. American *guidelines*

28. Pediatric Nephrology for Primary care, AAP, 2009
29. Pediatric Nephrology 6th edition 2010.
30. Flynn J, Tallus Nephrol J.2009_severe HPT in Children and Adolescents)
31. Ellis Avner ,Harmon,Naudet,Yoshikawa text book of pediatric Nephrology 6th edition 2010.
32. APLS –Advance pediatric life Support