STEPWISE APPROACH FOR DIAGNOSIS AND TREATMENT OF CHILDHOOD HYPERTENSION

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Objectives

- Introduction
- Diagnosis
- Algorithm for etiological diagnosis
- Treatment

Hypertension

Common

- It's prevalence in adult worldwide ranges 20-40%, average 30% (WHO).
- USA 33% (AAP 2017).
- Children….3.5% ……..obese children….11.7% (AAP 2017).

Serious

- Ischemic heart diseases and strokes are the most common cause of death worldwide 25%. Hypertension is the most common independent risk factor for both (WHO).

Simple to diagnose

It can be diagnosed by very simple devices.

Easy to manage

- It can be easily controlled by available drugs at relatively low cost.

Hypertension

Awareness :

- **It ranges from 30% -70% ……50% worldwide (WHO).**

Treatment and monitoring:

- **About 50% (WHO).**

Control:

- **It ranges from 7% - 28% ……13% worldwide (WHO).**

Guidelines for Diagnosis and Treatment of Childhood Hypertension

Guidelines for childhood hypertension include:

1) The National Heart, Lung and Blood Institute (NHLBI) of the National Institutes of Health (NIH):

Four reports:

- *1st report 1977: 1st age-related norms for BP in children*
- *2nd report 1987: Gender-related and techniques for measurement of BP*
- *3rd report 1996: Age, gender and height*
- *4th report 2004: Stag of hypertension and TLC*

2) American Academy of Pediatrics:

- *Guidelines for childhood hypertension AAP 2017*

Diagnosis

Diagnosis

- Proper measurement of blood pressure
- Percentile curve
- Stage of hypertension
- Assessment of end organ damage
- Associated conditions
- Mechanisms
- Etiology

Proper Measurement of BP

Frequency of routine BP measurement:

- **Children (1-13 years) with risk factors should checked their BP during every health care visit** ***(4th report 2004, AAP 2017)***

- **Children more than 3 years old without risk factors should checked their BP:**
  - **During every health care visit** ***(4th report 2004)***
  - **Annually** ***(AAP 2017)***

Proper Measurement of BP

- **Site of measurement**

  Right upper arm.

- **Position of the child**

  Seated, back supported, feet on the floor, uncrossed leg

- **Position of the arm**

  At the level of the right atrium, arm supported

- **Time of measurement**

  At the morning or at the evening.

Proper Measurement of BP

- **In children with hypertension, PR should be measured at least once in lower limb to exclude coarctation of the aorta.**
- **Devices**
  - ***Auscultatory (mercury /aneroid)***
  - ***Oscisllometric***
- **Place of measurement:**
  - ***Clinic (casual) …. Home… Ambulatory***
- **Size of cuff**
  - ***It covers 80-100% of the arm circumference***
  - ***Widths covers 40-50% of arm length***
  - ***Not loose, not tight***

Proper Measurement of BP

- First *Korotkoff* sound indicates systolic blood pressure, 5th *Korotkoff* sound indicates diastolic blood pressure.
- Auscultation of *Korotkoff* sound is done by the bell of stethoscope.
- The patient and observer should not speak during measurement of BP
- Crying and/or straining may raise systolic blood pressure as much as 40-50 mmHg.

Proper Measurement of BP

- ***If initial BP measurement is elevated,*** **another tow measures should be taken in the same setting, only the last two being averaged for the recorded blood pressure.**

- ***Ambulatory blood pressure monitoring,*** **circadian variation of arterial blood pressure being highest during the morning, gradually decreasing during the course of the day to reach the lowest levels at night.**

Dippers ***non dippers***

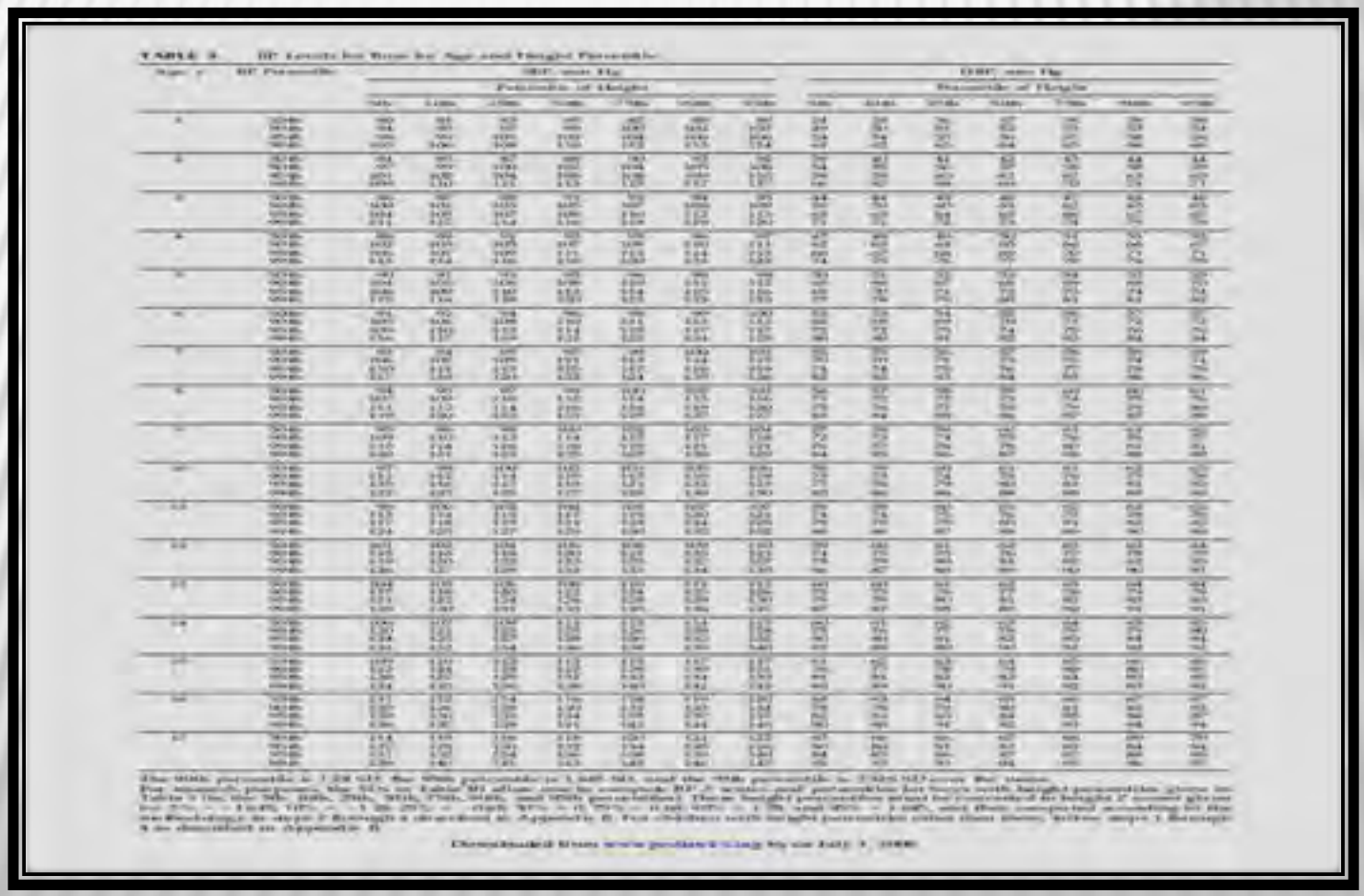
Proper Measurement of BP

- **Great variabilities of BP measurement have led to the consensus that:**

"Both measurement devices and technique should be standardized"

Percentile Curve

- Age (1977), gender (1987), height (1996) and BMI (2017)



Simple Screening for BP Values (AAP, 2017)

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

Stage of Hypertension (2004)

	SBP or DBP Percentile
Normal	< 90th
Pre hypertension	≥ 90th to <95th ≥ 120/80 even if below 90th percentile in adolescents
Stage I hypertension	95th percentile to 99th percentile plus 5 mm Hg
Stage II hypertension	> 99th percentile plus 5 mm Hg

Stage of Hypertension (2017)

Normal BP
<90th percentile

Elevated BP
>90th - <95th percentile

Stage I HTN
>95th - <95th percentile
+12 mmHg

Stage II HTN
>95th Percentile +12-30 mmHg

Sever hypertension
>95th Percentile +>30 mmHg

Stage of Hypertension (2004)

Practical application:

***Male* child, *age* 6 years, *high* 50th percentile**

- **Systolic BP**
  - **90th percentile…….. 107mmHg**
  - **95th percentile…….. 111mmHg**

- **Stage of HTN**
  - **Normal BP <107mmHg**
  - **Elevated BP 107-111mmHg**
  - **Stage 1 HTN 111-122mmHg**
  - **Stage 2 HTN 123-141mmHg**
  - **Sever HTN >141mmHg**

Assessment of End Organ Damage

Mandatory:

- **Cardiac evaluation:**
  - **Lt ventricular hypertrophy is assessed by ECHO cardiography**

    Mild…… Moderate…….. severe
- **Ophthalmological evaluation:**
  - **Hypertensive retinopathy is assessed by fundoscopic examination**

    Grade 1-4

Optional:

- **Vascular evaluation:**
  - **Intimal medial thickness of carotid arteries is assessed by ultrasound**
- **Microalbuminuria**

Associated Conditions

- Bronchial asthma
- Diabetes
- Heart failure
- Renal disease…… dialysis
- Medications

Mechanism

- Among the well-known pathways that contribute to elevated BP are:
  - The renin-angiotensin aldosterone system
  - Volume pathways
  - Neural pathways
  - Hormonal pathways
  - Vascular pathway
- Markers for many of these contributing factors cannot readily be measured clinically at present except a renin-angiotensin system……PRA

Mechanism

Plasma renin activity (PRA)

- **It is helpful to classify hypertension in children by plasma renin activity into:**
  - **A high renin level is suggestive for:**
    - ***Renovascular diseases***
    - ***Parenchymal renal diseases***
  - **An extremely low level of plasma renin activity may suggest one of the several forms of monogenic hypertension**

Mechanism

- **Methods:**
  - **Plasma renin activity (PRA)**
  - **Selective renal vein sampling….. >1.5**
  - **Direct renin consternation**

- **Limitations of use peripheral plasma renin activity:**
  - **Age depended…….. 4-16 ng/ml/h**
  - **Sample should be taken at the morning on supine position**
  - **Plasma aldosterone consternation (PAC)…… 2-40 ng/dl**
  - **Ratio PAC/PRA**

Etiology

- Essential
- Secondary
  - Renal
  - Renovascular
  - Coartication the aorta
  - Sympathetic over activity
  - Endocrinal
  - Vasculitis
  - Monogenic hypertension
  - Others

When to Suspect Essential vs Secondary

Essential HTN:

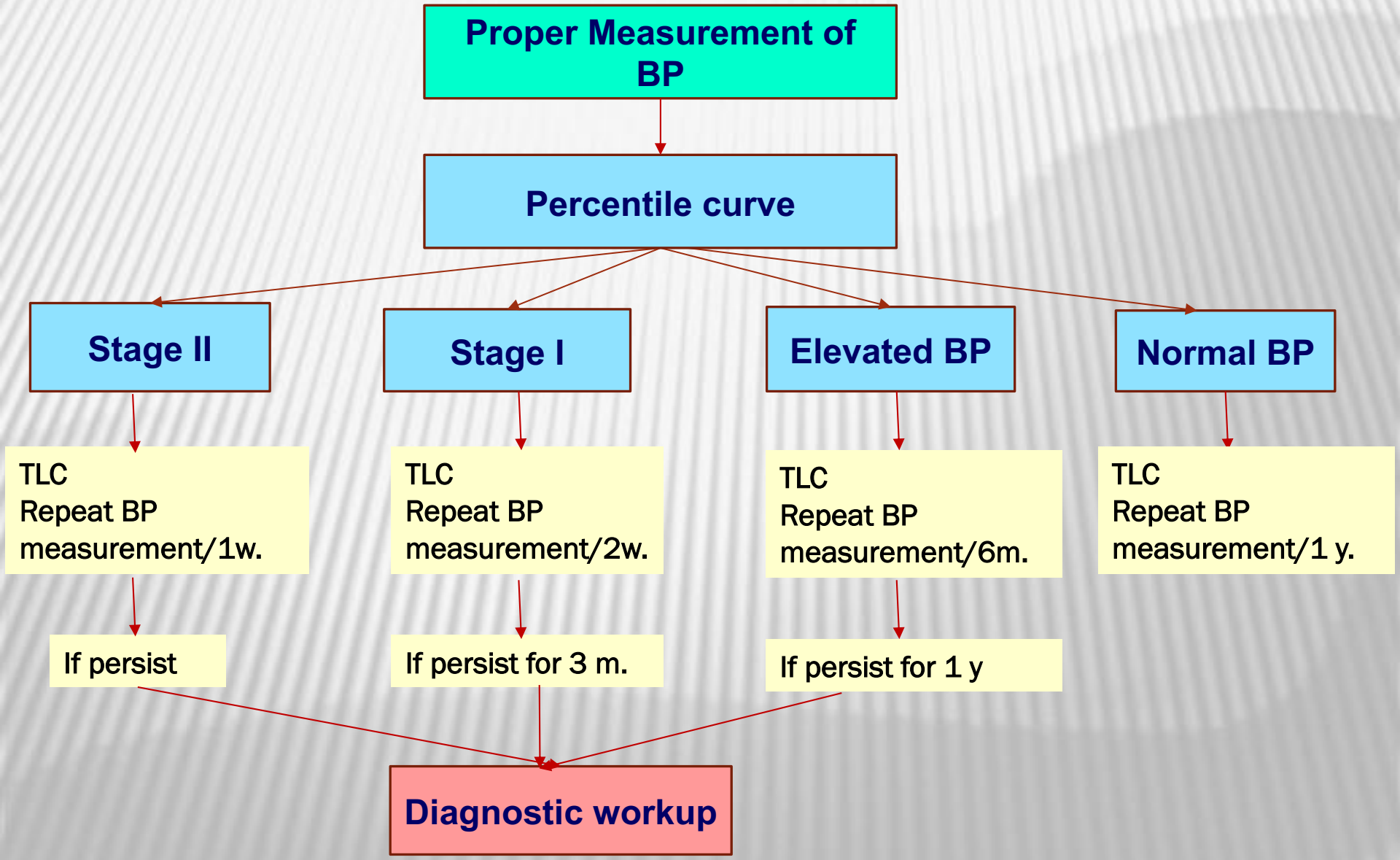
- Usually late onset (> 6 years) mild HTN associated with obesity and +ve family history of essential HTN
  - Fasting blood sugar, HbA1c and lipid profile

Secondary HTN:

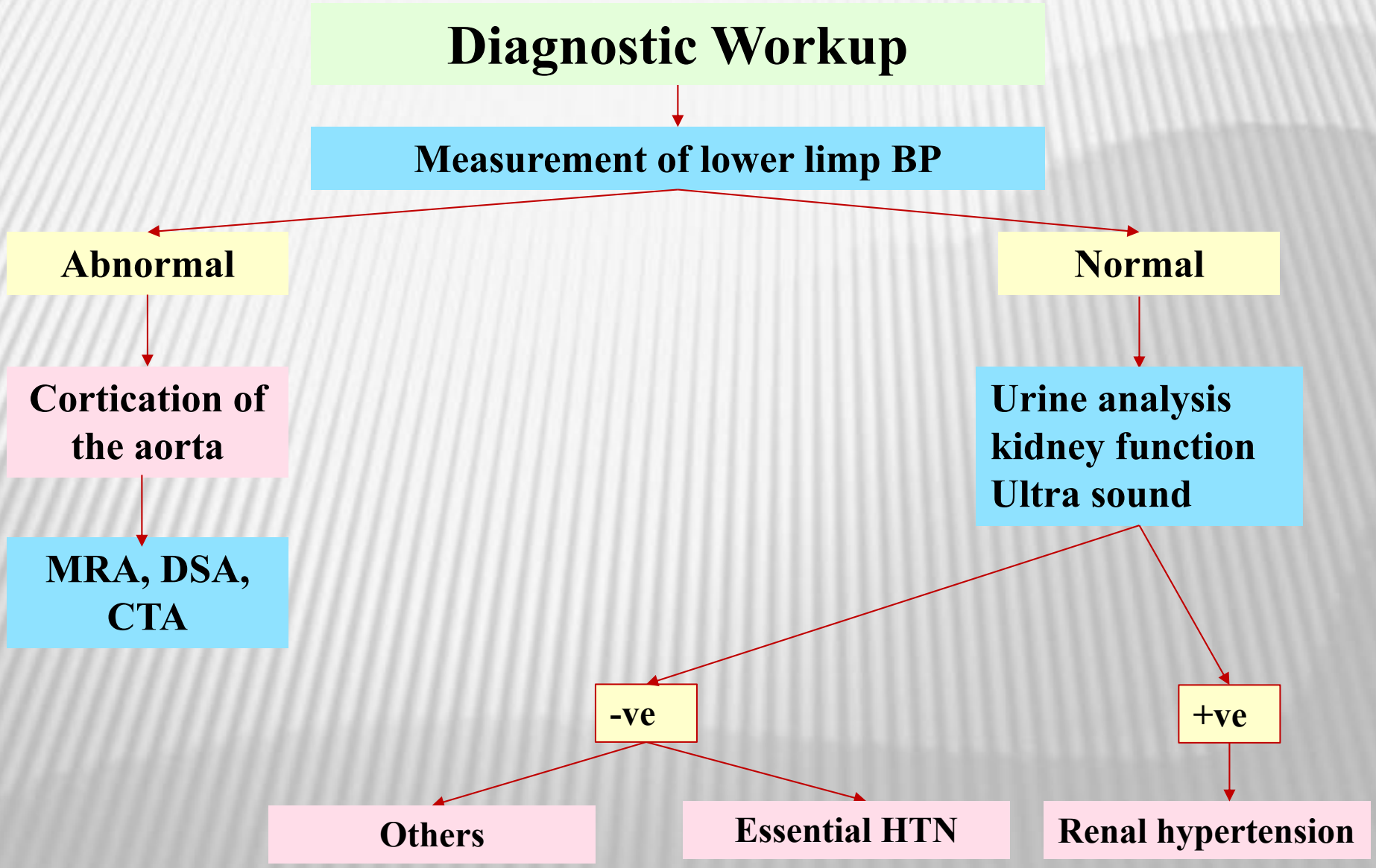
- Usually early onset (<6 years), sever HTN and history of renal or endocrinal disease or history or signs suggestive these diseases and family history of secondary HTN

Algorithm for Etiological Diagnostic

Diagnostic Algorithm



Diagnostic Algorithm



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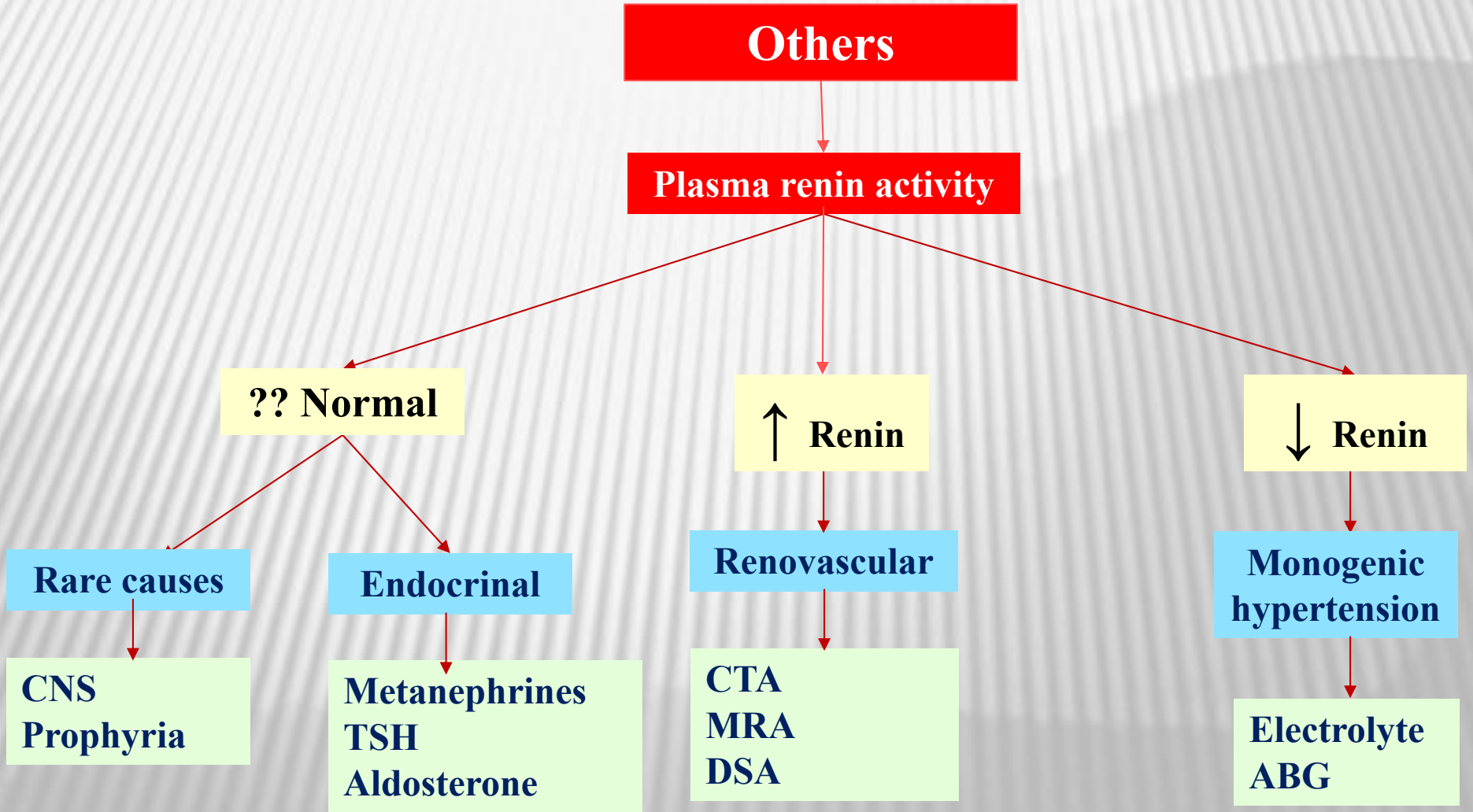
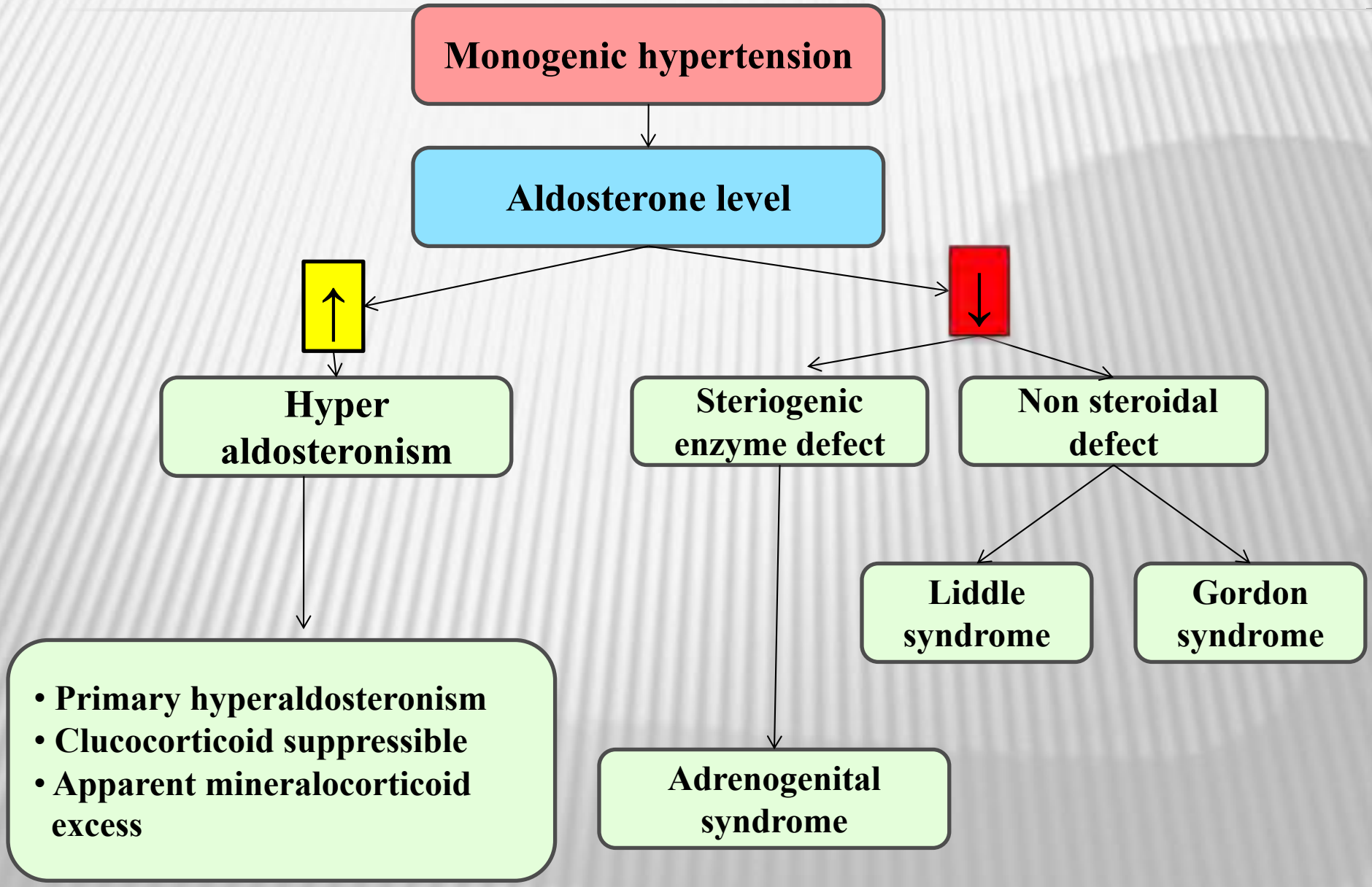


Monogenic Hypertension

- **When to suspect:**
  - **Low level of plasma renin activity**
  - **Early onset of sever hypertension**
  - **+ve family history**
  - **Associated electrolyte and/or acid-base balance disturbances**
  - **Abnormal physical findings**

Diagnostic Algorithm



TREATMENT

Treatment

- Target blood pressure control
- Monitoring
- Therapeutic lifestyle changes
- Pharmacological treatment
  - Indications
  - Classes of antihypertensive drugs
  - Factors affecting decision making
  - Initial selection of antihypertensive drug
  - Stepped care drug therapy approach

Target Blood Pressure Control

- **The target therapy for hypertension should be to reduce blood pressure below the 90th centile *(AAP, 2017)*.**
- **In case of chronic kidney disease, diabetes, or target organ damage, the goal should be to reduce BP to less than:**
  - **<57th centile. …..(*4th report 2004*)**
  - **<50th centile……*(AAP 2017)***

MONITORING

- **Assessment of end organ damage :**
  - ***Echocardiography***
  - ***Ophthalmological assessment***

- **Ambulatory blood pressure measurement (ABPM) at least once / year *(AAP 2017)* for :**
  - ***Mask HTN (MH)***
  - ***Non - dipper***

Therapeutic Lifestyle Changes TLC

- **Indications:**
  - **TLC is indicated in all stages of hypertension and even in normal children *(4th report, 2004 & AAP, 2017)***
- **Measures:**
  - **Weight reduction in obese children**
  - **Regular aerobic exercise: (3-5 sessions/week, 40-60 min/session.)**
  - **Stress reduction**
  - **Dietary alterations……*DASH* dietary approach to stop HTN**

Pharmacological Treatment

- **It is Indicated in children who:**
  - **Remain hypertensive in spite of TLC**
  - **Symptomatic HTN**
  - **Stage 2 HTN…….???? Not essential**
  - **Any stage of HTN with CKD or diabetes**

Pharmacological Treatment

- **Classes of anti hypertensive drugs**
- **1ST line therapy:**
  - *Angiotensin converting enzyme inhibitors (ACEIs)*
  - *Angiotensin receptor blockers (ARBs)*
  - *β blockers*
  - *Calcium channel blockers (CCBs)*
  - *Diuretics*
- **2nd line therapy**
  - *α blockers*
  - *α and β blockers*
  - *Direct vasodilators*

Nomenclature

- **ACEI…….*Pril*** **Captopril, Enalapril**
- **ARBs…….*sartan*** **Losartan, valsartan**
- **CCB……...*Dipine*** **Nifedipine, Amlodipine**
- **β blockers…...*Lol*** **Bisopralol**
- **α blockers…..*Zosin*** **Prazosin**

Factors Affecting Decision Making

- Etiology
- Pathogenesis
- Associated conditions
- Response to therapy
- Side effects
- Cost
- Compliance

Initial Selection of Antihypertensive Drugs

Contraindications

- **β blockers in:**
  - **Bronchial asthma**
  - **Diabetes**
  - **Ht failure**
- **ACEIs and ARBs:**
  - **Bilateral renal artery stenosis**
- **Diuretics:**
  - **Impaired kidney function**
    - ***Thiazide … GFR <50 ml/m^2/min***
    - ***Loop diuretics….<30 ml/m^2/min***
  - **Salt losing states**

Initial Selection of Antihypertensive Drugs

- **CKD with mild to moderate impaired renal function especially those associate with proteinuria:**
  1. **ACELs or ARBs**
  2. **Thiazide or Lasix**

- **ESRD on regular hemodialysis:**
  1. **Dry weight by proper ultrafiltration**
  2. **CCBs**
  3. **α blockers**

Initial Selection of Antihypertensive Drugs

- **Salt sensitive HTN:**
  1. **Diuretics as monotherapy**
  2. **CCBs**

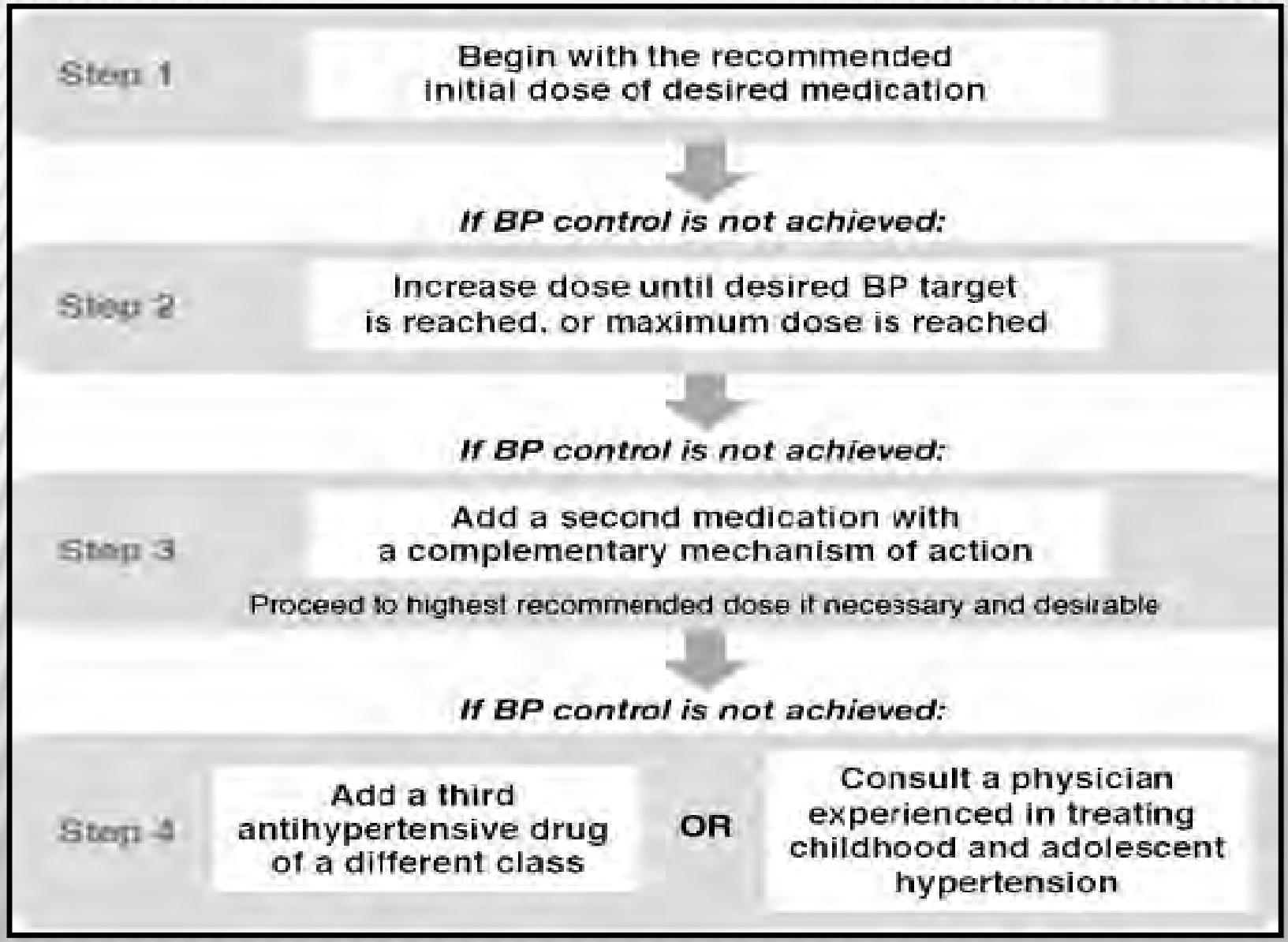
- **Sympathetic over activity, usually associated with migraine and tachycardia:**
  1. **β blockers**

Initial Selection of Antihypertensive Drugs

- **Volume expansion with normal or increase renin activity:**
  1. **CCBs**
  2. **Diuretics**

- **Volume expansion with low renin activity (monogenic hypertension):**
  1. **Mineralocortecoid excess → Potassium sparing diuretics (aldactone)**
  2. **Glucocorticoid suppressible → Dexamethasone**
  3. **Liddle syndrome → Amiloride**
  4. **Gordon syndrome → Thiazide**

Stepped Care Drug Therapy Approach



Conclusions

- **Hypertension is a common, serious and unresolved world wide health problem.**
- **Renal disease are the most common cause of hypertension in children.**
- **Diagnosis of hypertension should include: Proper measurement of BP, determine the stage of HTN according to centile curve, assessment of EOD, diagnosis of etiology and mechanism of hypertension as well as associated conditions.**

Conclusions

- **Therapeutic life style changes are indicated in management of all stages of hypertension.**
- **Factors affecting drug choice include: Etiology, pathogenesis, associated conditions, response to therapy, side effects, cost and compliance.**

Questions

Question No. 1

HTN is defined as?

A. Elevated PB
B. Sustained elevation of BP
C. Sustained elevation of BP >95th percentile
D. Sustained elevation of BP >95th percentile, BP is measured by standardized technique and devices

Question No. 2

In children aged 1-6 years, the most common cause of HTN is?

A. **Essential HTN**
B. **Rrenovascular diseases**
C. **Renal parynchemal diseases**
D. **Coartication of aorta**

Question No. 3

Initial drug therapy in children with HTN associated with sympathetic over activity, migraine and tachycardia is?

A. β Blockers
B. CCBs
C. Diuretics
D. ACEIs

THANK YOU