Ceylon College of Physicians

CLINICAL PRACTICE GUIDELINES

HYPERTENSION MANAGEMENT GUIDELINES

July 2016

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Abbreviations

ABPM	-	Ambulatory Blood Pressure Monitoring
ACE	-	Angiotensin Converting Enzyme
ACEI	-	Angiotensin Converting Enzyme Inhibitor
ACTH	-	Adrenocorticotropic Hormone
ARB	-	Angiotensin Receptor Blocker
AV	-	Atrio-ventricular
BB	-	Beta Blocker
BP	-	Blood Pressure
CCB	-	Calcium Channel Blocker
CHD	-	Coronary Heart disease
CKD	-	Chronic Kidney Disease
COPD	-	Chronic Obstructive Pulmonary disease
CPK	-	Creatine Phosphokinase
CRH	-	Corticotropin Releasing Hormone
CT	-	Computed Tomography
CV	-	Cardiovascular
CVD	-	Cardiovascular Disease
DBP	-	Diastolic Blood Pressure
DM	-	Diabetes mellitus
HBPM	-	Home Blood Pressure monitoring
LV	-	Left ventricular
LVF	-	Left ventricular Failure
LVH	-	Left Ventricular Hypertrophy
MAP	-	Mean Arterial Pressure
MRI	-	Magnetic Resonance Imaging
PVD	-	Peripheral Vascular Disease
SBP	-	Systolic Blood Pressure
SGOT	-	Serum Glutamic Oxaloacetic Transaminase
SGPT	-	Serum Glutamate Pyruvate Transaminase
TIA	-	Transient Ischaemic Attack
TOD	-	Target Organ Damage

1. INTRODUCTION

This guideline is developed as a part of clinical practice guidelines produced by the Ceylon College of Physicians. This is aimed at guiding all doctors who are involved in the treatment of hypertension in Sri Lanka. The Ceylon College of Physicians has produced hypertension management guidelines from time to time. The current updated hypertension guideline is produced in response to evolving new evidence and a growing need to update our clinical practice in keeping with the international trends. This new guideline will replace the existing guidelines. This guideline is modeled on the existing guidelines published by various international professional organizations. However relevant local data and modifications have been added to suite the local context.

Hypertension is one of the commonest preventable causes of premature morbidity and mortality world-wide. Hypertension is a major risk factor for chronic kidney disease, stroke (ischaemic and haemorrhagic), myocardial infarction, heart failure, cognitive decline, peripheral vascular disease and premature death. Untreated hypertension and uncontrolled hypertension is a major health problem even in developed countries. Studies have shown that considerable percentage of hypertensives who were treated for hypertension were unaware that they were hypertensives and were unaware about the complications of hypertension. The Joint National Committee of the US in its 7th report noted that approximately 30% of adults were unaware of their hypertension; up to 40% of people with hypertension were not receiving treatment; and, of those treated, up to 67% did not have their blood pressure under control.

Blood pressure in a population follows a normal distribution and there is no actual cut-point above which hypertension can be considered to exist. However epidemiological studies demonstrate that the disease risk associated with blood pressure has a continuous relationship with the blood pressure above 115/70 mmHg and the risk of cardiovascular events have been shown to double for every 20/10mmHg rise in blood pressure. The threshold blood pressure determining the presence of hypertension is defined as the level of blood pressure above which treatment has been shown benefit in terms of reducing mortality and morbidity. The term primary hypertension is preferred to the previous termed “essential hypertension”. Primary hypertension refers to approximately 90% people with sustained high blood pressure with no obvious, identifiable cause. The remaining 10% are termed “secondary hypertension” for which specific causes for the blood pressure elevation can be determined. This guideline is specifically designed to guide the management of primary hypertension.

Primary hypertension is remarkably common in Sri Lanka and the prevalence is strongly influenced by age and lifestyle factors. In hypertension systolic and/or diastolic blood pressures may be elevated. As the demographics of Sri Lanka is shifting towards an older population, the prevalence of hypertension and requirement for its treatment will continue to rise.

Routine periodic screening for high blood pressure is essential to detect high blood pressure in the population. Every opportunity to check the blood pressure should be used to detect hypertension. Early diagnosis, treatment and follow-up of patients with hypertension is one of the most common interventions in primary care settings.

2. KEY HIGHLIGHTS

- Hypertension is defined as, systolic blood pressure (SBP) of ≥140 mmHg and/or diastolic blood pressure (DBP) of ≥90 mmHg in all adults under the age of 60 years and SBP of ≥150 mmHg and/or a DBP of ≥90 mmHg in those aged 60 years or more.
- Mild to moderate primary hypertension is largely asymptomatic.
- Screening for hypertension is recommended in all adults over the age of 35 years and adults below 35 years if they have diabetes mellitus, established cardiovascular disease, renal disease or any other cardiovascular risk factors.
- Diagnosis of hypertension is based on accurate and multiple blood pressure recordings. Blood pressure measurements are usually done in the clinic settings but can be supplemented with home blood pressure monitoring (HBPM) or ambulatory blood pressure monitoring (ABPM).
- When measured in the clinic, take two or more readings until there is no substantial difference (SBP 10 mmHg or DBP 6 mmHg) between two consecutive readings. Record the **lower of the last two measurements** as the clinic blood pressure.
- If the final SBP is ≥180 mmHg and/or DBP is ≥110 mm Hg, the diagnosis of hypertension can be made at the first visit itself; If the final clinic SBP is <180 and DBP is <110 mm Hg but SBP ≥140 mmHg and/or DBP ≥90 mmHg at the first visit, the diagnosis should be confirmed at an additional patient visit, usually 1 to 4 weeks after the first visit. Diagnosis of hypertension is confirmed if SBP is ≥140 mmHg and/or DBP is ≥90 mmHg at both visits.
- ABPM or HBPM is required in situations where the diagnosis of hypertension is doubtful based on the clinic blood pressure. White coat hypertension and masked hypertension are two such situations where ABPM and/or HBPM are indicated to make the diagnosis.
- The initial evaluation of a patient with hypertension is aimed to exclude or identify secondary causes of hypertension, to determine target organ damage (TOD) and to assess total cardiovascular (CV) risk of the individual; The initial evaluation calls for a detailed medical history, physical examination and laboratory investigations.
- After initial assessment the following conditions require referral to a specialist for further evaluation and management.
    - White-coat hypertension / Masked hypertension (when ABPM is required)
    - Secondary causes (including chronic kidney disease)suspected
    - Hypertension in young (age <35 years)
- At the initial encounter, following situations require immediate admission to hospital for further evaluation and management.
    - Hypertensive emergencies
    - SBP ≥220 mmHg and/or DBP ≥120 mmHg
- The appropriate time of initiation of treatment, type of intervention either life style modifications or drug therapy and the target BP to be achieved depend on the CV risk level and presence of TOD.

- Treatment approach to hypertension has 5 steps.
  Step 1 – Decide the treatment category
  (lifestyle modifications alone or lifestyle modifications + antihypertensive medication)
  Step 2 – Decide on lifestyle modifications
  Step 3 – Decide on optimum antihypertensive medication (if indicated) based on compelling indications and contraindications
  Step 4 – Set targets for control of blood pressure
  Step 5 – Follow up
- In uncomplicated hypertension any of the following classes of drugs are recommended for initial therapy.
  - ACE inhibitors / angiotensin receptor blockers
  - Calcium channel blockers
  - Thiazide diuretics
- Beta blockers are no longer recommended as initial therapy in uncomplicated hypertension. However, patients who are already well controlled with beta blockers, the therapy may be continued unchanged.
- Start with the lowest dose of selected first-line antihypertensive medication. A second drug may be added rather than stepping up the monotherapy to achieve the target BP.
- Initiation with two drug combinations may be considered in patients with significant CV risk and markedly high BP values.
- Preferred combinations of antihypertensive drugs are,
  - Thiazides and ARB/ACEI
  - Thiazides and CCB
  - ACEI/ARB and CCB
  - Dihydropyridine CCB (nifedipine/ amlodipine) and beta blockers

  Combination of ACEI and ARB is not recommended
- Treatment targets for blood pressure control are given below.
  - Age < 60 years : SBP <140 mmHg and DBP <90 mmHg
  - Age ≥ 60 years : SBP <150 mmHg and DBP <90 mmHg
  - Patients with DM or CKD (irrespective of the age) : SBP <140 mmHg and DBP <90 mmHg
- Statins and or antiplatelet drugs are indicated for selected patients with high CV risk.
- Follow-up management includes, blood pressure monitoring, laboratory monitoring and emphasis on life style changes. Annual monitoring of serum electrolytes, serum creatinine, blood glucose, lipid profile (total cholesterol if lipid profile is not available) is recommended.
- Use of intravenous medications is recommended in the management of hypertensive emergencies; sodium nitroprasside, glyceryl trinitrate, labetalol and hydralazine are indicated in different clinical conditions; treatment timeline and targets differ depending on the nature of the emergency.
- Hypertension is defined as resistant when a therapeutic strategy that includes appropriate lifestyle measures plus a diuretic and two other antihypertensive drugs belonging to different classes at

adequate doses fails to lower SBP and DBP values to less than 140 and 90 mmHg (150 and 90mmHg in those aged ≥60 years), respectively.

- In order to make the diagnosis of resistant hypertension the other causes of uncontrolled hypertension should be excluded.
- Medications recommended for treatment of resistant hypertension include spiranolactone (the preferred drug in resistant hypertension), alpha blockers, beta blockers, centrally acting drugs such as methyl dopa and vasodilators such as hydralazine.

3. DEFINITIONS AND CLASSIFICATION

The absolute cut off values to define hypertension and the staging of hypertension has changed over the last several decades. The definitions and classifications used in this guideline are based on European[1] and American[2-3] guidelines.

Definitions of hypertension:

Based on current evidence,

- hypertension is defined as systolic blood pressure (SBP) of ≥140 mmHg and/or diastolic blood pressure (DBP) of ≥90 mmHg in all adults (>18 year) under the age of 60 years.
- for those aged 60 years or more SBP of ≥150 mmHg and a DBP of ≥90 mmHg is used as cut off values both to define and to treat hypertension.

Normotensive and pre-hypertensive:

- SBP of <130 mm Hg and a DBP of <80 mm Hg is defined as normotensive.
- SBP of 130-139 mm Hg and DBP of 80-89 mm Hg is defined as pre-hypertensive.

Classification of hypertension:

- Those with hypertension can be classified in to 3 grades depending on the systolic and diastolic blood pressure values. (Table 1)

Table 1: Classification of hypertension based on clinic blood pressure

Category	SBP		DBP
Grade I hypertension	140 - 159	and/or	90 - 99
Grade II hypertension	160 - 179	and/or	100 - 109
Grade III hypertension	≥ 180	and/or	≥ 110

Primary and secondary hypertension:

Hypertension remains classifiable into primary and secondary types. Careful evaluation for a possible secondary cause is needed in,

- all patients with onset of hypertension below the age of 35 years
- those with resistant hypertension
- those with poorly controlled blood pressure despite good drug compliance

4. EPIDEMIOLOGY

The global prevalence of hypertension has risen from 600 million in 1980 to 1 billion in 2008[4]. Worldwide prevalence in adults over the age of 25 years was reported as 40% in 2008. In the South-East Asia Region, approximately 35% of the adult population has hypertension and 9.4% of the total deaths are attributable to hypertension[5]. In Sri Lanka, prevalence of hypertension in 35-64 year old residents in Ragama MOH area in the Gampaha district were 30.4% (27.8% in males; 32.5% in females) and 31.8% of them were previously undetected[6]. Of the known hypertensives, 19.5% were not on antihypertensive medication and only 32.1% achieved target blood pressure levels. In another study carried out in 2005-2006 in seven provinces, the age adjusted prevalence of hypertension in all adults, males and females was 23.7%, 23.4% and 23.8%[7]. Male gender, increasing age, Sri Lankan Moor ethnicity, diabetes, physical inactivity and central obesity were significantly associated with hypertension.

5. CLINICAL FEATURES

- Mild to moderate primary hypertension is **largely asymptomatic**.
- Hypertensive encephalopathy is associated with headache, somnolence, confusion, visual disturbances, nausea and vomiting.
- Looking for clinical features suggestive of causes for secondary hypertension is an important aspect in clinical evaluation.

6. COMPLICATIONS

Uncontrolled and prolonged elevation of blood pressure results in structural and functional changes in many organ systems. These changes can lead to following complications.

1. **Hypertensive cardiac disease**
   Cardiac complications are the main cause of morbidity and mortality in hypertension.
   They include:
   - Left ventricular hypertrophy
   - Coronary artery disease
   - Heart failure
   - Arrhythmias

2. **Hypertensive cerebrovascular disease and dementia**
   - Hypertension is a major risk factor of hemorrhagic and ischemic stroke. Cerebrovascular complications are more closely related to systolic than diastolic blood pressure.
   - Hypertension is a risk factor for dementia of both vascular and Alzheimer types.

3. **Atherosclerotic vascular disease**
   - Renovascular disease
   - Peripheral vascular disease

4. **Hypertensive kidney disease**
    - Chronic kidney disease– due to poorly controlled hypertension
    - Acute kidney injury – due to accelerated hypertension

5. **Hypertensive retinopathy**

6. **Dissecting aneurysm of aorta**

7. DIAGNOSIS OF HYPERTENSION

7.1 Recommendations for Screening

- Screening for hypertension is recommended in the following categories.
    - Adults over the age of 35years
    - Adults below 35 years if they have diabetes mellitus, established cardiovascular disease, renal disease or any other cardiovascular risk factors

- If the blood pressure is considered as normal at the initial screening further screening is recommended as given below.
    - At each clinic visit in those with diabetes mellitus, established cardiovascular disease, and renal disease
    - Once in 2 years in the other categories

7.2 Measurement of blood pressure

- Diagnosis of hypertension is based on accurate and multiple blood pressure recordings. In clinical practice, blood pressure measurements are usually done in the clinic settings but can be supplemented with home blood pressure readings or ambulatory monitoring.

- Mercury sphygmomanometer using an auscultatory technique is the method of choice for measurement of blood pressure in the clinic. Electronic sphygmomanometers are widely used especially for home blood pressure measurements and they must be checked and properly validated at least once in six months. A list of validated electronic devices is available at www.bhsoc.org/bp-monitors/bp-monitors/. All sphygmomanometers should be serviced annually.

- If pulse irregularity is present as in atrial fibrillation, a mercury sphygmomanometer should be used in measuring blood pressure.

7.2.1 Clinic Blood Pressure Measurement

- Patient should be relaxed, seated with the back supported and with legs resting on the ground in the uncrossed position for 3-5 minutes.

- Patient's arm being used for the measurement should be outstretched and supported. Position the

cuff around the arm to place the center of the cuff bladder over the brachial artery and the lower border of the cuff about 2 cm above the elbow.

- Have the cuff at the heart level, whatever the position of the patient.

- Cuff and bladder dimensions should be adapted to the arm circumference. Use a standard bladder (12–13 cm wide and 35 cm long) for averagely built individuals. Have a larger and a smaller bladder available for large (arm circumference >32 cm) and thin arms, respectively.

- When adopting the auscultatory method, use phase I and V (disappearance) Korotkoff sounds to identify systolic and diastolic BP, respectively. Record the systolic and diastolic blood pressures to the nearest 2 mmHg.

- Take two measurements; wait one minute before repeating the measurement in the same arm.

- If there is a substantial difference between the two readings (SBP 10 mmHg or DBP 6mmHg) have the patient rest for 5 minutes and then take several readings until consecutive readings do not vary by greater than above values.
  Record the **lower of the last two measurements** as the clinic blood pressure.

- Check for postural hypotension when symptomatic or suspected (eg. elderly subjects, diabetic patients). Measure the blood pressure in the sitting or lying down position and 2 minutes after assumption of the standing position. **A** reduction in systolic blood pressure of 20mmHg or more after standing for at least one minute is defined as p**ostural hypotension.**

Confirmation of hypertension with clinic blood pressure

- If the final SBP is ≥180 mmHg and/or DBP is ≥110 mm Hg, the diagnosis of hypertension can be made at the first visit itself.

- If the final clinic SBP is <180 and DBP is <110 mm Hg but SBP ≥140 mmHg and/or DBP ≥90 mmHg at the first visit the diagnosis should be confirmed at an additional patient visit, usually 1 to 4 weeks after the first visit.
  Diagnosis of hypertension is confirmed if SBP is ≥140 mmHg and/or DBP is ≥90 mmHg at both visits.

7.2.2 Out-of-clinic blood pressure measurement

- **Ambulatory Blood Pressure Monitoring (ABPM) and Home Blood Pressure Monitoring (HBPM)** are methods used for out-of-clinic blood pressure measurement**.**

- ABPM or HBPM is required in situations where the diagnosis of hypertension is doubtful based on the clinic blood pressure. White coat hypertension and masked hypertension are two such situations where ABPM and/or HBPM are indicated to make the diagnosis.

    - **White-coat hypertension:** Small percentage of the population can have blood pressure in the hypertensive range when taken in a clinical setting, but not when taken in other settings.

    - **Masked hypertension:** In some people ambulatory blood pressure or home blood pressure may be high but the clinic blood pressure is normal. If a person has evidence of target organ damage with normal clinic blood pressure, masked hypertension should be suspected.

- Clinic BP is usually higher than ambulatory and home BP, therefore cut-off values for definition and diagnosis are different.

- The choice between the two methods may depend on the availability, convenience and sometimes patient preference. For initial assessment of the patient, HBPM may be more suitable in primary care and ABPM in specialist care. However, HBPM is more suitable than ABPM for follow up.

Ambulatory Blood Pressure Monitoring (ABPM)

Major advantage of ABPM is that it provides a series of blood pressure measurements throughout 24 hours and it gives a more reliable assessment of blood pressure than the measurements in the clinic environment. As ABPM requires specialized equipment, those patients should be referred to a specialist centre where such facility is available.

Details on ABPM are given in the Annexure 1.

Confirmation of hypertension with ABPM

Diagnosis of hypertension is confirmed with **any** of the following average BP values.

- Daytime (or awake) average SBP ≥135 and/or DBP ≥85 mmHg
- Nighttime (or asleep) average SBP ≥120 and/or DBP ≥70 mmHg
- 24-houraverage SBP ≥130 and/or DBP ≥80 mmHg

Home Blood Pressure Monitoring (HBPM)

- Home blood pressure is measured by a simple to use electronic device, usually by self-measurement. Patients should be given adequate information on the procedure and trained by a medical personal. Devices should be calibrated once in six months and serviced at regular intervals.
- HBPM is used for initial diagnostic evaluation and/or follow up when indicated.
- When used for a diagnostic evaluation, measurements should be taken for at least 3–4 days and preferably on 7 consecutive days, twice during the day (in the mornings as well as in the evenings). Two readings should be done per occasion with 1–2 min gap between the readings. The time and the blood pressure reading should be recorded immediately in a diary. Exclude the day one readings. Home BP is the average of the readings of the rest of the days.

  Details on HBPM are given in the Annexure 1.

Confirmation of hypertension with HBPM

Diagnosis of hypertension is confirmed when

- Based on the average of all the BP readings (with exclusion of the 1st day) SBP ≥135 and/or DBP ≥85 mmHg

8. EVALATION OF A PATIENT DIAGNOSED WITH HYPERTENSION

The initial evaluation of a patient with hypertension is aimed to,

1. **exclude or identify secondary causes of hypertension**
2. **determine target organ damage**
3. **assess total cardiovascular risk of the individual**

The initial evaluation calls for a detailed medical history, physical examination, laboratory investigations.

8.1 Secondary hypertension

Secondary hypertension refers to high blood pressure from an identifiable underlying cause. It may occur in up to 10% of hypertensive patients.

- It is important to diagnose secondary hypertension because if appropriately treated, patients might be cured, or show an improvement in BP control and a reduction of CV risk.

- Secondary hypertension is more likely when hypertension occurs in younger patients (less than 35 years of age), presents as accelerated hypertension (BP ≥180/110 mmHg with signs of papilloedema and/or retinal haemorrhages) or responds poorly to treatment.

- Detailed history, clinical examination and special investigations are important in identifying a secondary cause of hypertension. (Table 2)

Table 2: Causes of secondary hypertension

Causes of secondary hypertension
Acromegaly
Chronic kidney disease
Coarctation of aorta
Cushing syndrome
Drug-induced hypertension steroids, NSAIDs, OCP, erythropoietin, cyclosporine, tryptans, weight loss agents, MOI, indigenous medicines, recreational drugs (cocaine, amphetamines)
Hyperthyroidism
Obstructive sleep apnoea
Pheochromocytoma
Polycystic kidney disease
Primary hyperaldosteronism
Renovascular hypertension

- **If a secondary cause for hypertension is suspected, patient should be referred to a specialist centre for further evaluation.**

8.2 Target organ damage

Evidence of TOD should be sought carefully by appropriate techniques in all hypertensive patients (Table 3). This would help to identify individuals who need more aggressive treatment and to decide the most appropriate anti-hypertensive medications for each individual. Asymptomatic TOD plays a crucial role in determining the CV risk of individuals with hypertension.

Table 3: Target organ damage in hypertension

Target organ damage
Retina: hypertensive retinopathy
Heart: heaving apex, cardiomegaly, heart failure, arrhythmias
Peripheral arteries: peripheral vascular disease
Kidney: proteinuria, renal impairment
Brain: stroke, TIA, dementia

8.3 Total cardiovascular risk

Majority of individuals of the hypertensive population has additional CV risk factors (Table 4). When concomitantly present, BP and the other CV risk factors may potentiate each other, leading to a higher CV risk than the sum of each component taken separately. Therefore, the total CV risk should be considered along with BP levels to maximize the cost effectiveness of hypertension management. The type of intervention, the time of intervention and type of antihypertensive medications used differ in individuals with additional CV risk factors and higher CV risk.

Table 4: Cardiovascular risk factors in patients with hypertension

CV risk factors
Smoking
Diabetes mellitus
Dyslipidaemia
Established coronary artery disease
Cerebrovascular disease (stroke, TIA)
Microalbuminuria / albuminuria
Chronic kidney disease
Family history of premature coronary artery disease (first degree female relative <65 years or first degree male relative <55 years)

8.4 Clinical evaluation

The initial evaluation calls for a detailed medical history including family history, physical examination, laboratory investigations and further diagnostic tests to fulfill above aims. Some of the investigations are needed in all patients; others only in specific patient groups.

Medical History
Details about the duration of hypertension, current drug therapy and any adverse effects of medications in patients already known to have hypertension.
Past history or current symptoms of ischaemic heart disease, heart failure, cerebrovascular disease or peripheral vascular disease.
Past history of renal disease, haematuria and features suggestive of chronic kidney disease (polyuria, anorexia, fatigability)
Symptoms suggestive of secondary causes; • Repetitive episodes of sweating, headache, anxiety, palpitations (pheochomocytoma) • Episodes of muscle weakness suggestive of hypokalaemia (primary hyperaldosteronism) • Weight loss, tremors, palpitations, insomnia, anxiety, loose motions (hyperthyroidism) • Obesity, daytime somnolence, obesity, morning headaches (obstructive sleep apnoea)
Drug history should include chronic analgesic use, concurrent medications that can raise blood pressure (steroids, NSAIDs, oral contraceptive agents, erythropoietin, cyclosporin, tryptans, weight loss agents, MOI, Indigenous medicines) and use of recreational drugs(cocaine, amphetamines)
Family history of hypertension, diabetes mellitus, stroke, hyperlipidaemia, premature coronary heart disease and chronic kidney disease
Smoking habits, alcohol consumption, dietary habits and amount of physical exercise

Physical examination
Weight, height and BMI, waist circumference
Pallor, ankle oedema
Pulse rate, rhythm, left–right arm BP difference, radio-femoral delay, peripheral pulsations Carotid bruits, elevated JVP Heaving apex beat, cardiomegaly, 3^{rd}/ 4^{th} heart sounds, murmurs Basal crepiations in auscultation of lungs
Palpable kidneys, renal bruits
Features of endocrine disease; • Skin stigmata of neurofibromatosis (pheochromocytoma) • Cushingnoid features • Features of Acromegaly • Wasting, tremors, tachycardia, exophthalmos, goiter (hyperthyroidism)
Abnormalities of optic fundi (arteriovenous nipping, retinal haemorrhages, exudates, papilloedema)

Initial investigations should aim at assessing end organ damage and associated cardiovascular risk factors.

Initial Investigations
Urine analysis • Urine full report or dipstick for proteinuria and haematuria • Spot urine sample for microalbuminuria (albumin to creatinine ratio is preferred if available) if urine analysis is negative for protein
Fasting blood sugar, lipid profile (total cholesterol if lipid profile is not available)
Serum creatinine, serum electrolytes, ALT/AST, haemoglobin
12 lead ECG to look for left ventricular hypertrophy, coronary heart disease and arrhythmias

Further Investigations
Further investigations are based upon the clinical suspicion of secondary causes following clinical evaluation and results of basic investigations. **Referral to a specialist is recommended when further investigations are required.**
Echocardiography for assessment of left ventricular hypertrophy, cardiac function
Chest radiograph when coarctation of aorta is clinically suspected
Carotid Doppler if carotid bruits or TIAs Doppler ultrasound of peripheral arteries, ankle-brachial index when evidence of peripheral vascular disease
Abdominal ultrasound scan for assessment of kidney size in CKD, polycystic kidney disease
Renal Duplex ultrasonography is indicated in patients with renal bruits, young hypertensives and elderly patients to look for renovascular disease
24-hour urine urinary fractionated metanephrines or plasma-free metanephrines in suspected Pheochromocytoma and CT scan or MRI of the abdomen and pelvis,123 I-labelled metaiodobenzyl-guanidine scanningfor tumour location
Serum Aldosterone–renin ratio in suspected Primary hyperaldosteronism. Confirmatory tests: oral sodium loading, saline infusion, fludrocortisone suppression, Adrenal CT scan; adrenal vein sampling
24-h urinary cortisol excretion, overnight dexamethasone-suppression test, plasma ACTH, long dexamethasone suppression test or CRH stimulation test when Cushings syndrome is suspected

9. MANAGEMENT

9.1 INDICATIONS FOR ADMISSION TO HOSPITAL

At the initial encounter, following situations require immediate admission to hospital for further evaluation and management.

- Hypertensive emergencies *(refer to section 10)*
- SBP ≥220 mmHg and/or DBP ≥120 mmHg

Clinical judgment is required regarding admission of those with SBP ≥180 mmHg and /or DBP ≥110 mmHg. However these patients need a close follow up within a few days.

9.2 INDICATIONS FOR REFERRAL TO A SPECIALIST

After initial assessment the following conditions require referral to a specialist for further evaluation and management.

- White-coat hypertension / Masked hypertension (when ABPM is required)
- Secondary causes (including chronic kidney disease) suspected
- Hypertension in young (age <35 years)

9.3 TREATMENT APPROACH

The appropriate time of initiation of treatment and type of intervention, either life style modifications alone or with drug therapy, depends on the **CV risk level** and **presence of TOD.**[1-2,8-10]

TREATMENT APPROACH TO HYPERTENSION

Step 1 – Decide the treatment category
(lifestyle modifications alone or lifestyle modifications + antihypertensive medication)

Step 2 – Decide on lifestyle modifications

Step 3 –Decide on optimum antihypertensive medication (if indicated) based on compelling indications and contraindications

Step 4 – Set targets for control of blood pressure

Step 5 – Follow up

STEP 1: TREATMENT CATEGORY

Decide the treatment category

A. Start anti-hypertensive medications in addition to lifestyle modifications immediately after diagnosis, if the SBP ≥160 and/or DBP ≥100 mmHg.

B. In those with SBP 140-159 mmHg and/or DBP 90-99 mmHg, start anti-hypertensive medications in addition to lifestyle modifications, immediately after diagnosis, if they have any of the following.
   - Established cardiovascular disease (CHD, stroke, TIA, PVD)
   - Albuminuria / CKD
   - Target organ damage
   - Diabetes mellitus
   - A 10-year cardiovascular risk equivalent to 20% or greater.

C. In those with SBP 140-159 mmHg and/or DBP 90-99 mmHg without any of the conditions listed under treatment category B above start,
   - lifestyle modifications
   - regular BP monitoring
   - anti-hypertensive medications only if,
     - SBP becomes ≥160 and/or DBP becomes ≥100 mmHg at any stage.
     - SBP remains ≥140 and/or DBP remains ≥90 mmHg over 6-12 months

STEP 2: LIFESTYLE MODIFICATIONS

The institution of adequate lifestyle modifications is paramount towards an optimum management of hypertension. Patient compliance to life style changes and drug therapy is a challenge to the clinician and therefore patient education and motivation is important.

- **Cessation of smoking**

  Nicotine released from tobacco is believed to impact blood pressure through arousal of the sympathetic nervous system followed by the release of norepinephrine and epinephrine. In patients with hypertension, there is an increase in cardiovascular events in those who smoke compared with those who do not. Studies have shown that men with high blood pressure who smoke have an increased risk of total, ischemic, and hemorrhagic stroke, and that this risk is related to the number of cigarettes smoked[11]. Therefore tobacco use status should be established at each patient visit and hypertensive smokers should be counseled regarding giving up smoking.

- **Moderation of alcohol consumption**

  Limiting alcohol consumption is an important lifestyle modification for reducing blood pressure. Excess alcohol consumption interferes with blood pressure control. One meta-analysis indicated a dose-response relationship between decreased alcohol consumption and blood pressure reduction[12].

Hypertensive men who drink alcohol should be advised to limit their consumption to no more than 2-3 units (20–30 g), and hypertensive women to no more than 1-2 units (10–20 g), of ethanol per day. Total alcohol consumption should not exceed 140 g per week for men and 80 g per week for women.

- **Diet**

  A diet plan with local and cultural acceptance should be formulated with the principles stated below in consultation with a dietician where necessary. Hypertensive patients should be advised to eat vegetables, low-fat dairy products, soluble fibre, whole grains and protein from plant sources, reduced in saturated fat and cholesterol. Fresh fruits are also recommended, although with caution in overweight patients because high calorie content in some fruits may promote weight gain. Patients with hypertension should be advised to eat fish at least twice a week.The DASH eating plan outlines a diet rich in fruits and vegetables; high in low-fat dairy products, potassium, magnesium, and calcium; and low in total saturated fat. This dietary plan has been shown to produce mean reductions of 6 mm Hg in systolic blood pressure and 3 mm Hg in diastolic blood pressure[13].

- **Salt consumption**

  Salt consumption by Asians is considered to be high. Studies have shown that salt reduction had a 3 mm Hg greater reduction in systolic blood pressure than the control group[14]. A daily intake of salt should not exceed 5– 6 g. (1 teaspoon salt = 5 grams)

- **BMI**

  Weight loss is an important lifestyle modification in reducing blood pressure. A reduction of approximately 9 kg may produce a reduction in systolic blood pressure of 5 to 20 mm Hg[15].
  Maintenance of a healthy body weight (BMI of about 23 kg/m^2) and waist circumference (<80cm in females and <90cm in males) is recommended.

- **Physical exercise**

  Aerobic exercise has positive effects on blood pressure whether or not a person has hypertension, producing average reductions of 4 mm Hg in systolic blood pressure and 3 mm Hg in diastolic blood pressure[16]. Physicians should help patients find an activity that they enjoy, because enjoyment will increase their adherence. If a patient finds it difficult to make time to exercise, one suggestion might be a brisk walk at lunch, which helps break up the day and requires no additional time commitment. It is recommended that patients with pre-hypertension or hypertension exercise for 30 minutes on most days of the week.Hypertensive patients, especially those who follow a sedentary life style should be advised to participate in at least 30 min of moderate-intensity dynamic aerobic exercise (walking, jogging, cycling or swimming) on 5–7 days per week

- **Meditation**

  Though traditionally meditation is not recommended as a life style modification method in hypertension guidelines there are studies showing evidence of benefit. Meditation may have other benefits and does not appear to be harmful except to patients with psychosis.

STEP 3: ANTIHYPERTENSIVE THERAPY

- Identify patients who need drug treatment according to step 1.
- The choice of initial antihypertensive drug will depend on
  - Presence of target organ damage (Table 5)
  - Presence of co-morbid conditions
  - Patient compliance
  - Cost and availability
- In uncomplicated hypertension any of the following classes of drugs are recommended for initial therapy[3].
  - ACE inhibitors / angiotensin receptor blockers
  - Calcium channel blockers
  - Thiazide diuretics
- Beta blockers are no longer recommended as initial therapy in uncomplicated hypertension[3]. However, patients who are already well controlled with beta blockers, the therapy may be continued unchanged.

Major classes of antihypertensive drugs are described in annexure 2.

Table 5: Choice of antihypertensive drug based on TOD and associated clinical conditions (compelling indications)

Condition	Beneficial
Diabetes mellitus	ACEI, ARB
Asymptomatic TOD	
LVH	ACEI, ARB
Microalbuminuria/albuminuria	ACEI, ARB
CKD stage 1-3	ACEI, ARB
Symptomatic TOD	
Stroke	Thiazides, CCB
CKD stage 4-5	CCB, ACEI/ ARB (with caution due to hyperkalaemia)
CHD	BB, ACEI, ARB, CCB
Heart failure	ACEI, ARB, Diuretics
PVD	ACEI, CCB

ACEI - Angiotensin Converting Enzyme Inhibitors, ARB - Angiotensin Receptor Blockers, CCB – Calcium Channel Blockers, BB- Beta blockers, LVH – Left Ventricular Hypertrophy, CKD – Chronic Kidney Disease, CHD – Coronary heart Disease, PVD – Peripheral vascular Disease

- Exclude contraindications and be aware of possible situations where the drug should be used with caution (Table 6).

Table 6: Contraindications for antihypertensive medications

Drug	Contraindications	Cautions
Thiazide diuretics	Gout Pregnancy	Metabolic syndrome Glucose intolerance
CCB (dihydropyridine) nifedepine, amlodipine		Tachycardia Heart failure Angina
CCB (non-dihydropyridine) verapamil, diltiazem	AV block Severe LV dysfunction Heart failure	
ACEI / ARB	Pregnancy Hyperkalaemia Bilateral renal artery stenosis ACEI in angioneurotic oedema	
Beta-blockers	Bronchial asthma COPD* Heart block	
Spironolactone	Hyperkalaemia	

*It may be necessary for a patient with COPD without significant reversible airway obstruction to receive treatment with a beta blocker for a coexisting condition

- Start with the lowest dose of selected first-line antihypertensive medication. A second drug may be added rather than stepping up the monotherapy to achieve the target BP.

- Initiation with two drug combinations may be considered in patients with significant CV risk and markedly high BP values. Doses can be stepped up if necessary to achieve the BP target; if the target is not achieved by a two-drug combination at full doses, switching to another two-drug combination or addition of a third drug can be considered.

Preferred combinations of antihypertensive drugs are,

- Thiazides and ARB/ACEI
- Thiazides and CCB
- ACEI/ARB and CCB
- Dihydropyridine CCB (nifedipine/ amlodipine) and beta blockers

Combination of ACEI and ARB is not recommended

- Drug doses of major classes of antihypertensive drugs are given in table 7.

Table 7. Antihypertensive drug doses

Drug class	Drugs	Dose range (mg/day)	Dosing frequency
Thiazides	Hydrochlorothiazide	12.5-50	1-2
	Indapamide	1.25-2.5	1
ACEI	Captopril	25-150	2-3
	Enalapril	5-40	1-2
	Lisinopril	10-40	1
	Ramipril	2.5-10	1
	Perindopril	2.5 - 10	1
ARB	Losartan	25-100	1-2
	Telmisartan	20-80	1
	Candesartan	8-32	1
	Valsartan	80-320	1-2
	Irbesartan	150-300	1
CCB Dihydropyridine	Nifedipine SR	20-40	1-2
	Amlodipine	5-10	1
CCB Nondihydropyridine	Diltiazem	180-360	3
	Diltiazem Extended release	180-360	2
	Verapamil	120-480	2 -3
Beta blockers	Atenolol	25-50	1
	Bisoprolol	5-20	1
	Metoprolol	100-400	1-2
	Carvedilol	12.5-50	1-2
Aldosterone antagonists	Spiranolactone	25-50	1
Alpha blockers	Prazocin	1-20	2-3
	Prazocin Extended Release	2.5-5	1
Centrally acting drugs	Methyldopa	250-3000	2-3

STEP 4: TREATMENT TARGETS FOR HYPERTENSION

Treatment targets for blood pressure control are given below.

- Age < 60 years - SBP <140 mmHg and DBP <90 mmHg
- Age ≥ 60 years - SBP <150 mmHg and DBP <90 mmHg
- Patients with DM or CKD (irrespective of the age) - SBP <140 mmHg and DBP <90 mmHg

STEP 5: FOLLOW UP

Follow-up management includes:

- Blood pressure monitoring
- Laboratory monitoring
- Emphasis on life style changes

Blood pressure monitoring

- BP monitoring should be done every 2 to 4weeks at initiation of treatment or after adjusting medication till target BP is achieved.
- Thereafter BP should be monitored at least every 3 months. More frequent monitoring is required in patients with target organ damage and vascular risk factors.
- Hospital admission during follow up is indicated in following situations.
    - Hypertensive emergencies *(refer to section 10)*
    - SBP ≥220 mmHg and /or DBP ≥120 mmHg
      Clinical judgment is required regarding admission of those with SBP ≥180 mmHg and /or DBP ≥110 mmHg. If not admitted, they need a close follow up within a few days.

Laboratory monitoring

- In all patients annual monitoring of serum electrolytes, serum creatinine, blood glucose, lipid profile (total cholesterol if lipid profile is not available) is recommended.
- In renal impairment more frequent monitoring of serum creatinine and serum electrolytes should be done as guided by clinical assessment
- When ACEI, ARB, diuretics and aldosterone antagonist are used serum creatinine and serum electrolytes should be done at baseline and 2 weeks after initiation of treatment; thereafter when clinically indicated.

Significant rise in serum creatinine after starting an ACEI /ARB is suggestive of renovascular hypertension

Emphasis on therapeutic life style changes

At each follow up visit the patients should be educated regarding the importance of dietary modifications and exercise.

9.4 ADJUNCTIVE MEDICATIONS

Hypertension alone is not an indication for statins or antiplatelet drugs.

9.4.1 LIPID LOWERING DRUGS

Indications for statin therapy in a patient with hypertension

- Secondary prevention in patients with established CVD*: high intensity statin therapy
- Primary prevention in those with
  LDL-C ≥190 mg/dL : high intensity statin therapy
  DM : high intensity statin therapy
  No DM, LDL 70-189mg/dL and 10 year CV risk ≥20%
  : moderate intensity statin therapy

**CVD includes acute coronary syndromes, stable angina, coronary or other arterial revascularization, stroke, TIA, or peripheral arterial disease presumed to be of atherosclerotic origin*

Table 8. Doses of commonly used statins

High intensity	Moderate intensity
Atorvastatin 40 -80 mg	Atorvastatin 10- 20 mg
Rosuvastatin 20 -40 mg	Rosuvastatin 5 – 10 mg
	Simvastatin 20 - 40 mg
	Pravastatin 40 – 80 mg

Individuals on statins need to be regularly assessed.

- This should include a fasting lipid profile performed at 12 weeks after initiation or dose adjustment, and every 6 to 12 months thereafter.
- Other safety measurements (CPK, SGOT/SGPT) should be done as clinically indicated.

9.4.2 ANTI-PLATELET THERAPY

Indications for antiplatelet therapy in a patient with hypertension

- Secondary prevention in patients with CVD*
  - Low dose aspirin (75 – 150 mg / day) life long
  - Clopidogrel (75 mg /day) if there is history of aspirin allergy or intolerance
  - Dual antiplatelet therapy (aspirin + clopidogrel) up to 1 year after an acute coronary syndrome (STEMI / NSTEMI / Unstable angina)

- Primary prevention in those with 10 year CV risk ≥30%
  - Low dose aspirin (75 – 150 mg / day)

BP should be well controlled before starting antiplatelet therapy for primary prevention.

**CVD includes acute coronary syndromes, stable angina, coronary or other arterial revascularization, stroke, TIA, or peripheral arterial disease presumed to be of atherosclerotic origin*

10. Management of hypertensive emergencies

10.1 Definition of Hypertensive Emergencies

Hypertensive emergencies are defined as SBP ≥180 mmHg and/or DBP ≥120 mmHg, associated with impending or **acute TOD**, such as hypertensive encephalopathy, cerebral infarction, intracranial haemorrhage, acute pulmonary oedema, acute coronary syndrome, aortic dissection, acute kidney injury or eclampsia[17].

BP elevation in SBP or DBP (≥180 mmHg or ≥120 mmHg, respectively), not associated with acute end organ damage is **not** considered as a hypertensive emergency even if chronic end organ damage is present.

10.2 Treatment principles and therapy

Proper clinical assessment with targeted history and clinical examination is paramount in the management of hypertensive emergencies.

10.2.1 History

The history should include details on the diagnosis and aetiology of hypertension and medications used. A focus on symptoms suggestive of cardiac, neurological or renal dysfunction should be obtained. The use of recreational drugs should also be inquired.

10.2.2 Examination

Measure blood pressure in both arms and look for other evidence of an acute aortic dissection, evaluate for evidence of acute left ventricular failure including a gallop rhythm, and bi basal fine inspiratory crepitations. A detailed neurological examination should also be performed including fundoscopy for evidence of hypertensive retinopathy. Abdominal examination should be performed for pulsatile masses suggestive of aortic aneurysms.

10.2.3 Initial investigations

All patients should undergo FBC and blood picture to look for evidence of microangiopathic hemolytic anaemia, and an ECG to examine for evidence of coronary ischemia. A urine full report should be examined for an active urinary sediment and serum creatinine to evaluate for acute renal dysfunction. Appropriate imaging should be performed if aortic dissection or intracerebral pathology is suspected.

10.2.4 Medications

Use of intravenous medications is recommended in the management of hypertensive emergencies. The drugs in routine use are listed in table 9[14].

Table 9. Drugs used in management of hypertensive emergencies

Drug	Mechanism of action	Dose	Indicated clinical situations	Cautions / Contraindications
Sodium Nitroprusside	Direct arterial and venous vasodilator	0.25-10 mcg/kg/min	All clinical situations of hypertensive emergencies	Raised intracranial pressure Cerebrovascular and cardiovascular insufficiency Renal and hepatic impairment
Glyceryl trinitrate	Venous vasodilator	5-200 mcg/min	Acute coronary syndromes Acute left ventricular failure	Concomitant use of PDE 5 inhibitors Raised intracranial pressure
Labetalol	Combined alpha and beta adrenergic blocker	IV bolus 50mg over 2 min; repeated every 5 minutes; maximum total dose 200mg IV infusion 1-2mg/min	Aortic dissection Neurological emergencies Pre-eclampsia and eclampsia	Severe bradycardia, Phaeochromocytoma Acute left ventricular failure
Hydralazine	Direct arterial vasodilator	IV bolus 5-10 mg Repeated after 20-30 minutes	Pre-eclampsia and eclampsia	Dissecting aortic aneurysm

10.2.5 Treatment targets for common hypertensive emergencies

Treatment timeline and targets differ depending on the nature of the emergency.

Table 10. Hypertensive emergencies: treatment goals and targets[17]

Hypertensive emergency	Treatment timeline	Treatment target
Hypertensive encephalopathy	within 2 hours	SBP 20% reduction from baseline (reduction in MAP should not exceed more than 25% from baseline)
Acute coronary syndrome		
Acute LVF		
Acute ischaemic stroke and BP ≥ 220/120 mmHg		
Acute ischaemic stroke planned for thrombolysis and BP ≥ 185/110 mmHg		
Cerebral hemorrhage and SBP ≥ 180 mmHg or MAP ≥ 130mmHg		
Aortic dissection	Within minutes to 1 hour	SBP 100 – 120 mmHg and heart rate <60 bpm
Severe preeclampsia	Immediate	BP < 160/105 mmHg

11. UNCONTROLLED AND RESISTANT HYPERTENSION

11.1 Uncontrolled hypertension

In patients with uncontrolled BP, a cause should be looked for (table 11).

Table 11. Causes for uncontrolled blood pressure

Causes for uncontrolled blood pressure
Poor drug compliance
Inadequate medication dose
Co-administration of drugs causing hypertension
Excess alcohol
Substance abuse
Excess salt intake
White-coat hypertension*
Secondary causes including CKD
Resistant hypertension

*If white coat hypertension is suspected consider ABPM or HBPM.

11.2 Resistant hypertension

11.2.1 Definition

Hypertension is defined as resistant when a therapeutic strategy that includes appropriate lifestyle measures plus a diuretic and two other antihypertensive drugs belonging to different classes at adequate doses (but not necessarily including a mineralocorticoid receptor antagonist) fails to lower SBP and DBP values to less than 140 and 90 mmHg (150 and 90mmHg in people≥60 years), respectively[18].

In order to make the diagnosis of resistant hypertension the other causes of uncontrolled hypertension should be excluded.

11.2.2. Treatment of resistant hypertension

Medical management with add on therapy[18]

- Spiranolactone – the preferred drug in resistant hypertension
- Alpha blockers
- Beta blockers
- Centrally acting drugs e.g. methyl dopa
- Vasodilators e.g. hydralazine

Invasive therapies including renal denervation therapy demonstrated some promise in early studies, however later studies have not shown benefits in patients with resistant hypertension.

Table 12. Medications recommended for add on therapy in resistant hypertension

	Beta blockers	Alpha blockers	Centrally acting	Vasodilators	Aldosterone antagonists
Drugs	Atenolol	Prazocin	Methyldopa	Hydralazine	Spiranolactone
Mechanism of action	Blocks beta receptors (b1 in the heart) Reduces renin release (b1) and NE release (b2) Some have alpha blocking effect (Labetolol, carvedilol)	Blocks alpha adrenergic receptors in vascular smooth muscle	Central blockade of sympathetic output	Vasodilation	Blockade of the aldosterone receptor
Compelling indications	Post myocardial infarction	Phaeochromocytoma Obstructive uropathy	Hypertension in pregnancy	Severe PIH	Associated heart failure
Adverse effects	Heart block, Worsening of cardiac failure, Bronchospasm, Depression, Nightmares. PVD, Impaired glucose tolerance	Orthostatic hypotension, 1st dose hypotension, Ankle edema, Drug tolerance, Reflex tachycardia and worsening of heart failure	Dry mouth, Lethargy, Hemolytic anaemia Orthostatic hypotension	Fluid retention, Drug induced Lupus, Reflex tachycardia	Hyperkalemia Gynaecomastia
Contraindications	Asthma, Heart block, Depression	Orthostatic hypotension, Heart failure	Orthostatic hypotension		Hyperkalemia

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Annexure 1: ABPM and HBPM

Ambulatory Blood Pressure Monitoring (ABPM)

- ABPM is performed with the patient wearing a portable BP measuring device, usually on the non-dominant arm, for a 24–25 h period (so that it gives information on BP during daily activities and at night during sleep.)
- At the time of fitting of the portable device, the difference between the initial values and those from BP measurement by the operator should not be greater than 5mmHg. In the event of a larger difference, the ABPM cuff should be removed and fitted again.
- At the time of cuff inflation, the patient is instructed to stop moving and talking and keep the arm still with the cuff at heart level.
- The patient is instructed to engage in normal activities but to refrain from strenuous exercise
- The patient is asked to provide information in a diary on symptoms and events that may influence BP, in addition to the times of drug ingestion, meals and going to- and rising from bed.
- In clinical practice, measurements are often made at 15 min intervals during the day and every 30 min overnight; excessive intervals between BP readings should be avoided because they reduce the accuracy of 24-h BP estimates.
- The measurements are downloaded to a computer and a range of analyses can be performed. (average daytime, night-time and 24-h BP)
- At least 70% of BPs should be satisfactory, or else the monitoring should be repeated. The detection of artifactual readings and the handling of outlying values have been subject to debate but, if there are sufficient measurements, editing is not considered necessary and only grossly incorrect readings should be deleted. It is noteworthy that readings may not be accurate when the cardiac rhythm is markedly irregular.

Home Blood Pressure Monitoring (HBPM)

- The electronic device is simpler to use and is probably more reliable.(a list of validated blood pressure monitors s available at www.bhsoc.org/bp-monitors/bp-monitors/)
- For diagnostic evaluation, BP should be measured
  - at least 3–4 days and preferably on 7consecutive days
  - in the mornings as well as in the evenings.
  - in a quiet room, with patient in seated position, back & arm supported, after 5 minutes of rest
  - with two measurements per occasion taken 1–2 min apart
- The results with the time should be reported in a diary immediately after each measurement. (memory-equipped device is preferred)
- Home BP is the average of these readings, with exclusion of the first monitoring day.

Annexure 2: Major classes of antihypertensive drugs

	Thiazide diuretics	ACEI	ARB	CCB
Drugs	HCT, Indapamide	Captopril,Enalapril,Lisinopril, Perindopril Ramipril	Losartan, Telmisartan Valsartan Candesarten Irbesartan	**Dihydropyridin**e – Nifedipine, Amlodipine **Non-dihydropyridine** Verapamil, Diltiazem
Mechanism of action	Blocks the Na/Cl co-transport mechanism in the DCT	Inhibits the RAS by blocking conversion of AT I to AT II	Blocks AT II receptors	Blocks voltage gated calcium channels in vascular smooth muscle and myocytes
Compelling indications	Isolated systolic hypertension in the elderly	Heart failure Reduced LV function after MI Diabetes (type 1 & 2) Diabetic / non-diabetic renal disease	Intolerant to ACEI Heart failure Nephropathy in type 2 diabetes	LVH Atherosclerosis
Adverse effects	Hypokalemia, Hyponatremia, Hyperuricaemia, Hypercalcaemia Increased TG, Insulin resistance, Impotence	Cough, Hyperkalemia, Angioedema, Leucopenia, Cholestatic jaundice Teratogenicity	Hyperkalemia, Angioedema (Rare) Teratogenicity	**DHP CCB** Headache, Flushing, Ankle edema, Tachycardia, Worsening of heart failure, Gum hyperplasia **NDHP CCB** Bradycardia, Heart block, Constipation (more with verapamil), Ankle oedema
Contraindications	Gout Addison's Disease Refractory hypokalaemia / hyponatraemia	Pregnancy, Bilateral renal artery stenosis, Hyperkalemia	Pregnancy, Bilateral renal artery stenosis, Hyperkalemia	**DHP -** Heart failure**,** (except amlodipine), significant AS **Non DHP-** Heart Failure, Heart block
Notes	Efficacy drops when the GFR < 50	Monitor serum creatinine and electrolytes	May be less effective than CCB	Effective antihypertensives DHP should not be used as monotherapy in proteinuria

ACEI - Angiotensin Converting Enzyme Inhibitors, ARB - Angiotensin Receptor Blockers, DHP CCB – Dihydropyridine Calcium Channel Blockers, NDHP CCB – Non-dihydropyridine Calcium Channel Blockers, DCT – Distal Convoluted Tubule, RAS – Renin Angiotensin System, AT – Angiotensin, LVH – left ventricular Hypertrophy, MI – Myocardial Infarction, TG - Triglyceride