Management of Hypertension. A case-base presentation in the management of primary hypertension and the investigation of secondary causes of hypertension.

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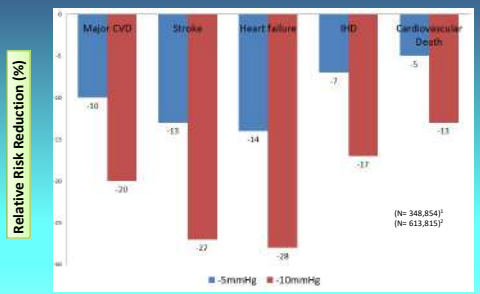
Relative Risk Reduction Proportional to Decrease in Office Systolic BP

Even Small BP Reductions Reduce Risk of Cardiovascular Mortality



BPLTTC. Lancet 2021;397:1625-36
D Ettehad D et al. Lancet 2016;387:957-67

ASPECTS COMMON TO ALL BP MEASUREMENT TECHNIQUES

Reliable, Validated BP monitors

Organisations with scientific association providing online lists of validated BP monitors

Organisation	Device lists (language)	Scientific association*	Website
STRIDE BP	International (English, Chinese, Spanish)	European Society of Hypertension – International Society of Hypertension – World Hypertension League	www.stridebp.org
BHS	UK/Ireland (English)	British and Irish Hypertension Society	www.bhsoc.org/bp-monitors
VDL	USA (English)	American Medical Association	www.validatebp.org
Hypertension Canada	Canada (English)	Hypertension Canada	www.hypertension.ca/bpdevices
Deutsche Hochdruckliga	Germany (German)	German High Pressure League	www.hochdruckliga.de/betroffene/blutdruck-messgeraete-mit-pruefsiegel
JSH	Japan (Japanese)	Japanese Society of Hypertension	www.jpnsh.jp/con_ac_wg1.html

*Two websites are not associated with a scientific organisation (www.dableducational.org, www.medaval.nl)

- → Use validated automated electronic upper-arm cuff device.
- → Select cuff size according to device instructions.
- → Each device has its own cuffs, which are not interchangeable with those of other devices.
- → Annual maintenance of device is necessary.

George S Stergiou et al. Journal of Hypertension 2021, 39:1293–1302

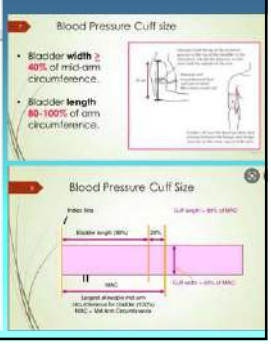
The selection of an appropriate cuff size is crucial for accurate BP measurement and depends on the arm circumference of each individual. A smaller than required cuff overestimates BP and a larger underestimates BP. A single cuff cannot fit the range of arm sizes of all adults.

TABLE 3
Recommended Cuff Sizes for Accurate Measurement of Blood Pressure

PATIENT	RECOMMENDED CUFF SIZE
Adults (by arm circumference)	width x length
33 to 36 cm	12 × 22 cm (small adult)
37 to 34 cm	16 × 30 cm (adult)
35 to 44 cm	16 × 30 cm (large adult)
45 to 52 cm	16 × 42 cm (adult thigh)
Children (by age)*	
Newborns and premature infants	4 × 8 cm
Infants	5 × 12 cm
Older children	9 × 18 cm

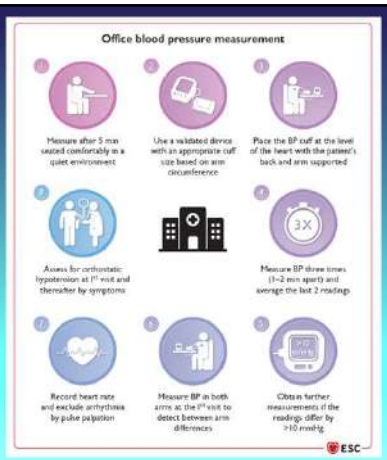
*—A standard adult cuff, large adult cuff, and thigh cuff should be available for use in measuring a child's leg blood pressure and for children with larger arms.

Information from Pickering TG, Hall JE, Appel LJ, Falkner BE, Graves J, Hill MN, et al.; Subcommittee of Professional and Public Education of the American Heart Association Council on High Blood Pressure Research. Recommendations for blood pressure measurement in humans and experimental animals. Part 1: blood pressure measurement in humans. Hypertension 2005;45:142–61.



Place the centre of the bladder over the brachial artery pulsation in the antecubital fossa. The lower end of the cuff should be 2–3 cm above the antecubital fossa. The cuff should exert comparable tightness at the top and bottom edges. One finger should easily fit under the cuff at its top and bottom.

George S Stergiou et al. Journal of Hypertension 2021, 39:1293–1302



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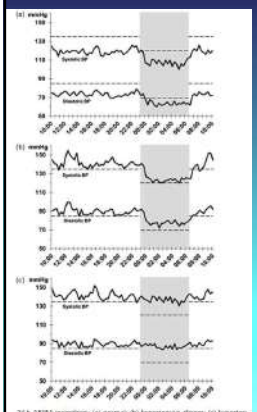
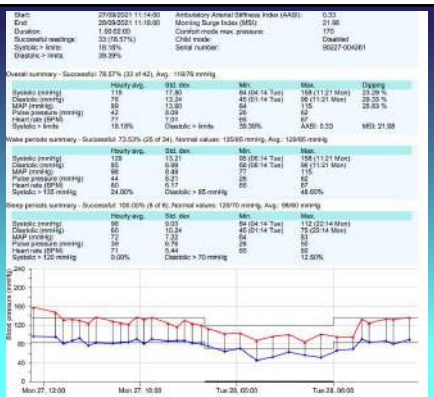
Ambulatory BP monitoring



- White Coat HTN
  - Elevated clinic BP & normal ABPM/HBPM
- Masked HTN
  - Normal Clinic BP & elevated ABPM / HBPM
  - Suspect if high normal BP, esp in diabetes or organ damage (LVH, CKD)
- Nocturnal HTN



NICE

When using ABPM to confirm a diagnosis of hypertension, ensure that at least 2 measurements per hour are taken during the person's usual waking hours (for example, between 08:00 and 22:00). Use the average value of at least 14 measurements taken during the person's usual waking hours to confirm a diagnosis of hypertension. [2011]

7 nocturnal measurements

24-hour ambulatory blood pressure recordings in clinical practice

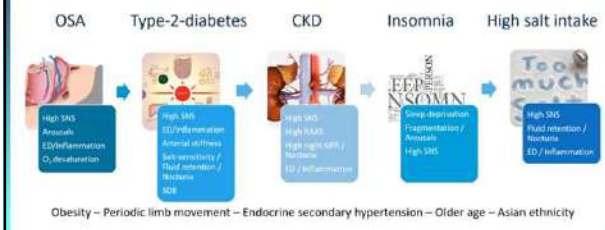
Why do we use ambulatory BP monitoring ?

1. Office blood pressures (BP) are influenced by many factors leading to imprecision
2. Ambulatory BP monitoring (ABPM) :
   - provides multiple BP readings in the usual environment of individuals
   - provides BP readings during routine daily activities and during the night
   - enables to identify white coat (WCH) and masked hypertension (MH)
   - provides additional prognostic BP phenotypes
   - provides evaluations of the 24h BP control during treatment
   - has stronger prognostic evidence for CV death and target organ damages

White-coat and masked HT: patient profile

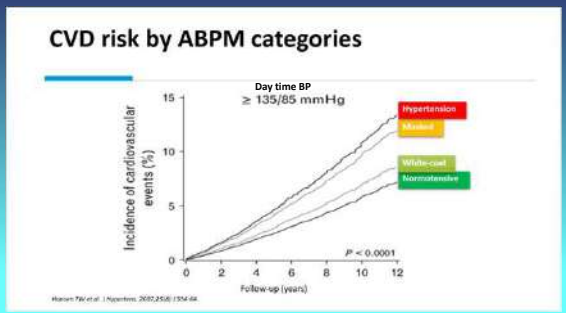
- **White-coat HT:**
  - Up to 30-40% hypertensive patients, >50% in the very old
  - Elderly / women
  - Grade I HT on office BP measurement
  - Lower prevalence of HMOD
  - CV risk is lower than sustained HT, but higher than normotensive **(corresponding to high-normal HT)**
- **Masked HT:**
  - Up to 15% of patients with a normal office BP
  - Often overlooked (mass screening with out-of-office BP is not feasible)
  - Younger people / men / smokers / alcohol consumption
  - High levels of physical activity
  - Anxiety / Job stress
  - HMOD, diabetes
  - CV risk is similar to sustained HT → **they are true hypertensives!**

Common conditions with Nocturnal Hypertension and associated mechanisms



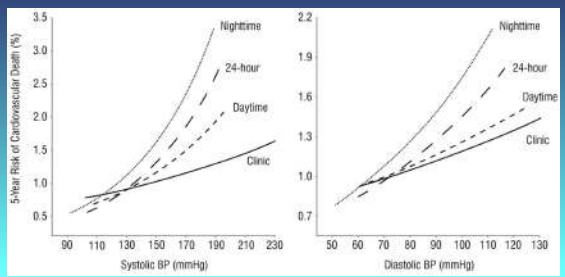
Obesity – Periodic limb movement – Endocrine secondary hypertension – Older age – Asian ethnicity

CVD risk by ABPM categories



Clinical Value of Nocturnal BP – Best Predictor of CV Mortality

Superiority of ambulatory BP for predicting CV death in untreated hypertensive patients



E. Dolan et al. Hypertension 2005;46:156-161

Comparison of ABPM and home BP monitoring

Comparison of ambulatory blood pressure monitoring and home blood pressure monitoring

ABPM	HBPM
Advantages	**Advantages**
Can identify white-coat and masked hypertension Stronger prognostic evidence Night-time readings Measurement in real-life settings Additional prognostic BP phenotypes Abundant information from a single measurement session, including short-term BP variability	• Can identify white-coat and masked hypertension • Cheap and widely available • Measurement in a home setting, which may be more relaxed than the doctor's office • Patient engagement in BP measurement • Easily repeated and used over longer periods to assess day-to-day BP variability
Disadvantages Expensive and sometimes limited availability Can be uncomfortable	**Disadvantages** • Only static BP is available • Potential for measurement error • No nocturnal readings[1]

Diagnosis of hypertension

- Clinic BP of 140/90 mmHg or higher
- ABPM daytime average or HBPM average of 135/85 mmHg or higher.

Hypertension in adults: diagnosis and management

Stage 1 hypertension
Clinic blood pressure ranging from 140/90 mmHg to 159/99 mmHg and subsequent ABPM daytime average or HBPM average blood pressure ranging from 135/85 mmHg to 159/94 mmHg.

Stage 2 hypertension
Clinic blood pressure of 160/100 mmHg or higher but less than 180/120 mmHg and subsequent ABPM daytime average or HBPM average blood pressure of 150/95 mmHg or higher.

Stage 3 or severe hypertension
Clinic systolic blood pressure of 180 mmHg or higher or clinic diastolic blood pressure of 120 mmHg or higher.

Masked hypertension
Clinic blood pressure measurements are normal (less than 140/90 mmHg), but blood pressure measurements are higher when taken outside the clinic using average daytime ambulatory blood pressure monitoring (ABPM) or average home blood pressure monitoring (HBPM) blood pressure measurements.

White Coat Hypertension

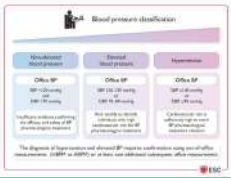
ESC European Society of Cardiology

New 2024 ESC categories

-Non-elevated
<120/70 mmHg

-Elevated
120-139/70-89 mmHg

-Hypertension
≥140/90 mmHg



Comparison of office, home, and ambulatory blood pressure measurement thresholds for elevated blood pressure and HTN

	Office BP (mmHg)	Home BP (mmHg)	Daytime ABPM (mmHg)	24 h ABPM (mmHg)	Night-time ABPM (mmHg)
Non-elevated BP	<120/70	<120/70	<120/70	<115/65	<110/60
Elevated BP	120/70–<140/90	120/70–<135/85	120/70–<135/85	115/65–<130/80	110/60–<120/70
Hypertension	≥140/90	≥135/85	≥135/85	≥130/80	≥120/70

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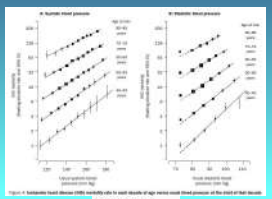
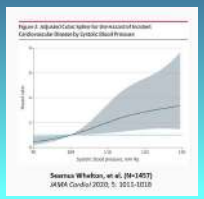


Prospective Studies Collaboration (1 million) Lancet 2002; 360: 1903–13



Seamus Whelton, et al. (N=1457) JAMA Cardiol 2020; 5: 1011-1018

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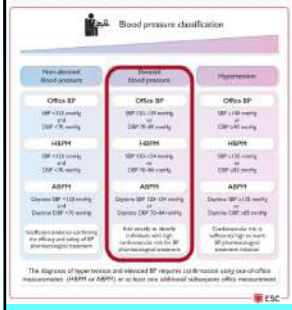
Risk assessment focused on those with elevated BP

Risk assessment focused on those with elevated BP



Step 1: Assess for high-risk CVD conditions

Step 2: Predict 10-year risk of CVD

Step 3: Evaluate sex-specific and shared risk modifiers

Step 4: Consider risk tests

Initiation of blood pressure-lowering drug treatment

Table 14 Initiation of blood pressure-lowering treatment based on confirmed blood pressure category and cardiovascular disease risk

Blood pressure (mmHg)	Non-elevated BP (<120/70)	Elevated BP (120/70 to 139/89)		Hypertension (≥140/90)
Risk		(a) All adults with SBP 120–129 mmHg (b) SBP 130–139 AND 10-year estimated CVD risk <10% AND no high-risk conditions or risk modifiers or abnormal risk tool tests	(a) SBP 130–139 AND high-risk conditions (eg, established CVD, diabetes mellitus, CKD, FH or HMOD) (b) SBP 130–139 AND 10-year estimated CVD risk ≥10% (c) SBP 130–139 AND 10-year estimated CVD risk 5% - <10% AND risk modifiers or abnormal risk tool tests	Assumed all at sufficiently high risk to benefit from pharmacological treatment
Treatment	Lifestyle measures for prevention Screen BP and CVD risk opportunistically	Lifestyle measures for treatment Monitor BP and CVD risk yearly	Lifestyle measures and pharmacological treatment (after 3-month delay). Monitor BP yearly once treatment control is established	Lifestyle measures and pharmacological treatment (immediate). Monitor BP yearly once treatment control is established
Target (mmHg)	**Maintain BP <120/70**	**Aim BP 120–129/70–79 mmHg[a]**		

BP, blood pressure; CKD, chronic kidney disease; CVD, cardiovascular disease; DBP, diastolic blood pressure; FH, familial hypercholesterolaemia; HMOD, hypertension-mediated organ damage; SBP, systolic blood pressure.
[a]Caution in adults with orthostatic hypotension, moderate-to-severe frailty, limited life expectancy, and older patients (aged ≥85 years).

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Cardiovascualr Risk Conditions warranting BP lowering Treatment

Figure 7 Sufficiently high cardiovascular risk conditions that warrant blood pressure-lowering treatment among adults with elevated blood pressure. CKD, chronic kidney disease; eGFR, estimated glomerular filtration rate. [a]Coronary heart disease, cerebrovascular disease, peripheral arterial disease. [b]See Section 7. [c]SCORE2-Diabetes should be considered to identify lower-risk individuals (<10% 10-year CVD risk), who may not require BP-lowering medication, particularly in individuals <60 years.

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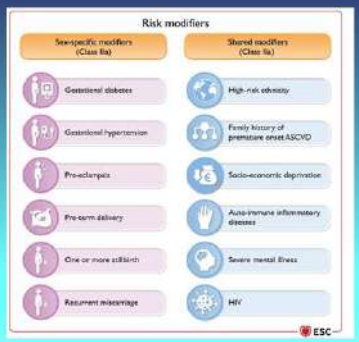
Cardiovascular disease risk modifiers to consider for up-classification of risk.



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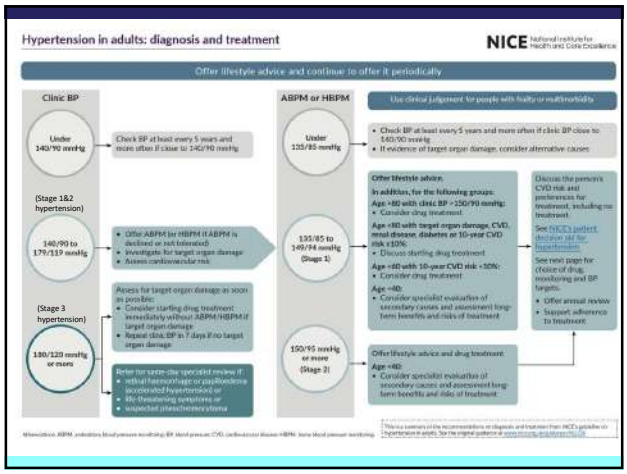


Hypertension in adults: diagnosis and management
NICE guideline [NG136]Published: 28 August 2019 Last updated: 18 March 2022

NICE National Institute for Health and Care Excellence

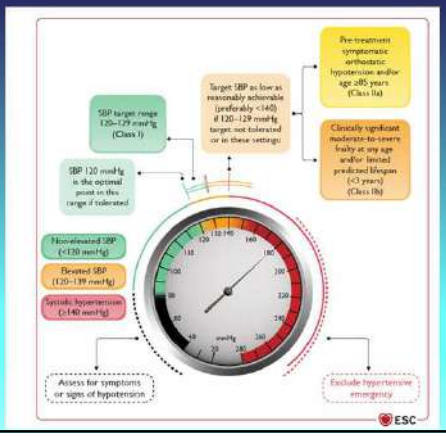
1.4.20 For adults with hypertension aged under 80, reduce clinic blood pressure to below 140/90 mmHg and ensure that it is maintained below that level. **[2019, amended 2022]**

1.4.21 For adults with hypertension aged 80 and over, reduce clinic blood pressure to below 150/90 mmHg and ensure that it is maintained below that level. Use clinical judgement for people with frailty or multimorbidity (see also NICE's guideline on multimorbidity). **[2019, amended 2022]**

1.4.22 When using ABPM or HBPM to monitor the response to treatment in adults with hypertension, use the average blood pressure level taken during the person's usual waking hours (see recommendations 1.2.6 and 1.2.7). Reduce blood pressure and ensure that it is maintained:

- below 135/85 mmHg for adults aged under 80
- below 145/85 mmHg for adults aged 80 and over.

Systolic blood pressure categories and treatment target range



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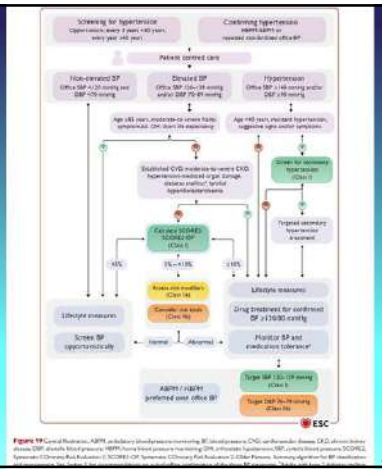

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Hypertension Treatment

Life-style Changes

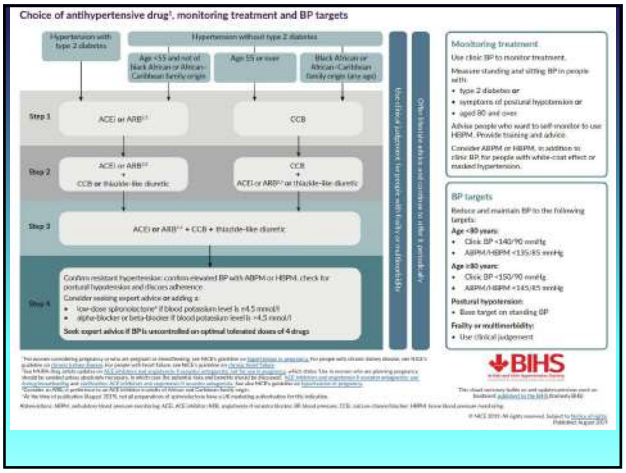
- Salt 5-6g /day
- ↓EtOH
- ↑ Fruit & Veg
- Low-fat dairy products
- Weight reduction. Weight loss of 5.1 kg - ↓SBP by 4.4 mmHg and ↓DBP by 3.6 mmHg.
- Exercise: 30 mins moderate exercise 5-7 days /wk
- Smoking Cessation support
- NICE - Discourage excessive consumption of coffee and other caffeine-rich products

Non Pharmacological therapies to reduce BP

Intervention	Approximate SBP Reduction
Weight reduction (to BMI 18.5 – 24.9 kg/m²)	5-20 mmHg / 10 kg
DASH eating plan - increased fruit / vegetables / low fat diary, reduced saturated and total fat intake	8-14 mmHg
Dietary sodium reduction (to < 6g sodium chloride / day)	2-8 mmHg
Regular aerobic physical activity (to 30 minutes/day)	4-9 mmHg
Moderating alcohol intake (Male < 2 units/day, Female <1 units/day)	2-4 mmHg

DASH diet: Dietary Approaches to Stop Hypertension (DASH) is an eating plan to lower or control high blood pressure. The DASH diet emphasizes foods that are lower in sodium as well as foods that are rich in potassium, magnesium and calcium — nutrients that help lower blood pressure. The DASH diet features menus with plenty of vegetables, fruits and low-fat dairy products, as well as whole grains, fish, poultry and nuts. It offers limited portions of red meats, sweets and sugary beverages.

Adapted from the JNC VII Report



Hypertension

Which Drug ?

- Age: Elderly → Thiazides, Calcium antagonists, A1RB
- Sex: Young females avoid ACE, A1RB
- Ethnicity: Blacks responds better to Ca antagonists, thiazides
- Cost effectiveness of drugs is important
- Co - morbidity: Diabetes → ACE, A1RB
  IHD → BB, Ca antagonist, ACE, AR1B
  LVF → ACE, A1RB, BB, Thiazide, Entresto
  Atrial fibrillation/palpitations → BB, Verapamil/Diltiazem
  Renal disease → ACE, A1RB
  Migraine → BB, Ca antagonist
  Asthma → avoid BB
  Prostate hypertrophy → doxazosin, prazosin (α blockers)

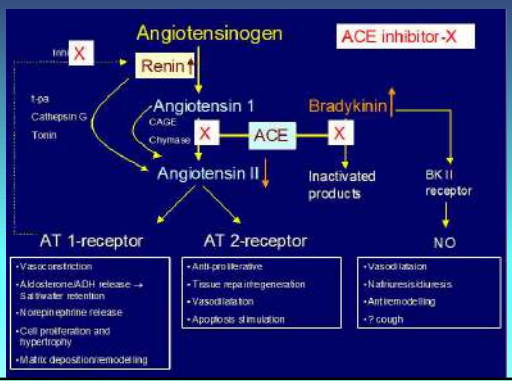
Table 15 Drugs to be preferred in specific conditions

Condition	Drug
Asymptomatic organ damage	
LVH	ACE inhibitor, calcium antagonist, ARB
Asymptomatic atherosclerosis	Calcium antagonist, ACE inhibitor
Microalbuminuria	ACE inhibitor, ARB
Renal dysfunction	ACE inhibitor, ARB
Clinical CV event	
Previous stroke	Any agent effectively lowering BP
Previous myocardial infarction	BB, ACE inhibitor, ARB
Angina pectoris	BB, calcium antagonist
Heart failure	Diuretic, BB, ACE inhibitor, ARB, mineralocorticoid receptor antagonists
Aortic aneurysm	BB
Atrial fibrillation, prevention	Consider ARB, ACE inhibitor, BB or mineralocorticoid receptor antagonist
Atrial fibrillation, ventricular rate control	BB, non-dihydropyridine calcium antagonist
ESRD/proteinuria	ACE inhibitor, ARB
Peripheral artery disease	ACE inhibitor, calcium antagonist
Other	
ISH (elderly)	Diuretic, calcium antagonist
Metabolic syndrome	ACE inhibitor, ARB, calcium antagonist
Diabetes mellitus	ACE inhibitor, ARB
Pregnancy	Methyldopa, BB, calcium antagonist
Blacks	Diuretic, calcium antagonist

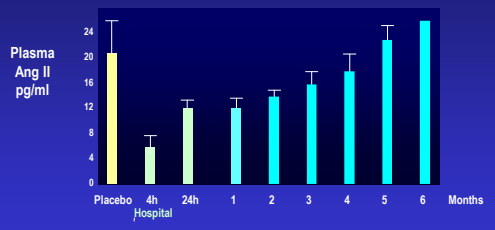
ACE = angiotensin-converting enzyme; ARB = angiotensin receptor blocker; BB = beta-blocker; BP = blood pressure; CV = cardiovascular; ESRD = end-stage renal disease; ISH = isolated systolic hypertension; LVH = left ventricular hypertrophy.

Notes on Using Antihypertensive Drugs

ACE inhibitors

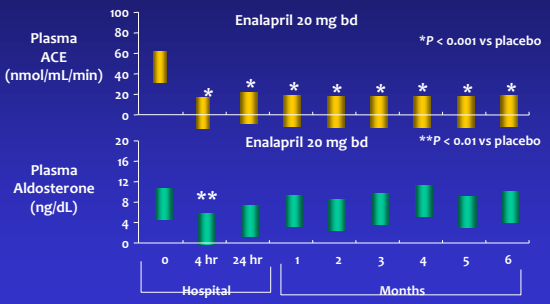


ACE escape: Ang II levels increase over time despite ACEi



Biollaz et al. J Cardiovasc Pharmacol 1982;4:966

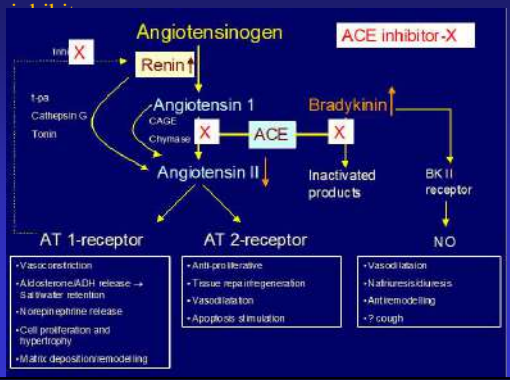
Aldosterone not adequately suppressed by ACE Inhibitors



Biollaz J, et al. J Cardiovasc Pharmacol. 1982;4:966-972

Notes on Using Antihypertensive Drugs

ACE



Notes on Using Antihypertensive Drugs

Angiotensin 1 receptor blockers

Pharmacologic Characteristics of the Angiotensin Receptor Blockers

ARBs	Half-life (h)	Tmax (h)	Bioavailability	Route of elimination: renal (R) biliary/fecal (B)	Food Interaction	Drug Interactions[a]	CYP metabolism
Losartan[†]	2	1–1.5	33%	35% R; 60% B	Yes[bc]	Rifampin, fluconazole	2C9, 3A4
Candesartan cilexetil	9	3–5[d]	42%	33% R; 67% B	No	None	2C9 (negligible)
Eprosartan	5–9	1–3	63%	7% R; 90% B	Yes[†]	None	No
Irbesartan	11–15	1.5–2	60–80%	20% R; 80% B	No		2C9, 3A4 (negligible)
Telmisartan	24	0.5–1	43%	<3% R; >97% B	No	Digoxin	No
Valsartan	6	2–4	23% (capsule); 50% (solution)	13% R; 83% B	Yes[†]	None	2C9 (small)
Olmesartan medoxomil	12–14	1.7–2.5	26%	35–50% R; 50–65% B	No	None	No
Azilsartan medoxomil	12	1.5–3	60%	42% urine; 55% B	No	None	2C9, CYP2B6 (negligible), CYP2C8 (negligible)

Given in a separate window

[a]Co-administration of ARBs with lithium increases lithium toxicity due to increase renal absorption of lithium
[†]Losartan is converted to EXP-3174 with terminal half-life of 6–9 hours and T_{max} of 3–4 hours
[b]Food delays absorption and lowers its C_{max} but the AUC of it and EXP-3174 are not significantly altered.
[c]Tmax of candesartan, its active metabolite.
[d]30–50% reduction in bioavailability
[e]High fat food increases bioavailability by 80% and AUC by 55% but shows gut absorption.

HMA Abraham et al. Drug Saf (2015) 38:33–54

Notes on Using Antihypertensive Drugs

Table 2 Doses for hypertension and other indications of angiotensin receptor blockers (ARBs)

ARBs	Starting dose (mg/day)[a]	Maximum dose (mg/day)	Dosing interval	Other approved indications, apart from hypertension
Losartan [22]	50	100	Once daily or twice daily	Diabetic nephropathy when serum creatinine is increased and proteinuria is present in patients with hypertension and type 2 diabetes; stroke reduction in patients with hypertension and left ventricular hypertrophy (non-black only)
Candesartan cilexetil [24]	16[b,c]	32	Once daily or twice daily	Treatment of heart failure (NYHA classes II–IV)
Eprosartan [28]	600	800	Once daily or twice daily	None
Irbesartan [25]	150[b]	300	Once daily	Diabetic nephropathy when serum creatinine is increased and proteinuria is present in patients with hypertension and type 2 diabetes
Telmisartan [27]	40[b]	80	Once daily	Cardiovascular risk reduction in patients unable to take ACE inhibitors
Valsartan [23]	80 or 160[c]	320	Once daily	Treatment of heart failure (NYHA classes II–IV); reduction of cardiovascular mortality in clinically stable patients with left ventricular failure or dysfunction following myocardial infarction
Olmesartan medoxomil [26]	20[b]	40	Once daily	None
Azilsartan medoxomil [29]	40 or 80	80	Once daily	None

ACE angiotensin-converting enzyme, *NYHA* New York Heart Association
[a] Recommended starting monotherapy dose in the absence of dehydration
[b] Lower doses for initial therapy are available for patients with renal dysfunction, including older persons
[c] Lower starting doses are typically initiated for the indication of heart failure (candesartan and valsartan) in twice-daily regimens

HMA Abraham et al. Drug Saf (2015) 38:33–54

Notes on Using Antihypertensive Drugs

NICE National Institute for Health and Care Excellence

1.4.38 If starting or changing diuretic treatment for hypertension, offer a thiazide-like diuretic, such as indapamide in preference to a conventional thiazide diuretic such as bendroflumethiazide or hydrochlorothiazide. [2019]

Chlorthalidone is twice as potent as hydrochlorthiazide.

Use loop rather than thiazides if eGFR <30 ml/min (ESC guidelines 2018)

The NEW ENGLAND JOURNAL of MEDICINE

Chlorthalidone for Hypertension in Advanced Chronic Kidney Disease

Eligible patients had stage 4 CKD (estimated GFR, 15 to < 30ml/min per 1.73 m^2 per BSA

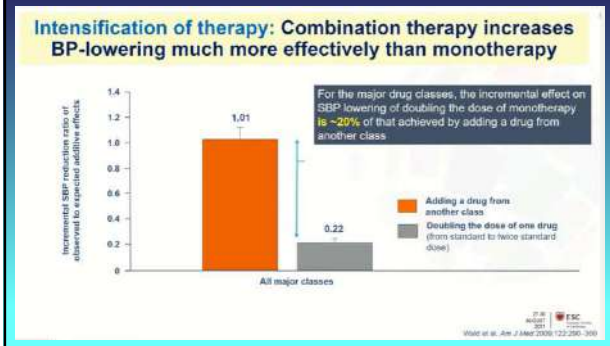
Notes on Using Antihypertensive Drugs

- Avoid ACEI in bilateral RAS
- Do not give combinations of RAS blockers (ACEi, ARA)
- Avoid β-blockers + thiazide diuretics if prediabetic / metabolic syndrome

Calcium channel blockers

- **Ankle swelling. Dihydropyridines > Diltiazem**

Intensification of therapy: Combination therapy increases BP-lowering much more effectively than monotherapy



Diagnostic Evaluation

Hypertension

Investigation of patients with hypertension - baseline investigations

Blood tests - FBC, U&E, CREATININE, URIC ACID, LFT, gamma GT, Ca& P04, fasting GLUCOSE, fasting LIPIDS, TFT

ECG Presence of left ventricular hypertrophy

Urine tests Dip stick to test for CELLS, PROTEIN, BLOOD AND GLUCOSE

Ambulatory BP monitor / validated home BP monitor

Echocardiogram (open access) - Presence of left ventricular hypertrophy

Hypertension

Patients requiring further investigation to exclude secondary causes

- Young age < 30 - 40yrs (particularly if end organ damage, CVD, renal disease of DM) and no risk factors
- Moderate/severe hypertension
- Presentation with hypertensive emergency
- Raised creatinine
- Blood, protein or cells in urine
- Low plasma K
- Variable hypertension
- Resistant hypertension - failure to respond to multiple antihypertensive drugs
- Large postural drop in blood pressure
- Sudden loss of BP control and non-dipping or reverse dipping on ABPM

Factors that can increase Blood Pressure

Medications

- NSAIDS
- Recreational drugs - Cocaine, Amphetamines
- Over the counter "cold" medication - phenylephrine
- Anabolic Steroids
- Oral Contraceptives

Excessive EtOH (>3-4 drinks/day)
High Salt Diet
Obesity
Sleep apnoea

Hypertension

Criteria for requesting 24 hour urinary catecholamines excretion

- Clinical suspicion of phaeochromocytoma (headaches, palpitations and sweating)
- Moderate/severe hypertension
- Variable hypertension/postural hypotension
- Failure to respond to drug treatment

Criteria for renal investigations

- Clinical suspicion of renal disease
- Severe hypertension
- Young age <40yrs
- Raised creatinine
- Blood, protein or cells in urine
- Failure to respond to drug treatment

Which renal investigation?

- Renal U.S. if underlying renal disease suspected
- Renal CT angiogram, magnetic resonance angiography or invasive renal angiogram if renal artery stenosis is suspected.

Criteria for requesting plasma renin and aldosterone measurements

- clinical suspicion of 1° Hyperaldosteronism

Hypertension

Symptoms	Possible cause
Low Potassium (excluding diuretic induced hypokalaemia) 50% of patients with Conn's do not have hypokalaemia. Low potassium brought on by a small dose of diuretic may be a clue.	Primary Hyperaldosteronism (Including Conn's) Secondary Hyperaldosteronism (e.g. Renal Artery Stenosis, renal artery fibromuscular dysplasia)
Cushingoid appearance, oligomenorrhorea, easy bruising	Cushing's Glucocorticoid treatment
Palpitations, sweats, postural hypotension, anxiety pale skin (pallor), blurred vision, weight loss, increased thirst and urination, constipation, abdominal pain, elevated glucose, red and white blood cells, psychiatric disturbances, and cardiomyopathy.	Phaeochromocytoma
Cardiac murmur without previous investigation Radiofemoral delay	Aortic coarctation
Resistant hypertension	Sleep apnoea, non-compliance

For Urinary and Plasma Catecholamine Assessment

For Catecholamine assessment

Avoid 48 hours before:

- Chocolate
- Cocoa
- Bananas
- Citrus fruits
- Vanilla
- Alcohol
- Tea/coffee

For 5HIAA

Avoid 48 hours before:

- Banana
- Chocolate
- Dried fruits
- Citrus fruits
- Avocado
- Tomato
- Plum
- Kiwi
- Pineapple
- Mollush

Causes of Pseudo-Resistant Hypertension

1. **Poor patient adherence : up to 50-60%!**
   - Side effects of medication
   - Complicated dosing schedules
   - Poor relations between doctor and patient
   - Inadequate patient education
   - Memory or psychiatric problems or poor cognition (elderly)
   - Costs of medication
2. **Related to antihypertensive medication**
   - Inadequate doses : **50% of the prescriptions!**
   - Inappropriate combinations
3. **Physician inertia**
   - failure to change or increase dose regimens when not at goal

CASES

CASE 1

I should be most grateful for your help in the unusual situation with this twenty year old healthy asymptomatic young woman who checked her blood pressure yesterday because her father was checking his and found that it was very high at 172/116 and on repeated measurements up to 183/126. This morning she rechecked it for me again and again it was very similar with the diastolic blood pressure consistently over 120. We brought her to the surgery and checked it here and on repeated readings her diastolic blood pressure was 120 and systolic 160. [redacted] has no symptoms at all, in particular no chest pain, no palpitations, no headache and no visual symptoms and no sweating. She is not known to have had any blood pressure problems before. It was checked at the Practice in April 2019 when it was 130/70 and in January 2019 it was 110/70. She is on no regular medication. Her father has raised blood pressure but there is no family history of premature heart disease or stroke.

At surgery her pulse was 96 and regular. Her weight is 67.4kg which makes her BMI 21.5. Her urine dipstick was clear. I sent her for baseline bloods and started her on Amlodipine 5mg which we increased to 10 mg after a few days as her diastolic BP remained at >100. I organised for her to have an ECG, and sought advice from an endocrinologist via advice and guidance. This included further blood test to check pituitary function, US of liver (raised ALT) and kidneys, and referrals for review. We do not have access to 24 hr BP monitoring.

I enclose the ECG, and her blood results to date are available on ICE- so far nothing highly significant.

Thank you for your assessment of her and further help.

Ph

20 year old female

[redacted] DOB 06/04/2000

Thank you for referring this lady for a Cardiology opinion. She was incidentally found to have significantly elevated home blood pressure recordings using her father's blood pressure monitor. She was referred to the Endocrinology Team. Between your referral and my telephone consultation today she has had a number of blood tests which has demonstrated elevated urinary catecholamine levels. [redacted] Consultant Endocrinologist is currently investigating her. I understand an MIBG scan has been arranged at UCL Hospital. Her blood pressure was also better controlled. She is currently taking Amlodipine 10mg daily and Doxazosin 1mg daily.

It is interesting that she is minimally symptomatic with occasional headaches and the odd palpitation symptoms.

As she is currently being investigated I have not got too involved apart from arranging an echocardiogram as a baseline. I will write and let you know the results. I have not arranged any further follow-up appointments.

Yours sincerely,

Dictated and verified by Doctor but not signed

Dr Azad Ghuran MB ChB, MRCP, MD, FESC
Consultant Cardiologist

Sample EG-20210E00027 (TYPE UNSPECIFIED) Collected 05 Aug 2020 15:52 Received 05 Aug 2020 15:52

PLASMA METANEPHRINES

PLASMA NORMETADRENALINE	1370	pmol/L

Interpretation:

Below 1000 pmol/l - catecholamine secreting tumour unlikely

Between 1000 and 3500 pmol/l - equivocal

Neither rules in nor rules out diagnosis of catecholamine secreting tumour

Above 3500 - High likelihood of catecholamine secreting tumour

PLASMA METADRENALINE	267	pmol/L

Interpretation:

Below 600 pmol/l - catecholamine secreting tumour unlikely

Between 600 and 900 pmol/l - equivocal

Neither rules in nor rules out diagnosis of catecholamine secreting tumour

Above 900 - High likelihood of catecholamine secreting tumour.

Hypertensive in her 20s. Previously raised plasma mets, requesting repeat and al

Sample 00201E05500 (Blood) Collected 29 Jul 2020 09:07 Received 03 Aug 2020 14:24

24HR URINE METANEPHRINES

Dates of collection		29/07/20-30/07/20	
24hr Urine Volume		2.83	Litre
Urine Normetanephrine	*	38.68	umol/24hr
Urine Metanephrine		8.05	umol/24hr
Urine Methoxytyramine	*	12.31	umol/d

Raised levels highly suggestive of a neuroendocrine tumour.

As reported by St Helier Hospital Chemical Pathology Department.

I had a telephone consultation with [redacted] today. This telephone consultation was an administrative error as I had discharged her when I last spoke to her given that she was being reviewed by the Endocrinology Team - Dr [redacted]. Nevertheless it was fascinating to catch up with [redacted].

Her echocardiogram from October 2021 showed a structurally normal heart with normal left ventricular wall thickness.

Helena consistently had elevated urinary and plasma metadrenalines. She was referred for an MIBG scan to UCL in London. This showed no significant catecholamine activity. Because of the persistently elevated metanephrines she was referred to Dr [redacted], Consultant Endocrinologist at Addenbrook's Hospital. An abdominal CT scan showed a paraganglioma in the bladder which was confirmed on an MRI and subsequently a PET scan. She has now had this resected by a Urologist at Addenbrooke's Hospital. She says she is feeling a lot better and is now having bladder retraining exercises. She is also off her Doxazosin 12mg which she was taking pre-operatively.

[redacted] history is quite fascinating as she had minimal symptoms apart from a serendipitous pickup of an elevated blood pressure whilst using her father's blood pressure machine. She had minimal palpitation symptoms and her occasional headaches settled after increasing her hydration.

As she is currently doing well no further cardiology input is required, I have again discharged her. I wish her all the best for the future.

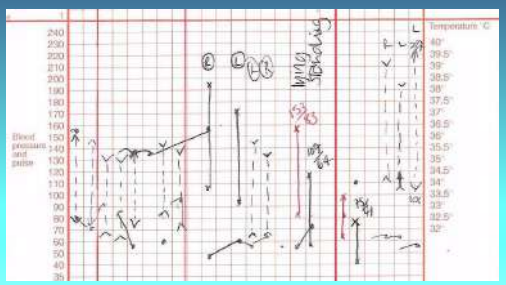
Yours sincerely,

Dictated and verified by Doctor but not signed

Dr Azad Ghuran MB ChB, MRCP, MD, FESC
Consultant Cardiologist

Phaeochromocytoma

52 yr. old female with episodic severe headache, photophobia, N&V, agitation, confusion, and aggression



CASE 2

Thank you very much for referring this pleasant 42-year-old gentleman whom you found to be hypertensive. Thank you very much for your thorough assessment and helpful referral letter. Back in August, he was opportunistically checked and was found to be hypertensive with recordings of 155/105 and home blood pressure recordings of 161/109. You slowly started him on antihypertensive medication. There is no history of previous urinary tract infections. He did suffer with headaches in the past, however since getting glasses three years ago he has had no further problems. He does not add salt to his food, however he consumes a lot of cheese and occasionally eats takeaways and processed foods. There is no significant past medical history apart from a congenital inguinal hernia which was repaired in infancy.

His current medication consists of ramipril 10 mg daily, indapamide 2.5 mg daily, amlodipine 10 mg daily.

There is no significant family history. He is married with two children, does not smoke and drinks alcohol occasionally. He works as a programmer.

Examination: pulse 61 beats per minute regular, JVP not elevated. Office blood pressure 167/86, heart sounds S1 plus S2 plus a soft 1/6 systolic murmur in the aortic area. His chest was clear. His abdomen was soft with no organomegaly and no bruits. There was no radiofemoral delay. His ECG showed sinus rhythm with normal conduction indices and wave form morphology. His echocardiogram showed a structurally normal heart with normal laminar flow in the descending aorta which excludes aortic coarctation.

I note his recent Us&Es on the 11th December 2013 showed sodium 143 mmol/l, potassium 3.7 mmol/l with an eGFR of 80 ml/min. His thyroid function test, liver function test and urinary catecholamines were all normal. His total cholesterol is 5.5 mmol/l with an HDL component of 1.2 mmol/l and a cholesterol to HDL ratio of 4.6.

I agree that given his young age that we need to exclude a secondary cause and consequently I have arranged for him to have an MRA of his kidneys and adrenals. His potassium is a little bit on the low side given that he is on 10 mg of ramipril and consequently I have arranged for him to have a renin aldosterone level. His ambulatory blood pressure recording done on the 5th February showed an overall average of 136/83 with a day average of 139/87 and a night average of 129/75. His blood pressure is therefore reasonably controlled, and given his elevated clinic blood pressure recording today there is also an element of white coat hypertension which we will need to bear in mind.

I would like to review him again in three months' time and he will keep an eye on his blood pressure recordings over the next few months. Thanks very much for your referral and should you have any queries, please do not hesitate to contact me.

Yours sincerely,

Dr Azad Ghuran MB ChB, MRCP, MD
Consultant Cardiologist

CS

Further to this gentleman's clinic review, he has now had his MRA of his kidneys and adrenals and repeat renin/aldosterone level. I am glad to say that the MRA of his kidneys and adrenals were both unremarkable with no masses or abnormalities. His repeat aldosterone level came back with a plasma aldosterone of 260 pmol/l (100-450) and renin 0.2 pmol/ml/hr and an aldosterone/renin ratio of 1300. When his repeat renin/aldosterone level was done he was taking ramipril 10 mg daily and amlodipine 10 mg daily.

When he first had his renin-aldosterone levels done on the 9th June 2014, he was taking ramipril 10 mg daily, amlodipine 10 mg daily and indapamide 2.5 mg daily, his aldosterone level was 830, renin 0.3 with an aldosterone/renin ratio of 2767. His Us&Es at the same time was sodium 142 mmol/l, potassium 3.8 mmol/l, creatinine 79 µmol/l with an eGFR more than 60 ml/min.

I cannot exclude Conn's syndrome based on his renin/aldosterone levels, however I am at a loss to explain the rationale for his reduction in the aldosterone level in his recent blood test. I have also spoken to Charing Cross Hospital where the assay was done and they are also unsure of the mechanism.

As I cannot exclude Conn's syndrome I would like to refer him to Professor Morris Brown at [redacted] Hospital for a second opinion. I have spoken to [redacted] about this and he is happy for me to proceed. He is due to see me in clinic shortly and I will discuss this in more detail when he attends. Should you have any queries, please do not hesitate to contact me.

Yours sincerely,

Dictated and verified by Doctor but not signed

Dr Azad Ghuran MB ChB, MRCP, MD
Consultant Cardiologist

Aldosterone interpretation:-
Random 100-860 pmol/L
Recumbent overnight 100-450 pmol/L
As reported by Charing Cross Biochem Dept

Random 0.6-9.1 pmol/ml/Hr
Recumbent overnight 1.1-2.7 pmol/ml/Hr
Ambulant (30min) 2.8-4.5 pmol/ml/Hr
As reported by Charing Cross Biochem Dept

CASE 3

Thank you for referring this pleasant 56-year-old gentleman with uncontrolled hypertension for a cardiology opinion. He has been diagnosed with hypertension for over 10 years and has been intolerant to a number of antihypertensive drugs. He was initially commenced on ramipril and bendroflumethiazide. After three years, he developed a cough and a rash, and this combination was discontinued. Candesartan caused muscle ache, joint pain and a low mood. Amlodipine caused missed beats, a feeling of lethargy and nausea. Doxazosin caused dizzy spells and interacted with asparagus to make him feel exhausted. Moxonidine caused decreased concentration and "a foggy" vision. He recently restarted bendroflumethiazide 2.5 mg daily. He has a dull headache most of the time, however there is no flushing, sweating episodes or panic attacks to suggest an underlying endocrinological association. He does not add salt to his food. He has a history of renal calculi in the 1990's.

His past medical history includes bilateral vasectomy, a resected giant cell tumour of the left index finger, and a tonsillectomy.

His current medication consists of bendroflumethiazide 2.5 mg daily. Since on bendroflumethiazide he has nocturia up to three times a night.

His father died at 59 years and was an alcoholic. He died from asphyxia following vomiting. His mother had a CVA at 58 years and suffered with diabetes mellitus. She died at 71 years of age. He has an older sister who died of ovarian cancer and may have had Conn's syndrome.

SA

He lives with his partner, does not smoke and drinks up to five bottles of wine per week. I have asked him to reduce his alcohol intake significantly.

On systemic enquiry, I understand he is a heavy snorer. Although he has no current hypersomnolence he did suffer with this when he was on Moxonidine.

Examination: weight 131.5 kg, height 185 cm, and BMI 38.4 kg/m^2. Pulse 79 beats per minute regular, JVP not elevated, blood pressure 190/110 mmHg, 190/108 mmHg and 186/106 mmHg. Heart sounds S1 plus S2. His chest was clear. His abdomen was soft and non-tender with no organomegaly. There were no carotid or abdominal bruits. Fundoscopy should AV nipping with arteriolar narrowing.

His ECG showed sinus rhythm with voltage criteria for left hypertrophy using the limb leads.

Urinalysis showed a trace of intact blood and a trace of protein.

His U&E's done in February 2017 should a sodium of 141 mmol/l, potassium 4 mmol/L and creatinine 96 mmol/l. His total cholesterol is 5.7 mmol/l, HDL 1.74 mmol/L LDL 3.37 mmol/l and triglycerides 1.3 mmol/l.

I have arranged some blood tests including a cortisol level, a renin aldosterone level and glucose. I have arranged for him to have an echocardiogram, an ambulatory BP monitor and an MRA of his kidneys. I have commenced him on telmisartan 40 mg daily and this dose can be increased to 80 mg daily if required. I think we need to exclude sleep apnoea given his high body mass index and hypertension. I have referred to [redacted], Consultant Respiratory Physician at [redacted] Hospital for an opinion. I plan to review him again in a few weeks' time with the results of his investigations.

1. **Hypertension.**
2. **Intolerant to antihypertensive agents. Ramipril – cough and possibly a rash. Candesartan - myalgia, arthralgia and low mood. Amlodipine caused missed beat, lethargy and nausea. Doxazosin caused dizzy spells and exhaustion. Moxonidine reduced concentration and caused visual disturbance.**
3. **Vasectomy.**
4. **Resection of Giant cell tumour of the left index finger.**
5. **Tonsillectomy.**
6. **Sleep apnoea**

I reviewed Mr. [redacted] today in clinic. I understand he has been diagnosed with sleep apnoea and since commencing CPAP he feels significantly better.

His recent ambulatory blood pressure recording showed an overall day average of 135/90 mm Hg, a day average of 137/94 mmHg and a night average of 126/77 mm Hg.

His blood pressure control has significantly improved although can still do with some fine tuning.

His current medication consist of telmisartan 80 mg daily and bendroflumethiazide 2.5 mg daily.

I have changed the bendroflumethiazide to indapamide 2.5 mg daily. I would consider adding a third agent if he does not meet the target blood pressure of ≤ 135/85 mm Hg. I plan to review him again in six weeks' time.

Diagnoses:

1. **Hypertension.**
2. **Intolerant to antihypertensive agents. Ramipril – cough and possibly a rash. Candesartan - myalgia, arthralgia and low mood. Amlodipine caused missed beat, lethargy and nausea. Doxazosin caused dizzy spells and exhaustion. Moxonidine reduced concentration and caused visual disturbance.**
3. **Vasectomy.**
4. **Resection of Giant cell tumour of the left index finger.**
5. **Tonsillectomy.**
6. **Sleep apnoea**

I reviewed Mr [redacted] today in clinic. He remains remarkably well. His blood pressure is excellently controlled, and if anything probably a little low. It varies between 107-125/72-82 mmHg.

His current medication consists of Telmisartan 80 mg once daily and Indapamide 2.5 mg daily.

He is due to go to Australia next week for one month. I have advised him that if his blood pressure remains low or he gets symptoms of dizziness, he may have to reduce the Telmisartan to 40 mg daily. I would appreciate if you can check a cholesterol profile and treat according to current guidelines. For the time being, I have not arranged any further follow up appointments, but it will be a pleasure to review him again in clinic should the need arise.

Yours Sincerely,

Dr Azad Ghuran MB ChB (Edin), MRCP, MD (Edin), FESC
Consultant Cardiologist

CASE 3

Re [redacted]

50 yr. old female

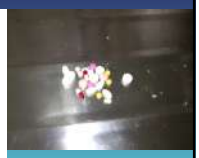
Diagnoses:

1. Previous resistant hypertension due to non-compliance. Thoroughly investigated, has normal urinary catecholamines, plasma metanephrines, renal MRA, renal angiogram, renal aldosterone levels and immunology
2. CVA
3. COPD
4. Breast cancer
5. Coronary angiogram 26th July 2013 showed moderate disease in the mid LAD and diffuse mild plaque disease in the circumflex artery and diffuse plaque disease and moderate narrowing in the mid course of a dominant right coronary artery

I reviewed [redacted] today in clinic. We finally came to the cause of her resistant hypertension which no doubt was non-compliance with her medication. I am glad to say that since she has been changed to a dosette box her blood pressure is well controlled at 105/62 with a pulse 65 beats per minute. I have not arranged any further follow-up appointments but I will of course be happy to see her should the need arise.

Yours sincerely,

Dr Azad Ghuran MB ChB, MRCP, MD
Consultant Cardiologist



22 tablets found in the patient's bed side bin

CASE 3A

DIAGNOSES

1. Resistant hypertension (normal thyroid function test, random cortisol, renin aldosterone ratio, potassium 3.4, sodium 139, normal urea and creatinine, normal ultrasound scan of kidneys)
2. Beta thalassaemia trait

I reviewed this lady today in clinic. Her blood pressure is elevated at 196/123. Unfortunately she was unsure as to whether she has been commenced on spironolactone and [redacted] as well as her daughter denies non-compliance with her medication. I note her echocardiogram done in August 2009 showed normal LV cavity size and wall thickness. Her urinary catecholamines done recently showed normal urine metadrenaline and total metadrenaline however the urine normetadrenaline was mildly elevated at 3 (0 to 2.5). Based on previous correspondence I note she is taking amlodipine and atenolol which can mildly elevate urinary catecholamine excretion and given the absence of symptoms to suggest a pheochromocytoma I have not arranged any further investigations. I will arrange for her to admitted to our cardiac suite as a day case where we will supervise the administration of her medication and monitor the blood pressure during the course of the day. If this does indeed confirm that the blood pressure remains elevated then the next investigation would be MRA of the kidneys and I will add spironolactone or amiloride. Unfortunately she did not bring the list of medication with her today and I have asked her to bring all her tablets when she attends the cardiac suite. If she is truly hypertensive and resistant to further medication then the next therapeutic intervention would be to consider renalsdenervation.

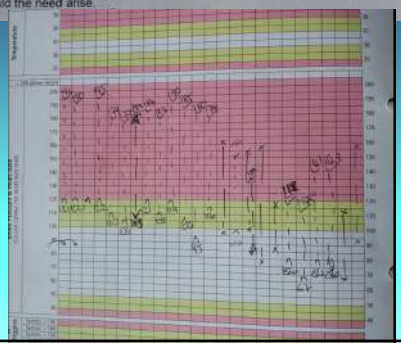
Yours sincerely,

Dr Azad Ghuran, MD MRCP
Consultant Cardiologist

44 year old female

Further to this lady's recent clinic review I arranged for her to attend the Cardiac Suite to administer her antihypertensive medication under supervision. She was given amlodipine 10 mg, spironolactone 25 mg, candesartan 16 mg, doxazosin 8 mg, atenolol 50 mg and bendroflumethiazide 2.5 mg at 08:35 and the blood pressure fell to as low as 120/85 by 12:40. There is no doubt that this lady is non-compliant with her medication and prior to adding any further therapy or arranging any investigations I suggest she regularly takes her medications.

I have not arranged any further follow-up for the time being but I would of course be happy to review her should the need arise.



CASE 4

Thank you very much for referring this pleasant 60-year old gentleman for a cardiology opinion. I understand that he attended for a medical and had an ECG, which showed prominent voltage complexes suggestive of left ventricular hypertrophy. From a cardiac perspective, he is well and asymptomatic. He exercises daily either by running or cycling.

In terms of risk factors for ischaemic heart disease, he smokes occasionally between 3-4 cigarettes a week, and his recent lipid profile showed a cholesterol of 5.5 mmol/L, HDL 2.1 mmol/L, LDL 3.1 mmol/L and triglycerides 0.7 mmol/L.

His past medical history includes childhood asthma, cervical disc degeneration and an appendicectomy. His PSA was recently elevated, and he is currently being investigated by Mr [redacted] Consultant Urologist. He also recently suffered an episode of plantar fasciitis, and is currently under Mr [redacted] Consultant Orthopaedic Surgeon.

His current medication consists of Cialis when required, and Arthrotec when required.

His father died at 77 years and suffered with amyloidosis, prostate cancer and hypertension. His mother died at 87 years from flu, and also suffered with bronchitis, Parkinsonian type symptoms, dementia, depression and anxiety.

He lives with his wife and has three sons. He drinks up to 30 units of alcohol a week, and I have asked him to halve his alcohol intake. He works as a barrister.

He has a very good diet, low in sugar and carbohydrates. He does not add salt to his food, and there is no significant consumption of processed foods.

Examination: pulse 67 bpm and regular. JVP was not elevated. Blood pressure 140/76 mmHg and 132/74 mmHg. Heart sounds S1 + S2 + a soft 2/6 systolic murmur at the apex. His abdomen was soft and non-tender.

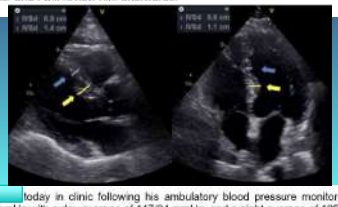
The ECG done at your practice, which you kindly sent, showed sinus rhythm with a ventricular rate of 51 bpm. He has prominent voltage complexes in leads V4 and V5. However, the intrinsicoid deflection was normal, with normal voltage criteria in the limb leads, and I suspect the prominent voltages probably reflect his slim build. I repeated his ECG today and this was within normal limits.

Thank you for enclosing his blood tests, which showed normal U&Es, liver function tests, iron indices, calcium, HbA1c, thyroid function tests, vitamin D and full blood count.

For reassurance I have arranged for him to have an echocardiogram. He is aware that he needs to stop smoking to reduce his overall cardiovascular risk. I will review him following his echocardiogram.

I had a telephone consultation with Mr [redacted] today to go over the results of his echocardiogram. It showed normal biventricular cavity size with good function. There was a basal septal bulge with the remainder of the left ventricular wall thickness being normal. The right ventricular wall thickness was normal. There were no significant valvular abnormalities. There was mild increase flow in the left ventricular flow tract with no gradient.

His echocardiogram showed no significant left ventricular hypertrophy, but there are early changes which can be seen sometimes in patients with hypertension. I have arranged for him to have an ambulatory blood pressure monitor and I will review him afterwards.



I reviewed Mr. [redacted] today in clinic following his ambulatory blood pressure monitor. The overall average was 140/78 mmHg with a day average of 147/84 mmHg, and a night average of 125/6 mmHg.

Based on his ambulatory blood pressure monitor, Mr. [redacted] is hypertensive. Together with the findings on his echocardiogram, there is evidence of organ involvement. Consequently, I have commenced him on antihypertensive medication today. I have started Telmisartan 20 mg daily. Telmisartan has a half life of 24 hours, which will reduce the peak and trough variation of blood pressure control. It also has endothelial protective effects. I will appreciate if you can recheck his U&Es in 7-10 days' time. The target blood pressure should be less than 130/80 mmHg and the Telmisartan dose can be increased. A second agent may be required to achieve the target blood pressure. I have not arranged any further follow-up appointments, but it will be a pleasure to review him should the need arise.

CASE 5

Thank you very much for referring this pleasant 50-year old lady for a cardiology opinion. She has a 12-month history of chest pain, which she describes as a tightness in the left upper chest region that can occur at any time, but can also occur on exertion. Four days ago, she was rushing and walking when she developed chest pain that radiated to the left forearm. This lasted approximately 10 minutes but later returned. She was unsure how long it remained for the second time. She suffers from heartburns but her current chest pain is different.

Her risk factors include smoking (15 cigarettes a day), and her cholesterol is around 5.5 mmol/L from memory. There is also a family history of ischaemic heart disease, as summarised below.

She suffers with chronic migraines and had radiofrequency denervation, chronic fatigue syndrome, chronic pruritus, chronic generalised pain, and a disc operation on her lower back. She coughed up blood approximately five years ago and had a CT scan, which showed some emphysematous changes.

Her current medication consists of lansoprazole 30mg daily.

Her father died at 78 years with oesophageal cancer. He also suffered with Parkinson's disease associated with dementia. He had a history of ischaemic heart disease and underwent PCI, which was complicated and required emergency bypass surgery. He also subsequently had a pacemaker. Her mother is alive at 73 years and suffers with hypertension. She has a younger sister, 47 years, who suffers with asthma.

She lives with her husband and has two daughters, 18 years and 22 years. She does not drink any alcohol.

Examination: pulse 66 bpm and regular. JVP was not elevated. She was anxious. Blood pressure 184/104 mmHg, 184/104 mmHg and 184/104 mmHg. Heart sounds S1 + S2. Her chest was resonant to percussion, with normal vesicular breath sounds. Her abdomen was soft and non-tender, with no organomegaly.

On systemic enquiry, she mentioned that after she had her Pfizer booster vaccine three months ago, she developed left calf pain and swelling, and had an elevated D-dimer. An ultrasound scan of her left calf was normal.

Her ECG today showed normal sinus rhythm, with normal conduction indices and waveform morphology.

Mrs [redacted] has a number of risk factors and has chest pain. I have arranged for her to have an echocardiogram, a CT coronary angiogram with extended lung views, an ambulatory blood pressure monitor, and some baseline blood tests. I will review her again after her investigations.

Thank you for arranging a recent troponin level, which was normal.

I reviewed Mrs [redacted] today in clinic following her recent investigations. Her U&Es, calcium, liver function tests, thyroid, glucose, iron indices, full blood count, and HBA1c were all normal. Her total cholesterol is 5.6 mmol/L, triglycerides 1.2 mmol/L, HDL 1.5 mmol/L, and LDL 3.6 mmol/L.

Her ambulatory blood pressure monitor showed an overall average of 118/72 mmHg with a day average of 121/75 mmHg and a night average of 112/67 mmHg.

Her echocardiogram showed a structurally normal heart.

Her CT coronary angiogram showed a calcium score of 0 with normal unobstructed coronary arteries. There is no evidence of any pulmonary embolic events. There are several cystic areas within the lungs with no clear zonal predilections.

I have reassured [redacted] that she does not have any cardiac pathology and her coronary arteries are normal. Her cholesterol level should initially be treated with lifestyle changes with regular exercise and dietary alterations. Given the findings in her lungs, I would suggest a respiratory opinion. She previously had a CT scan in the past and was told she had emphysema, but this was over five years ago. A respiratory consultant can always obtain the images from HCA Imaging at 88 Harley Street, London. I have not arranged a further follow-up appointment, but I will be happy to see her again should the need arise.

CASE 7

Diagnoses: **dob 30.07.1961**

1. **Hypertension**
2. **Hyperlipidaemia**
3. **Coronary angiogram 2nd October 2017, showed a 60% calcific stenosis in the proximal LAD with further mild disease in the mid course (FFR 0.91). Mild plaque disease at the ostium and proximal circumflex artery. Mild plaque disease in the dominant right coronary artery.**
4. **Good LV systolic function.**
5. **Left cruciate ligament repair.**
6. **Felt unwell on Bisoprotol, and Amlodipine caused ankle swelling**
7. **Stress echocardiogram done 8th December, 2016 demonstrated no inducible myocardial ischaemia**
8. **Endoscopy 2017 - normal**

I had a telephone consultation with Mrs [redacted] today. I last saw her in November 2017. Over the past few years she has had the occasional chest pain triggered by stress and was reviewed on two occasions at University College London Hospital. She had normal ECGs and troponin and was subsequently discharged. She has a Kardia ECG monitor which she uses and this usually shows a normal rhythm. On the whole, she has been well with good controlled blood pressure until the COVID-19 lockdown.

She has been working from home. She started developing some postural symptoms whilst gardening and on measuring of her blood pressure it was 107/80mmHg sitting and 84/44mmHg standing. Her perindopril was decreased to 4mg approximately two weeks ago.

During the week days, her blood pressure starts off controlled after taking her medication on a morning at around 131/74mmHg and 132/81mmHg. It then increases throughout the day at around 149/82mmHg, 144/84mmHg and 173/95mmHg. After reprimanding a colleague, her blood pressure increased to 190/119mmHg. On a weekend when she is not working and more relaxed, her blood pressure can fall to 97/57mmHg while sitting and 76/46mmHg while standing. Her pulse when relaxed is around 55-60 BPM and when stressed around 85-90 BPM.

Her current medication consists of perindopril 4mg at around 8-9am, Indapamide 2.5mg around 8-9am, diltiazem SR 90mg twice daily, lansoprazole 30mg once daily, aspirin, Chemydur SR 120mg at 8-9am and atorvastatin 80mg at night.

I have asked her to omit the diltiazem morning dose on the weekend. She will monitor her blood pressure on the morning and evening of Monday, Wednesday, Friday, Saturday and Sunday. I will review her blood pressure control after three weeks. She mentioned that she may consider early retirement which no doubt will help with better blood pressure control. I plan to review her again with a telephone consultation in three weeks' time.

4/52 review

I had a telephone consultation with [redacted] I am glad to hear that since changing her anti-hypertensive medication, her dizzy symptoms have improved. She sent me a list of her blood pressure recordings and this has confirmed that her blood pressure tends to be higher during the week when she is working and lower on weekends. Her blood pressure also tended to be higher on an evening. I have suggested that she takes Indapamide around mid day or early afternoon, which will help reduce the increase in blood pressure in the evenings. She will continue with Perindopril 4 mg at around 8-9 AM, Diltiazem SR 90 mg twice daily, Lansoprazole 30 mg once daily, Aspirin, Chemydur SR 120 mg (8-9 AM), and Atorvastatin 80 mg at night.

I have not arranged any further follow-up appointments, but I will be happy to see her again in clinic should the need arise.

Yours Sincerely,

Dr Azad Ghuran MB ChB (Edin), MRCP, MD (Edin), FESC
Consultant Cardiologist

CASE 8

This 65-year old gentleman made an appointment today for a cardiology review. He recently had a health check and was found to have an abnormal ECG, which precipitated this referral. He currently has no cardiorespiratory symptoms.

In terms of risk factors for ischaemic heart disease, his total cholesterol is 6.5 mmol/L, LDL 3.4 mmol/L, HDL 1.25 mmol/L and triglycerides 4.2 mmol/L. His brother had a myocardial infarction at 65 years, and also suffers with diabetes mellitus. There is no other significant family history.

He has a history of gout and erectile dysfunction.

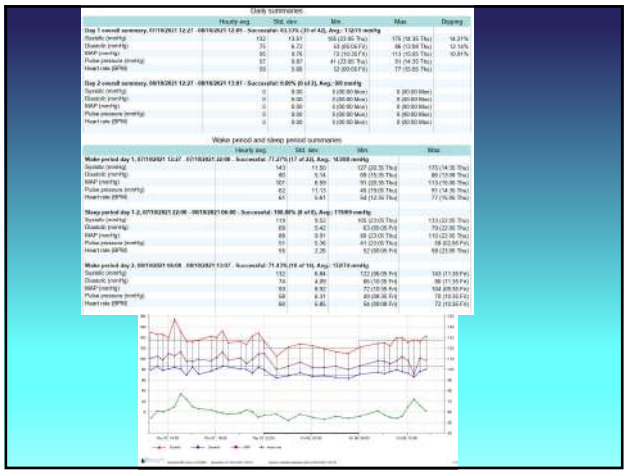
He is on no regular medication and currently takes vitamins.

He lives with his wife and has two children, 31 years and 28 years. He drinks between 2-4 units of alcohol a week. He works as an IT manager.

Examination: pulse 54 bpm and regular. JVP was not elevated. Blood pressure 144/80 mmHg, 146/80 mmHg and 144/80 mmHg. Heart sounds S1 + S2. His chest and abdomen were unremarkable.

The ECG done at his medical showed sinus rhythm, with a sinus bradycardia. The computer-generated report suggested a possible inferior myocardial infarction. I repeated his ECG today, and this showed sinus bradycardia with a ventricular rate of 53 bpm. There was a borderline left axis. There were very small preceding r waves in leads III and aVF, and therefore there was no evidence of any Q waves to suggest a possible myocardial infarction.

Given his high cholesterol, family history of ischaemic heart disease and QRISK score of 26.4%, I would recommend commencing a statin agent. He is keen to avoid commencing a statin unless absolutely necessary. Given his risk factors, together with his previous ECG, I have arranged for him to have an echocardiogram, as well as a CT coronary angiogram. If he is developing early coronary artery disease, then it would be strongly recommended to commence a statin agent. I will review him after his investigations.



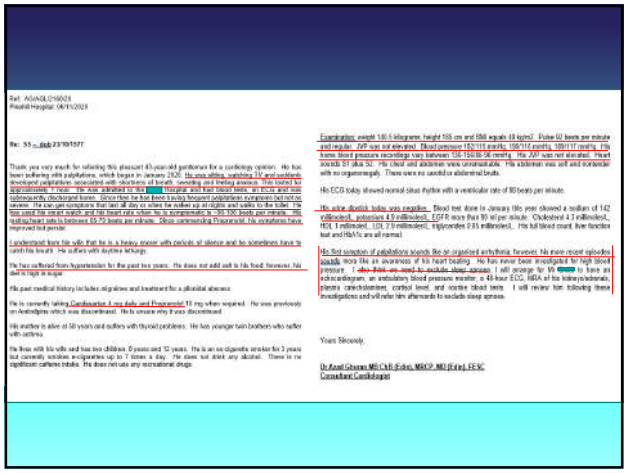
I reviewed Mr [redacted] today following his investigations.

His cardiac CT scan showed a calcium score of 180 Agatston units. The LAD is patent throughout its course, with no obstructive disease. There is an eccentric non-significant calcified plaque at the origin of the first diagonal artery and a 50% calcified stenosis in the proximal course. There is a small, calcified plaque in the mid-course of the circumflex artery. In the distal circumflex artery, there were several small, calcified plaques, which made luminal assessment difficult, as it was a small calibre vessel. The right coronary artery is a dominant vessel with eccentric calcified and non-calcified plaque in the mid-course, and a 50% calcified stenosis in the posterior descending artery. The visualised lungs and pleural spaces were clear.

His echocardiogram today showed normal biventricular cavity size, with good biventricular function. There is mild concentric left ventricular hypertrophy (1.3 cm mid-septum, 1.3 cm posterior walls). There is mild aortic regurgitation. There are no other significant valvular abnormalities. The pulmonary artery pressure was normal. The basal septum had a sigmoid appearance, with a bulge. His echocardiogram suggests hypertensive heart disease, however his clinic blood pressure was borderline elevated when I reviewed him in clinic. It was 144/80 mmHg.

Given the development of early coronary artery disease, I would appreciate it if you could commence [redacted] on Atorvastatin 20 mg daily. This can be increased to 40 mg to achieve a target LDL cholesterol of <1.4 mmol/L.

I would like to exclude hypertension and I arranged a 24-hour ambulatory blood pressure monitor. This showed an overall average of 132/75 mmHg, a day average of 138/78 mmHg and a night average of 119/69 mmHg. His BP is again borderline. Given his coronary artery disease and echocardiographic findings, I would suggest commencing ramipril 2.5 mg once daily aiming for a home blood pressure < 130/80 mmHg. Please monitor his renal function after commencing ramipril. I have not arranged a routine follow up appointment but I have left his appointment open over the next three months should he wish for a further review.



Re: Mr [redacted] – dob 23/10/1977

[redacted]

I reviewed [redacted] today in clinic following his investigations.

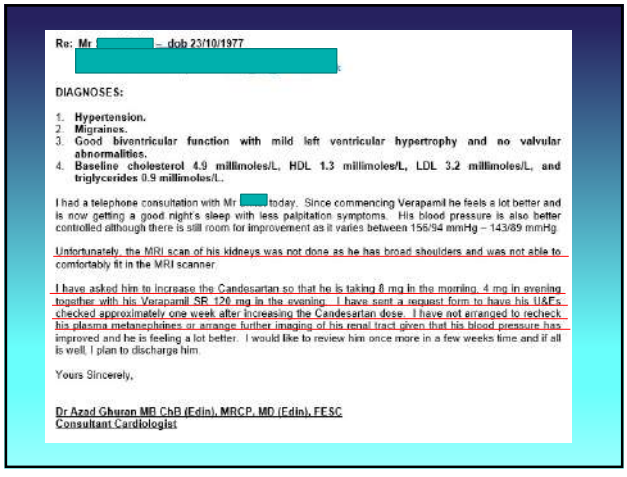
His blood test showed normal renal function with an EGFR of more than 19 mL/min, normal liver function, calcium, glucose, thyroid function and cortisone levels. His total cholesterol is 4.9 millimoles/L, HDL 1.3 millimoles/L, LDL 3.2 millimoles/L and triglycerides 0.9 millimoles/L. The plasma noradrenaline was mildly elevated at 2700 pmol/L (less than 2482) with normal plasma adrenaline and plasma dopamine. The plasma noradrenaline is only mildly elevated with normal adrenaline and dopamine. I will await the results of the MRI of his kidneys and adrenals before deciding whether to investigate further.

His ambulatory blood pressure monitor showed an overall average of 143/96 mmHg with a day average of 149/101 mmHg and a night average of 126/83 mmHg.

His echocardiogram showed mild left ventricular hypertrophy with good function and no significant valvular abnormalities.

His 48-hour ECG showed sinus rhythm with a minimum heart rate of 58 beats per minute, maximum 100 beats per minute with a mean of 73 beats per minute. There were no rhythm disturbances throughout the recording nor did Mr Smith have any palpitation symptoms.

I have commenced Mr [redacted] on Verapamil SR 120 mg daily which he will take on evenings as he gets palpitations symptoms at nights. He will continue to monitor his home blood pressure and if it is greater than 135/85 mmHg, I have asked him to increase the Candesartan to 8 mg daily. I would like to exclude sleep apnoea given that he is a heavy snorer with day-time lethargy and a high body mass index. I have referred him to Dr. [redacted] Consultant Respiratory Physician, at [redacted]. I would like to review Mr [redacted] again in 6 weeks' time.



Re: Mr [redacted] – dob 23/10/1977

[redacted]

DIAGNOSES:

1. **Hypertension.**
2. **Migraines.**
3. **Good biventricular function with mild left ventricular hypertrophy and no valvular abnormalities.**
4. **Baseline cholesterol 4.9 millimoles/L, HDL 1.3 millimoles/L, LDL 3.2 millimoles/L, and triglycerides 0.9 millimoles/L.**

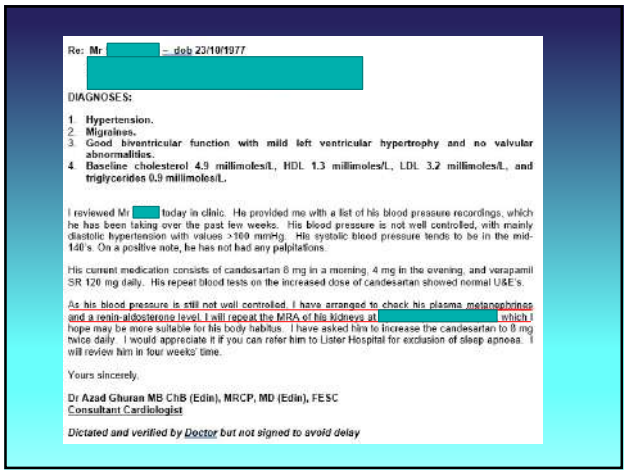
I had a telephone consultation with Mr [redacted] today. Since commencing Verapamil he feels a lot better and is now getting a good night's sleep with less palpitation symptoms. His blood pressure is also better controlled although there is still room for improvement as it varies between 156/94 mmHg – 143/89 mmHg.

Unfortunately, the MRI scan of his kidneys was not done as he has broad shoulders and was not able to comfortably fit in the MRI scanner.

I have asked him to increase the Candesartan so that he is taking 8 mg in the morning, 4 mg in evening together with his Verapamil SR 120 mg in the evening. I have sent a request form to have his U&Es checked approximately one week after increasing the Candesartan dose. I have not arranged to recheck his plasma metanephrines or arrange further imaging of his renal tract given that his blood pressure has improved and he is feeling a lot better. I would like to review him once more in a few weeks time and if all is well, I plan to discharge him.

Yours Sincerely,

Dr Azad Ghuron MB ChB (Edin), MRCP, MD (Edin), FESC
Consultant Cardiologist



Re: Mr [redacted] – dob 23/10/1977

[redacted]

DIAGNOSES:

1. Hypertension.
2. Migraines.
3. Good biventricular function with mild left ventricular hypertrophy and no valvular abnormalities.
4. Baseline cholesterol 4.9 millimoles/L, HDL 1.3 millimoles/L, LDL 3.2 millimoles/L, and triglycerides 0.9 millimoles/L.

I reviewed Mr [redacted] today in clinic. He provided me with a list of his blood pressure recordings, which he has been taking over the past few weeks. His blood pressure is not well controlled, with mainly diastolic hypertension with values >100 mmHg. His systolic blood pressure tends to be in the mid-140's. On a positive note, he has not had any palpitations.

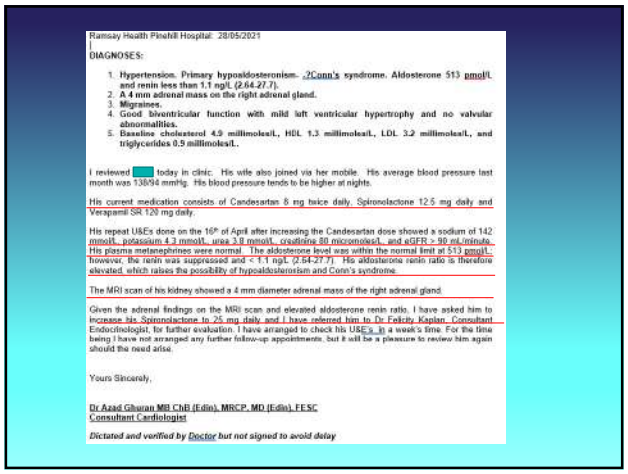
His current medication consists of candesartan 8 mg in a morning, 4 mg in the evening, and verapamil SR 120 mg daily. His repeat blood tests on the increased dose of candesartan showed normal U&E's.

As his blood pressure is still not well controlled, I have arranged to check his plasma metanephrines and a renin-aldosterone level. I will repeat the MRA of his kidneys at [redacted] which I hope may be more suitable for his body habitus. I have asked him to increase the candesartan to 8 mg twice daily. I would appreciate it if you can refer him to Lister Hospital for exclusion of sleep apnoea. I will review him in four weeks' time.

Yours sincerely,

Dr Azad Ghuran MB ChB (Edin), MRCP, MD (Edin), FESC
Consultant Cardiologist

Dictated and verified by Doctor but not signed to avoid delay



Ramsay Health Plan/nill Hospital: 28/05/2021

DIAGNOSES:

1. Hypertension. Primary hypoaldosteronism. ?Conn's syndrome. Aldosterone 513 pmol/L and renin less than 1.1 ng/L (2.64-27.7).
2. A 4 mm adrenal mass on the right adrenal gland.
3. Migraines.
4. Good biventricular function with mild left ventricular hypertrophy and no valvular abnormalities.
5. Baseline cholesterol 4.9 millimoles/L, HDL 1.3 millimoles/L, LDL 3.2 millimoles/L, and triglycerides 0.9 millimoles/L.

I reviewed [redacted] today in clinic. His wife also joined via her mobile. His average blood pressure last month was 138/94 mmHg. His blood pressure tends to be higher at nights.

His current medication consists of Candesartan 8 mg twice daily, Spironolactone 12.5 mg daily and Verapamil SR 120 mg daily.

His repeat U&Es done on the 16th of April after increasing the Candesartan dose showed a sodium of 142 mmol/L, potassium 4.3 mmol/L, urea 3.8 mmol/L, creatinine 80 micromoles/L, and eGFR > 90 mL/minute. His plasma metanephrines were normal. The aldosterone level was within the normal limit at 513 pmol/L, however, the renin was suppressed and < 1.1 ng/L (2.64-27.7). His aldosterone renin ratio is therefore elevated, which raises the possibility of hypoaldosteronism and Conn's syndrome.

The MRI scan of his kidney showed a 4 mm diameter adrenal mass of the right adrenal gland.

Given the adrenal findings on the MRI scan and elevated aldosterone renin ratio, I have asked him to increase his Spironolactone to 25 mg daily and I have referred him to Dr Felicity Kaplan, Consultant Endocrinologist, for further evaluation. I have arranged to check his U&Es in a week's time. For the time being I have not arranged any further follow-up appointments, but it will be a pleasure to review him again should the need arise.

Yours Sincerely,

Dr Azad Ghuran MB ChB (Edin), MRCP, MD (Edin), FESC
Consultant Cardiologist

Dictated and verified by Doctor but not signed to avoid delay

Diagnosed with severe sleep apnoea. CPAP – Significantly better.

Referred to Hypertension Unit at Addenbrooke's Hospital

Selective venous sampling. PET CT

Right renal mass was benign

Small adenoma left adrenal gland – Conn's syndrome

Resection June 2023

Spoken to him 15th November 2023 Feels great. Off medication. Blood pressure controlled but a little variable – being monitored

Patient 1

- 36 yr. old Polish lady
- PMHx: gestational Diabetes 1993
- 2000 to GP
  - Sweating easily after physical exertion
  - Night sweats, palpitations, morning headaches and hot flushes during the day
  - Symptoms occurred during mid cycle and pre menstruation

GP → ? hypertensive

Patient 1

2001

- BM = 7 mmol/l (father's glucometer)
- GP → ↑ cholesterol, FBG = 7.1 mmol/l
- Started atenolol 50 mg.
- BP still not controlled → GP → ↑atenolol but patient refused.
- Demanded an 24-hr. ambulatory BP recording and US abdomen

Patient 1

2001

- 24-hr. ABP recording = nocturnal hypertension (systolic ~ 220 mmHg @ 1-3am)

- Cardiologist @ Purley Hospital
  - US scan
  - Urinary catecholamines
  - stopped atenolol → ramipril and Diltiazem XL 300 mg.

Patient 1

2002

- US : 4 x 2 cm right adrenal mass.
- CT : 4 x 6 x 3 cm right adrenal mass and an ill-defined 2 x 2 cm lesion in the left suprarenal region

Patient 1

Test	Result	Units	Ref. Range
Noradrenaline	3413	nmol/24 hrs	118-500
Adrenaline	81.6	nmol/24 hrs	0-100
Dopamine	1700	nmol/24 hrs	0-300

Δ Bilateral phaeochromocytoma

Patient 1

October 2002

- Referred to BPU
- Patient adamant only one tumour on the right.
  Polish Clarivoyant 1993 → an illness requiring an abdominal operation, and a scar on right side only.
- CT scan reviewed: right adrenal mass, ?? left adrenal mass. Arrange a MRI / MIBG
- Ramipril and diltiazem stopped → Phenoxybenzamine 10 mg BD and atenolol 25 mg OD
- ??MEN - PTH, gastrin, somatostatin, PP and neurotensin

Patient 1

MRI

Patient 1

MIBG (metaiodobenzylguanidine scintigram)

Patient 1

- Referred to Mr. [redacted]
- Operated on 14/02/03 → successful
- Histopathology report consistent with a benign phaeochromocytoma
- Antihypertensives discontinued
- BP on 5/03/03 → 112/72

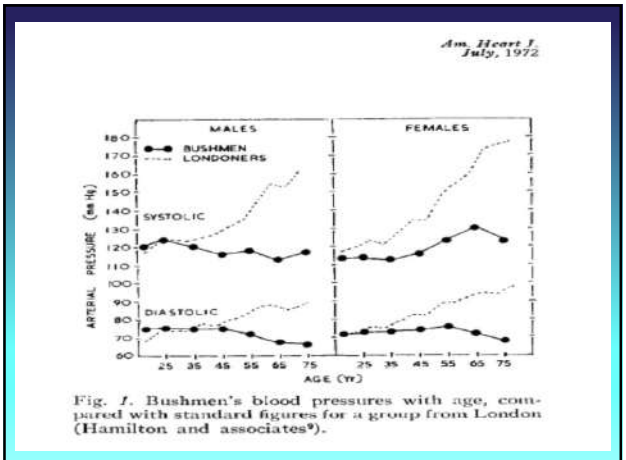


Fig. 1. Bushmen's blood pressures with age, compared with standard figures for a group from London (Hamilton and associates[9]).

Management of Hypertension. A case-base presentation in the management of primary hypertension and the investigation of secondary causes of hypertension.

Dr. Azad Ghuran MB ChB (Edin), MRCP, MD (Edin), FESC
Consultant Cardiologist

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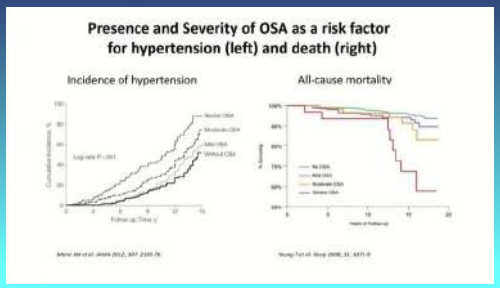
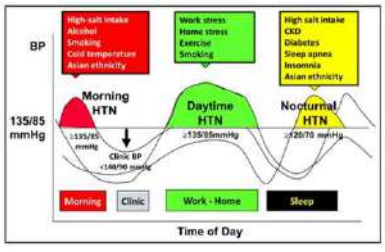
Presence and Severity of OSA as a risk factor for hypertension (left) and death (right)



Intervention	Approximate SBP Reduction
Weight reduction (to BMI 18.5 – 24.9 kg/m²)	5-20 mmHg / 10 kg
DASH eating plan - increased fruit / vegetables / low fat diary, reduced saturated and total fat intake	8-14 mmHg
Dietary sodium reduction (to < 6g sodium chloride / day)	2-8 mmHg
Regular aerobic physical activity (to 30 minutes/day)	4-9 mmHg
Moderating alcohol intake (Male <2 units/day, Female <1 units/day)	2-4 mmHg

Supplementary Table 2 – Non-pharmacological therapies for the treatment of hypertension, and the approximate blood pressure response. Adapted from The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC 7) [Ref 29]. DASH - Dietary Approaches to Stop Hypertension

The HOPE Asia Network Consensus panel

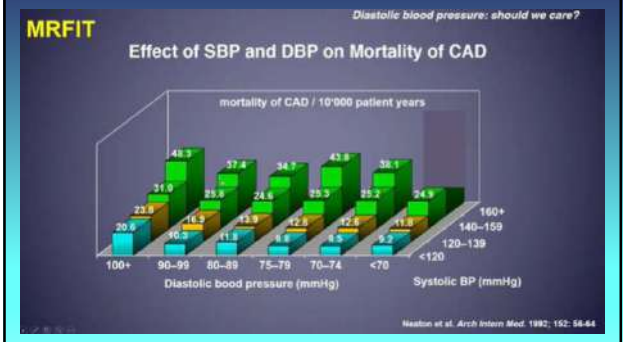


Diagnostic Evaluation

Confirm Dx
- Assess Cardiovascular risk
- Concomitant conditions

Asymptomatic organ damage?

Consider possibility of 2° HTN?



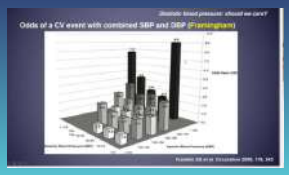


Table 1 Causes of secondary hypertension

Endocrine
- Primary aldosteronism (PA)
- Cushing's syndrome (CS)
- Pheochromocytoma / paraganglioma (PPGL)
- Primary hyperparathyroidism (PHPT)
- Hypothyroidism
- Thyrotoxicosis
- Acromegaly
- Apparent Mineralocorticoid Excess (congenital)

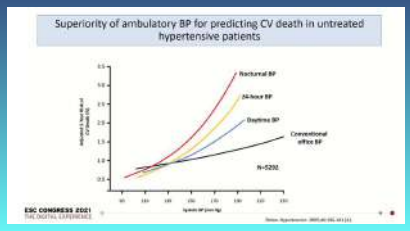
Renal
- Renal parenchymal disease
- Renin-producing tumor
- Primary sodium retention (Liddle's syndrome)
- Gordon' syndrome (hyperkalemia with metabolic acidosis, normal renal function, low or low-normal plasma renin activity, and normal or elevated plasma aldosterone concentration)

Obstructive sleep apnea

Reno-vascular hypertension (RVH)
- Atherosclerotic (ATS-RVH)
- Fibromuscular dysplasia (FMD-RVH)

Coarctation of the aorta
- Arteritis
- Intramral (i.e. microscopic polyangiitis, granulomatosis with polyangiitis)
- Schönlein-Henoch purpura
- Cryoglobulinemic vasculitis

Iatrogenic
- Drugs and exogenous hormones (i.e. contraceptive pills, immunosuppressive, non-steroidal anti-inflammatory drugs, etc.)
- Acquired Apparent Mineralocorticoid Excess (licorice, etc.)
- Cancer therapies (angiogenesis inhibitors as bevacizumab, and others)



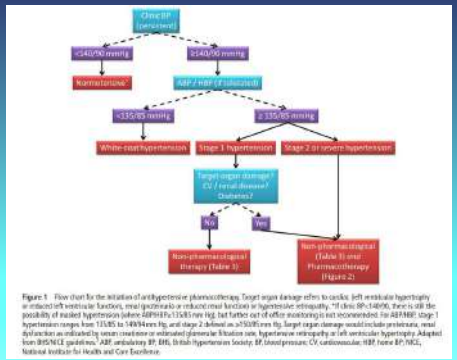


Figure 1 Flow chart for the initiation of antihypertensive pharmacotherapy. Target organ damage refers to cardiac (left ventricular hypertrophy or reduced left ventricular function), renal (proteinuria or reduced renal function) or hypertensive retinopathy. *If clinic BP >140/90, there is still the possibility of masked hypertension (where 6HPH/Px135/85 mm Hg), but further out-of-office monitoring is not recommended. †In AF/HBP, stage 1 hypertension ranges from 135/85 to 149/94 mm Hg, and stage 2 defined as ≥150/95 mm Hg. Target organ damage would include proteinuria, renal dysfunction as indicated by serum creatinine or estimated glomerular filtration rate, hypertensive retinopathy or left ventricular hypertrophy. Adapted from BHS/NICE guidelines.[3] ABP, ambulatory BP; BHS, British Hypertension Society; BP, blood pressure; CV, cardiovascular; HBP, home BP; NICE, National Institute for Health and Care Excellence.

Office Blood Pressure Treatment Target Ranges

Recommendations	Class	Level
It is recommended that the first objective of treatment should be to lower BP to < 140/90 mmHg in all patients, and provided that the treatment is well tolerated, treated BP values should be targeted to 130/80 mmHg or lower, in most patients.	I	A
In patients < 65 years receiving BP-lowering drugs, it is recommended that SBP should be lowered to a BP range of 120 to < 130 mmHg in most patients.[a]	I	A
In older patients (aged ≥ 65 years) receiving BP-lowering drugs:		
• It is recommended that SBP should be targeted to a BP range of 130 to < 140 mmHg.	I	A
• Close monitoring of adverse effects is recommended.	I	C
• These BP targets are recommended for patients at any level of CV risk and in patients with and without established CVD.	I	A

[a]Less evidence is available for this target in low–moderate-risk patients.

www.escardio.org/guidelines

Williams B, Mancia G et al. Eur Heart J (2018); doi:10.1093/eurheartj/ehy339
Williams B, Mancia G et al. J Hypertens (2018); doi:10.1097/HJH.0000000000001940

17

HYPERTENSION - Use of specific drugs

DRUG	INDICATIONS	CONTRA-INDICATIONS
Diuretics	Elderly	Gout, diabetes, urinary freq.
BB	Angina, ?CHF	Asthma, PVD
ACEI	CHF, diabetes	RAS, PVD
A-II	ACEI cough	RAS, PVD
Ca++ blockers	Elderly, angina	Unstable angina
Alpha-blockers	Prostatism, lipids^	Postural hypotension
Centrally acting	Elderly	Conduction disorders

Oral Antihypertensive Drugs

Drug	Trade name	Usual dose range, mg/day (frequency)	Major side effects
Diuretics (partial list) – all but furosemide once a day:			Biochemical abnormalities:
Hydrochlorothiazide	Hydrodiuril, Esidrix	12.5–50	↓Potassium, ↑cholesterol, ↑glucose
Chlorthalidone	Hygroton	12.5–50	Rare: blood dyscrasias, photosensitivity, pancreatitis
Metolazone	Mykrox, Diulo	0.5–10	
Indapamide	Lozol	2.5	
Furosemide	Lasix	40–240	Loss of any hypercholesterolemia
Torsemide	Demadex	5–40	Short duration of action Long duration of action
Potassium-sparing agents (plus thiazide)			
Spironolactone	Aldactazide	25–100	Hyperkalemia, gynecomastia
Dyrenium	Dyrazide, Maxzide	25–100	Hyperkalemia
Amiloride	Moduretic	5–10	Hyperkalemia
Adrenergic inhibitors			
Peripheral			Sedation, depression
Reserpine	Serpasil	0.05–0.25 (1)	Orthostatic hypotension, diarrhea
Guanethidine	Ismelin	10–150	
Guanadrel	Hylorel	10–75	
Central alpha agonists			
Methyldopa	Aldomet	500–3000 (2)	Hepatic and "auto-immune" disorders
Clonidine	Catapres	0.2–1.2 (2)	Sedation, dry mouth, "withdrawal"
Guanabenz	Wytensin	8–32 (2)	Sedation, dry mouth, "withdrawal"
Guanfacine	Tenex	1–3 (1)	Sedation, dry mouth, "withdrawal"
Alpha-blockers			
Doxazosin	Cardura	1–20(1)	Postural hypotension (mainly with first dose), lassitude
Prazosin	Minipress	2–20 (2)	
Terazosin	Hytrin	1–20 (1)	
Beta-blockers			
Acebutolol	Sectral	200–800 (1)	
Atenolol	Tenormin	25–100 (1–2)	Serious: bronchospasm, congestive heart failure, masking of insulin-induced hypoglycemia, depression
Betaxolol	Kerlone	5–20 (1)	
Bisoprolol	Zebeta	2.5–10 (1)	
Carteolol	Cartrol	2.5–10 (1)	
Metoprolol	Lopressor, Toprol-XL	50–200 (1–2)	
Nadolol	Corgard	40–320 (1)	Less serious: poor peripheral circulation, insomnia, fatigue, decreased exercise tolerance, hypertriglyceridemia, decreased HDL (except with ISA-agents)
Pentobitol	Levatol	10–20 (1)	
Pindolol	Visken	10–60 (2)	
Propranolol	Inderal	40–480 (2)	
Timolol	Blocadren	20–60 (2)	
Combined α- and β-blocker			
Labetalol	Normodyne, Trandate	200–1200 (2)	Postural hypotension, beta-blocking side effects
Carvedilol	Coreg	12.5–50 (2)	

Oral Antihypertensive Drugs

Drug	Trade name	Usual dose range, mg/day (frequency)	Major side effects
Direct vasodilators			
Hydralazine	Apresoline	50–400 (2)	Headaches, tachycardia, lupus syndrome
Minoxidil	Loniten	5–100 (1)	Headaches, fluid retention, hirsutism
Calcium channel blockers			
Verapamil (SR)	Isoptin, Calan, Verelan	90–480 (1–2)	Constipation, conduction defects, decreased contractility, gingival hyperplasia
Diltiazem (SR and CD)	Cardizem, Dilacor, Tiazac	120–240 (1–2)	Nausea, headache, conduction defects, decreased contractility, gingival hyperplasia
Dihydropyridines			
Amlodipine	Norvasc	2.5–10 (1)	Flush, headache, local ankle edema
Felodipine	Plendil	5–20 (1)	
Isradipine	DynaCirc	5–20 (1–2)	
Nicardipine SR®	Cardene	60–90 (2)	
Nifedipine (XL)	Procardia XL, Adalat CC	30–120 (1)	
Nisoldipine	Sular	20–60 (1)	
Nifedipine	Procardia	30–120 (1)	Bradycardia, conduction defects
Angiotensin converting enzyme inhibitors			
Benazepril	Lotensin	5–40 (1)	Cough, rash, loss of taste, hyperkalemia
Captopril	Capoten	25–150 (2–3)	Rare: Leukopenia, angioedema
Enalapril	Vasotec	5–40 (2)	
Fosinopril	Monopril	10–40 (1)	
Lisinopril	Prinivil, Zestril	5–40 (1)	
Moexipril	Univasc	7.5–15 (1)	
Quinapril	Accupril	5–80 (1)	
Ramipril	Altace	1.25–20 (1)	
Trandolapril	Mavik	1–4 (1)	
Angiotensin-receptor blockers			
Losartan	Cozaar	50–100 (1–2)	Hyperkalemia, no cough, but angioedema can occur
Valsartan	Diovan	80–320 (1)	
Irbesartan	Avapro	150–300 (1)	

Hypertension

Which Drug ?

Indication	Antihypertensive drugs
Compelling indications unless contraindicated	
Diabetes mellitus with proteinuria	ACE inhibitor, particular by type 1 diabetes
Nondiabetic chronic renal failure with proteinuria	ACE inhibitor (question-able value if plasma creatinine ≥5 mg/dL (265 μmol/L)
Congestive heart failure	ACE inhibitor, diuretic
Isolated systolic hypertension (older patients)	Diuretics (preferred), calcium blocker (long-acting DHP)
Myocardial infarction	Beta blocker (without ISA), ACE inhibitor (with systolic dysfunction or anterior infarct)
May have favorable effect on comorbid conditions	
Angina pectoris	Beta blocker, calcium blocker
Atrial fibrillation and tachycardia	Beta blocker, calcium blocker (non-DHP)
Diabetes mellitus with proteinuria	Calcium blocker (non-DHP)
Dyslipidemia	Alpha blocker
Essential tremor	Beta blocker (non-cardioselective)
Congestive heart failure	Carvedilol, losartan
Hyperthyroidism	Beta blocker
Migraine	Beta blocker (non-cardioselective), calcium blocker (non-DHP)
Myocardial infarction	Diltiazem, verapamil
Osteoporosis	Thiazide diuretic
Preoperative hypertension	Beta blocker
Benign prostatic hypertrophy	Alpha blocker
Contraindications	
Bronchospastic disease	Beta blocker
Depression	Reserpine
Liver disease	Methyldopa
Pregnancy	ACE inhibitor, angiotensin II receptor antagonist
Second or third degree heart block	Beta blocker, calcium blocker (non-DHP)
May have adverse effect on comorbid conditions	
Depression	Beta blocker, central alpha agonist
Diabetes mellitus	Beta blocker, high dose diuretic
Gout	Diuretic
Liver disease	Labetalol
Renovascular disease	ACE inhibitor, angiotensin II receptor antagonist

D.B. 45 yrs. Male Afrocaribbean

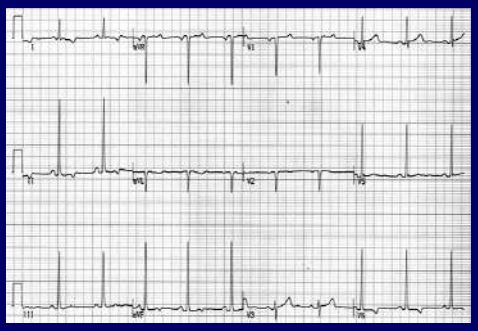
- **Referred by GP for further management:**
  - **–managed for High BP for 12 months.**
  - **–BP difficult to control. 195/115**
  - **–Tired, low libido**
  - **–No CP, SOB, Ankle oedema, Palpitation**
- **CV Risk factors**
  - **–BMI 26**
  - **–Salt in diet +** **-No DM**
  - **–alcohol 2-4 units/night**
  - **–cholesterol ?**
  - **–F/H: Mother had stroke age 68 yrs.**
- **Drug history**
  - **–Atenolol 100 mg**
- **S/H: Lives with family, work as a Postman**

D.B. 45 yrs. Afrocaribbean- Examination

- Exam.: Well, overweight
  - HR: 60 bpm
  - BP: 168/98 (Av. 3 readings)
  - Fundi: I/II high BP changes
  - S1 + loud S2, S4. Other systems were unremarkable.

- Blood: Na: 141 Hb: 15.1 Urine Dipstick -ve
  K: 4.0 WBC: 7.3
  Urea 7
  Cr: 109
  Chol: 5.2

- ECG:



D.B. 45 yrs. Afrocaribbean -Management:

Management:

- Exclude secondary cause

- Life style
  - Diet: high fibre, fruits & veg., fish (Ω-3 fatty acids)
  - Low salt (Na) diet high K
  - Low alcohol
  - Exercise/Weight loss
  - Drug therapy:

- Drug therapy:
  - ACE-I (low renin hypertension – less effective)
  - B Blockers (low renin hypertension – less effective)
  - Ca channel Blockers, thiazide, candesartan

Management of Hypertension. A case-base presentation in the management of primary hypertension and the investigation of secondary causes of hypertension.

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