The High Blood Pressure

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Outline

- Presentations
  - Introduction
  - Definitions
  - Evidence
  - Summary

Case 1

- 35 year old female was referred to your clinic after undergoing screening for employment. Her blood pressure was found to be high (149/93 mmHg). She has no complaints and is otherwise healthy.
- PMH: nil
- Meds: nil
- FHx: High BP in father and brother
- SHx: Single, works as a nurse, smokes shisha once weekly, no illicit drug use.

Case 1

- On physical exam: BMI 25, looks healthy, not in distress
- BP: 145/93, HR: 78
- CVS: S1 + S2 + 0
- Chest: clear
- Abd: Soft, Lax, no bruit
- Rheum and Neuro: normal

Question 1. Is this hypertension?

- A. Yes
- B. No
- C. I don’t know
- D. Other

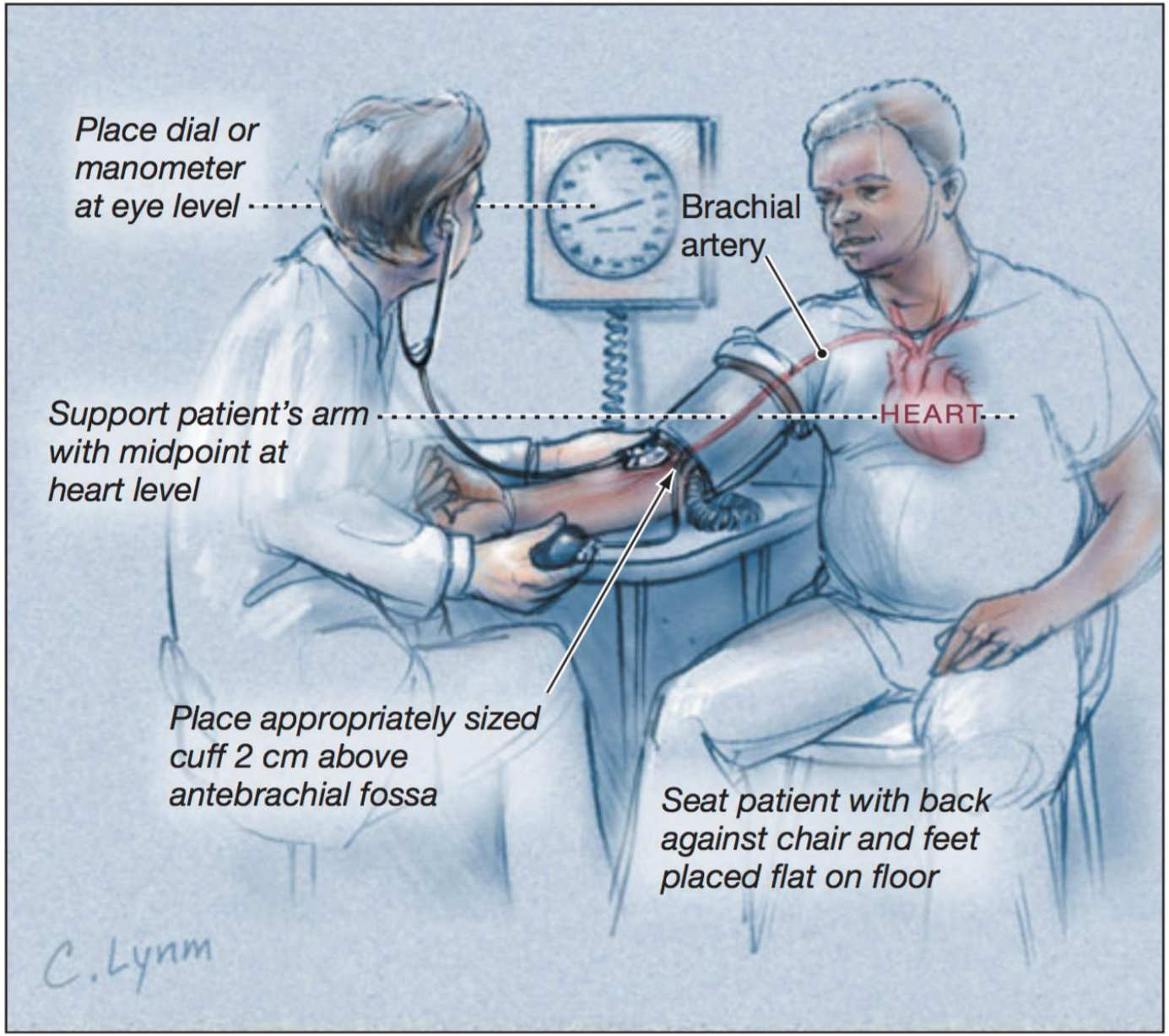


Figure 23-1 Clinical Measurement of Indirect Blood Pressure
See Table 23-2 for appropriate cuff sizing.

Question 2. What is the next step in management?

- A. Repeat blood pressure in 2 weeks
- B. Do a 24 hour ambulatory BP recording
- C. Check electrolytes, urea and creatinine
- D. US kidneys

Epidemiology

- 1 in 3 adults (>20 years old) have high blood pressure
- Incidence goes up with age
- 5 – 10% of all hypertension is secondary
- Searching for secondary hypertension is expensive and cumbersome
- Need better selection of who to screen and offer specific treatments

Reprinted From The Journal of the American Medical Association
December 11, 1967 Volume 202

Effects of Treatment on Morbidity in Hypertension

Results in Patients With Diastolic Blood Pressures Averaging 115 Through 129 mm Hg

Veterans Administration Cooperative Study Group on Antihypertensive Agents

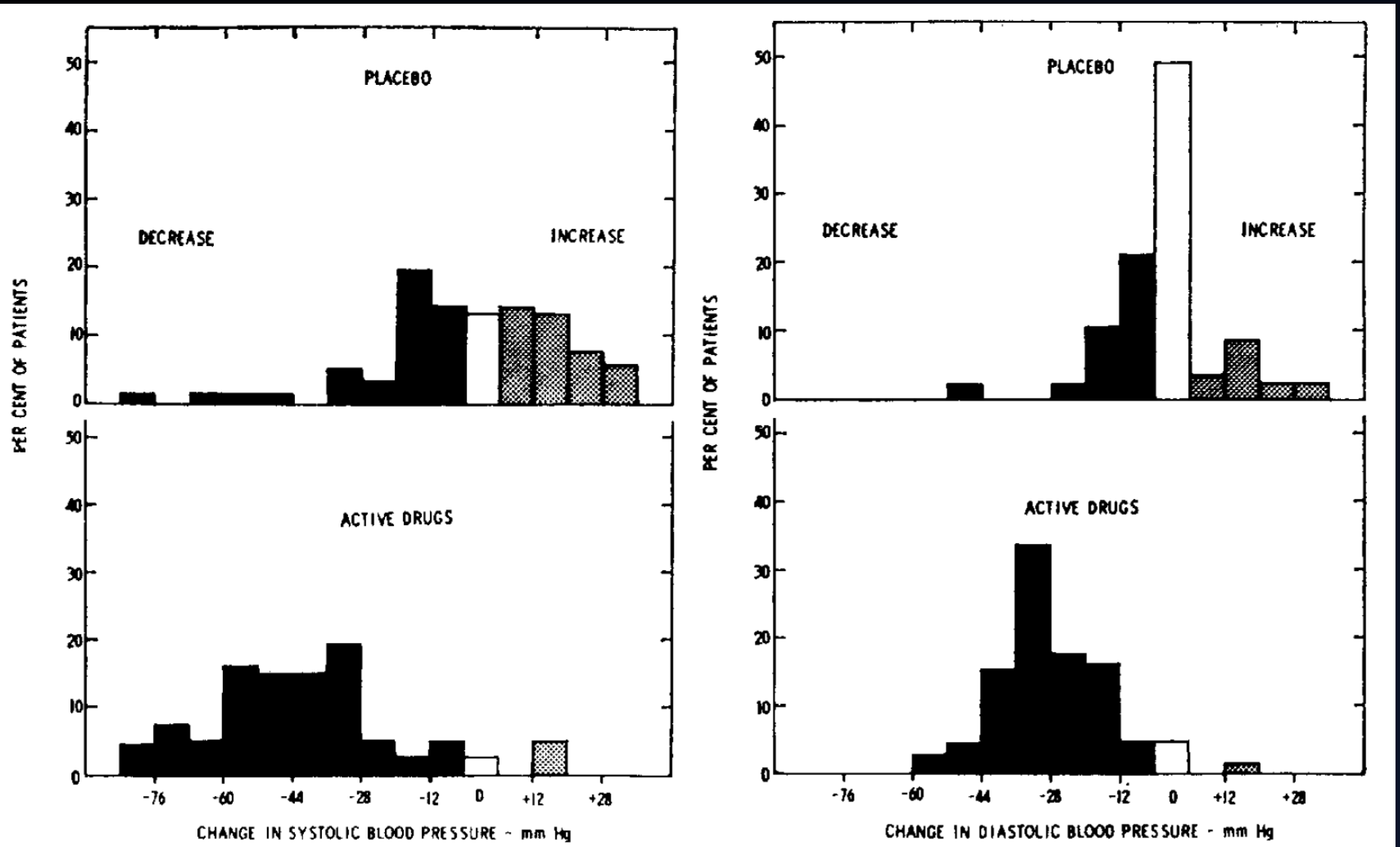
A group of 143 male hypertensive patients with diastolic blood pressures (at the clinic) averaging between 115 and 129 mm Hg were randomly assigned to either active (hydrochlorothiazide plus reserpine plus hydralazine hydrochloride) or placebo treatment. Twenty-seven severe, complicating events developed in the placebo-treated patients as compared to two in the active group. Four deaths occurred in the placebo-treated group and none in the actively treated patients. Other complications in the placebo group included grade 3 or 4 hypertensive retinopathy, congestive heart failure, increasing azotemia, cerebrovascular thrombosis, transient ischemic attacks, cerebral hemorrhage, myocardial infarction, and severely elevated blood pressure. Severe complications in the active-treatment group were one cerebrovascular thrombosis and one case of multiple drug toxicity. Male patients with diastolic blood pressures averaging 115 mm Hg or above represent a high-risk group in which antihypertensive therapy exerts a significant beneficial effect.

without signs of accelerated hypertension at admission whose diastolic blood pressures prior to treatment averaged 115 through 129 mm Hg.

Plan of Investigation

All patients were hospitalized for the initial work-up. Male patients whose diastolic blood pressures from the fourth through the sixth day of hospitalization averaged 90 through 129 mm Hg without treatment were considered for admission to the prerandomization trial period.

Severity was evaluated in five categories. These were the average diastolic blood pressure during hospitalization and the degree of clinically detectable hypertensive damage in the following four target organs: the optic fundi, the brain, heart, and kidneys. Severity of damage in each category was graded on a scale from 0 (no detectable abnormality) to 4 (most severe changes). The criteria used



Changes in systolic (*left*) and diastolic blood pressure (*right*) after four months of treatment in 57 patients given placebos (*above*) and 68 patients treated with hydrochlorothiazide plus reserpine plus hydralazine (*below*).

Modification in Treatment Regimens.—Of the 73

Table 4.—Incidence of Mortality and Morbidity

	Placebo-Treated Patients	Actively Treated Patients
Deaths	4	0
Class A events	10	0
Subtotal	**14**	**0**
Other treatment failures	7	1
Total terminating events	**21**	**1**
Class B events (nonterminating)	6	1
Total	**27**	**2**

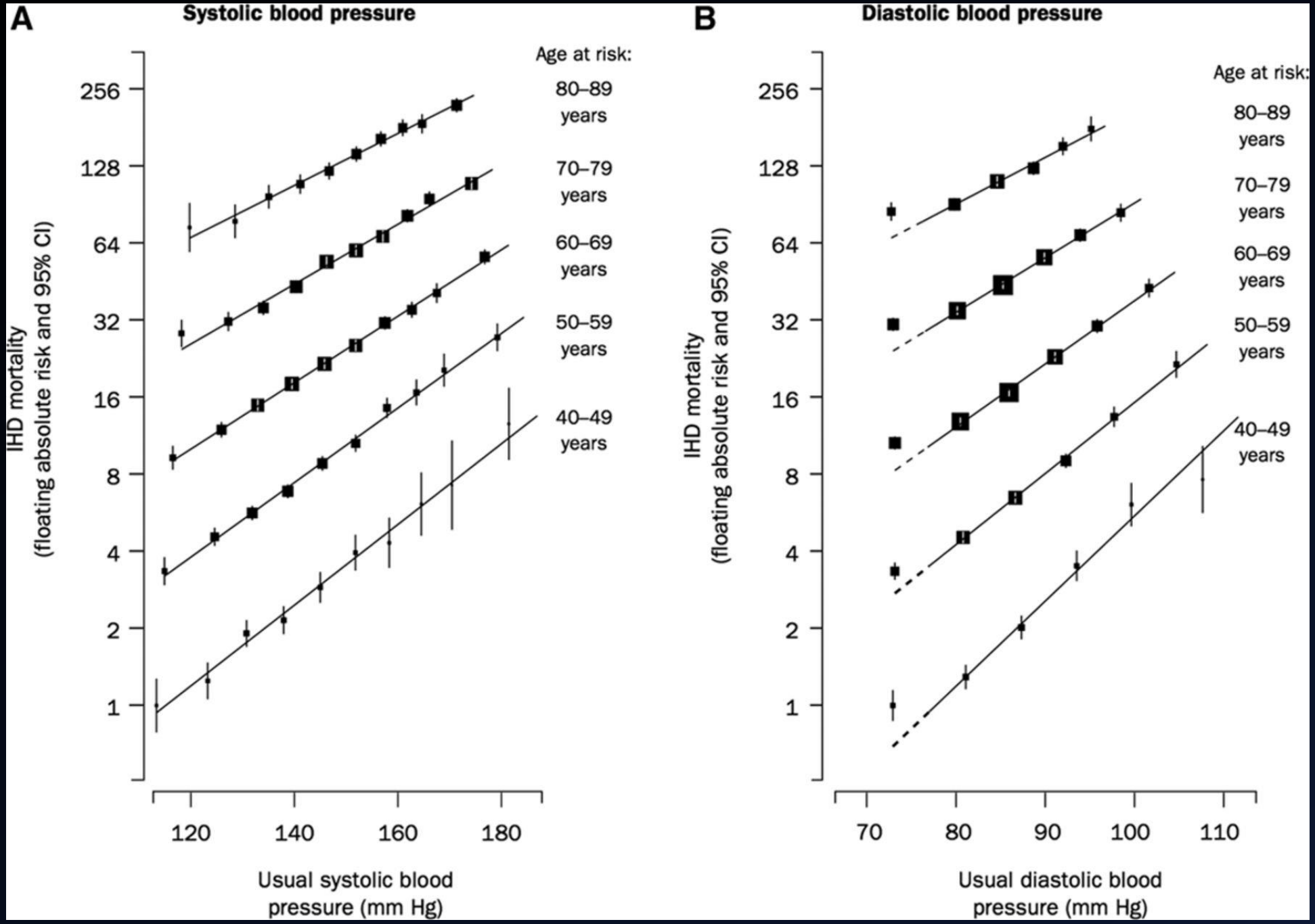
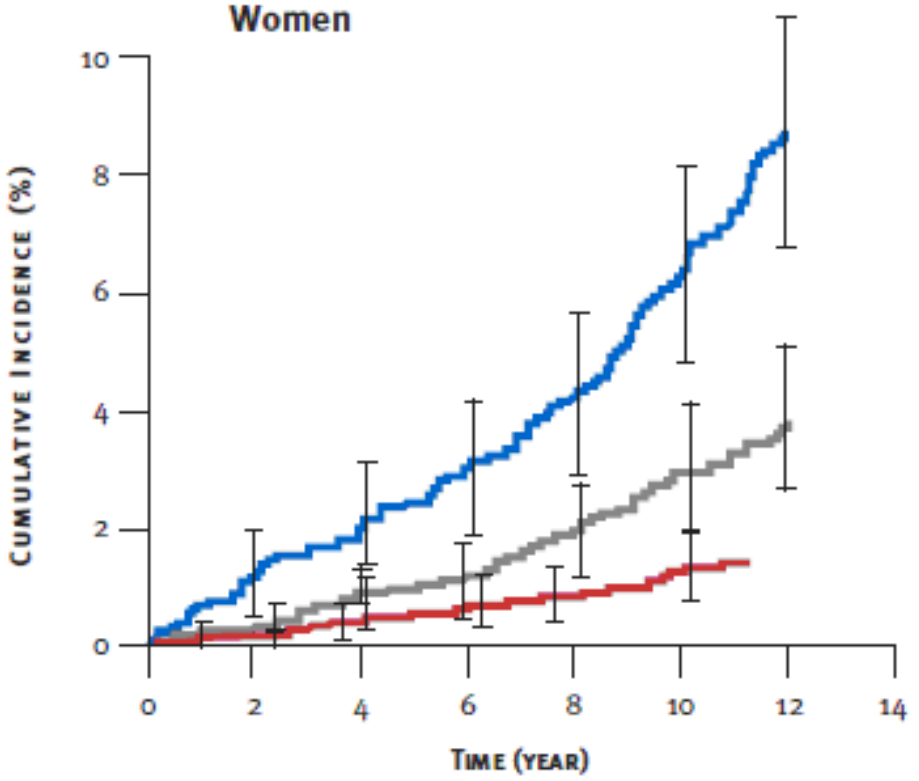
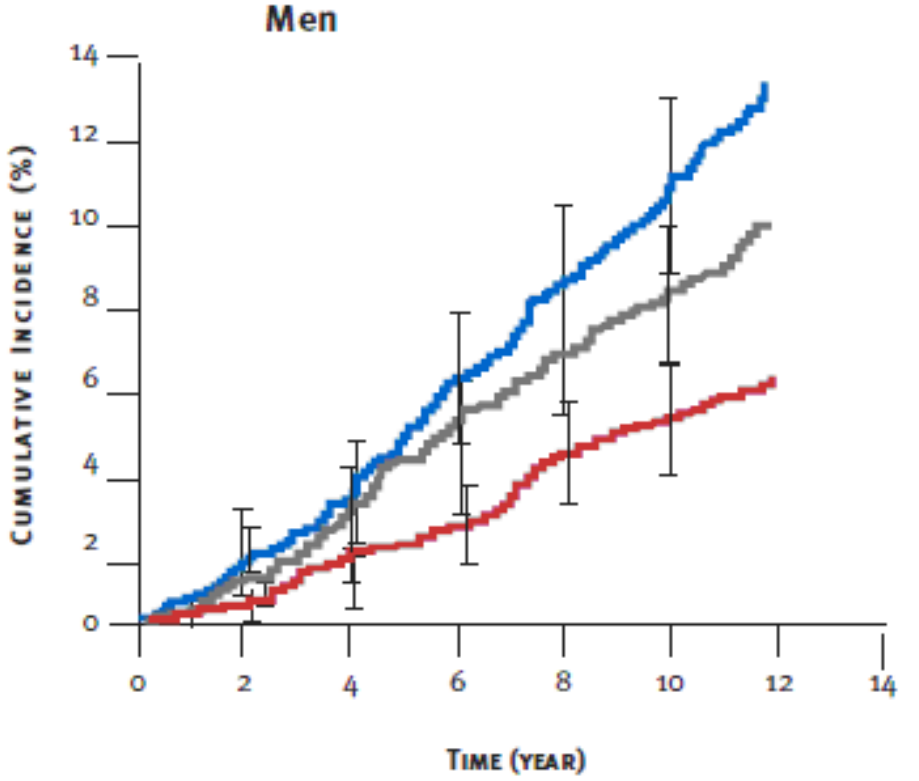

A
Systolic blood pressure
Age at risk:
80–89 years
70–79 years
60–69 years
50–59 years
40–49 years
IHD mortality (floating absolute risk and 95% CI)
256
128
64
32
16
8
4
2
1
120
140
160
180
Usual systolic blood pressure (mm Hg)
B
Diastolic blood pressure
Age at risk:
80–89 years
70–79 years
60–69 years
50–59 years
40–49 years
IHD mortality (floating absolute risk and 95% CI)
256
128
64
32
16
8
4
2
1
70
80
90
100
110
Usual diastolic blood pressure (mm Hg)

Figure 11. **Impact of high normal blood pressure on the risk of cardiovascular disease**





Number at Risk

Optimal	1,875	1,867	1,851	1,839	1,821	1,734	887
Normal	1,126	1,115	1,097	1,084	1,061	974	649
High normal	891	874	859	840	812	722	520

Number at Risk

Optimal	1,005	995	973	962	934	892	454
Normal	1,059	1,039	1,012	982	952	892	520
High normal	903	879	857	819	795	726	441

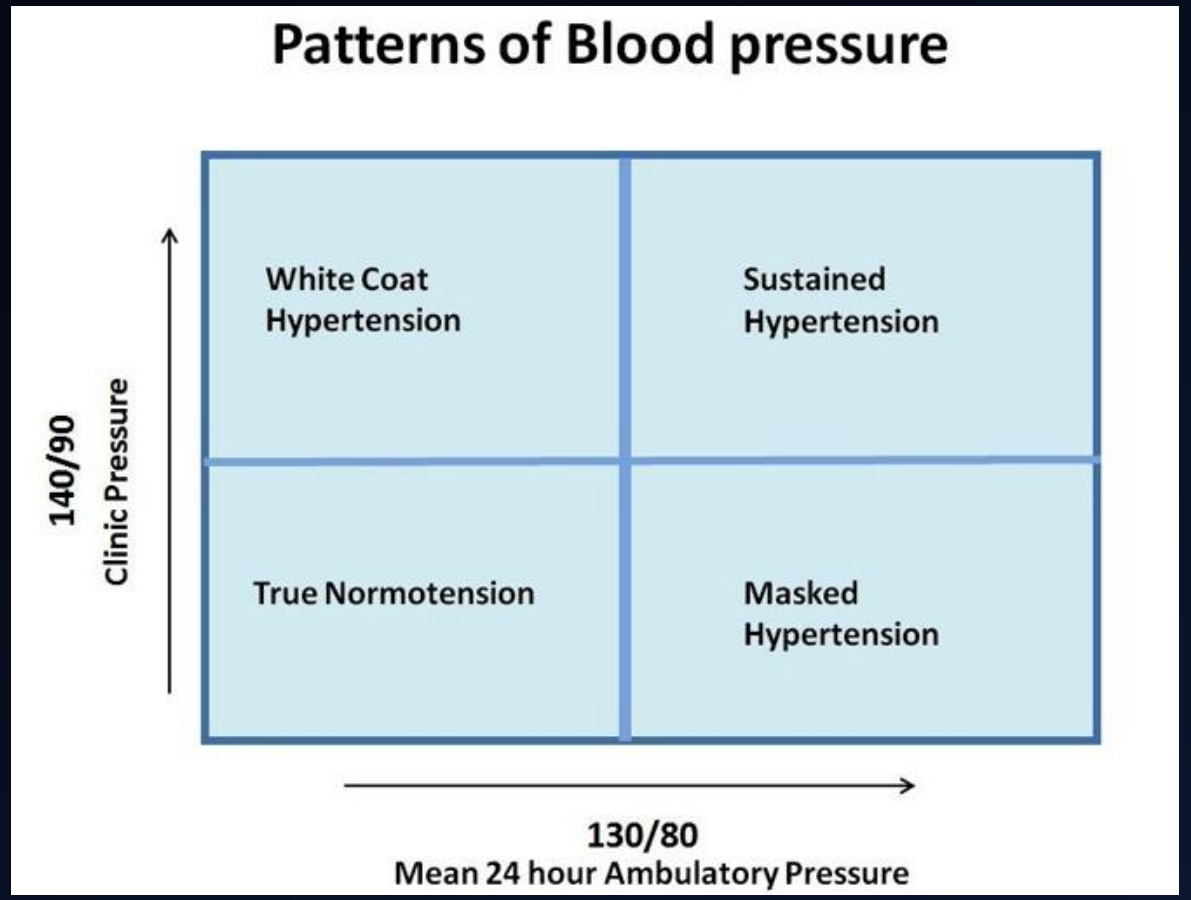
High Normal Normal Optimal

Cumulative incidence of cardiovascular events in women (panel A) and men (panel B) without hypertension, according to blood pressure category at the base-line examination. Vertical bars indicate 95 percent confidence intervals. Optimal BP is defined here as a systolic pressure of <120 mmHg and a diastolic pressure of <80 mmHg. Normal BP is a systolic pressure of 120–129 mmHg or a diastolic pressure of 80–84 mmHg. High-normal BP is a systolic pressure of 130–139 mmHg or a diastolic pressure of 85–89 mmHg. If the systolic and diastolic pressure readings for a subject were in different categories, the higher of the two categories was used.

Source: Vasan RS, et al. Impact of high-normal blood pressure on risk of cardiovascular disease. N Engl J Med *2001;345:1291–7.*

Hypertension definitions

- Prehypertension
- Hypertension
  - Stages
  - Urgency
  - Emergency
- White Coat syndrome
- Masked Hypertension



Criteria for HTN diagnosis

Table 3

Thresholds values for office, home and ambulatory blood pressure measurement

Category	Systolic (mmHg)	Diastolic (mmHg)
Office BP	≥140	≥90
Home BP	≥135	≥85
Ambulatory BP		
24 h	≥130	≥80
Daytime (or awake)	≥135	≥85
Nighttime (or asleep)	≥120	≥70

Ambulatory BP measurement

1.2.2 If blood pressure measured in the clinic is 140/90 mmHg or higher:

- Take a second measurement during the consultation.
- If the second measurement is substantially different from the first, take a third measurement.

  Record the lower of the last two measurements as the clinic blood pressure. **[2011]**

1.2.3 If the clinic blood pressure is 140/90 mmHg or higher, offer ambulatory blood pressure monitoring (ABPM) to confirm the diagnosis of hypertension. **[2011]**

1.2.4 If a person is unable to tolerate ABPM, home blood pressure monitoring (HBPM) is a suitable alternative to confirm the diagnosis of hypertension. **[2011]**

NICE

Ambulatory BP measurement

Table 4.4 Recommendations on methods of blood pressure measurement

Methods of measuring blood pressure	Grade of recommendation	Level of evidence
a. If clinic blood pressure is ≥140/90 mmHg, or hypertension is suspected, ambulatory and/or home monitoring should be offered to confirm the blood pressure level.	Strong	I
b. Clinic blood pressure measures are recommended for use in absolute CVD risk calculators. If home or ambulatory blood pressure measures are used in absolute CVD risk calculators, risk may be inappropriately underestimated.	Strong	–
c. Procedures for ambulatory blood pressure monitoring should be adequately explained to patients. Those undertaking home measurements require appropriate training under qualified supervision.	Strong	I
d. Finger and/or wrist blood pressure measuring devices are not recommended.	Strong	–

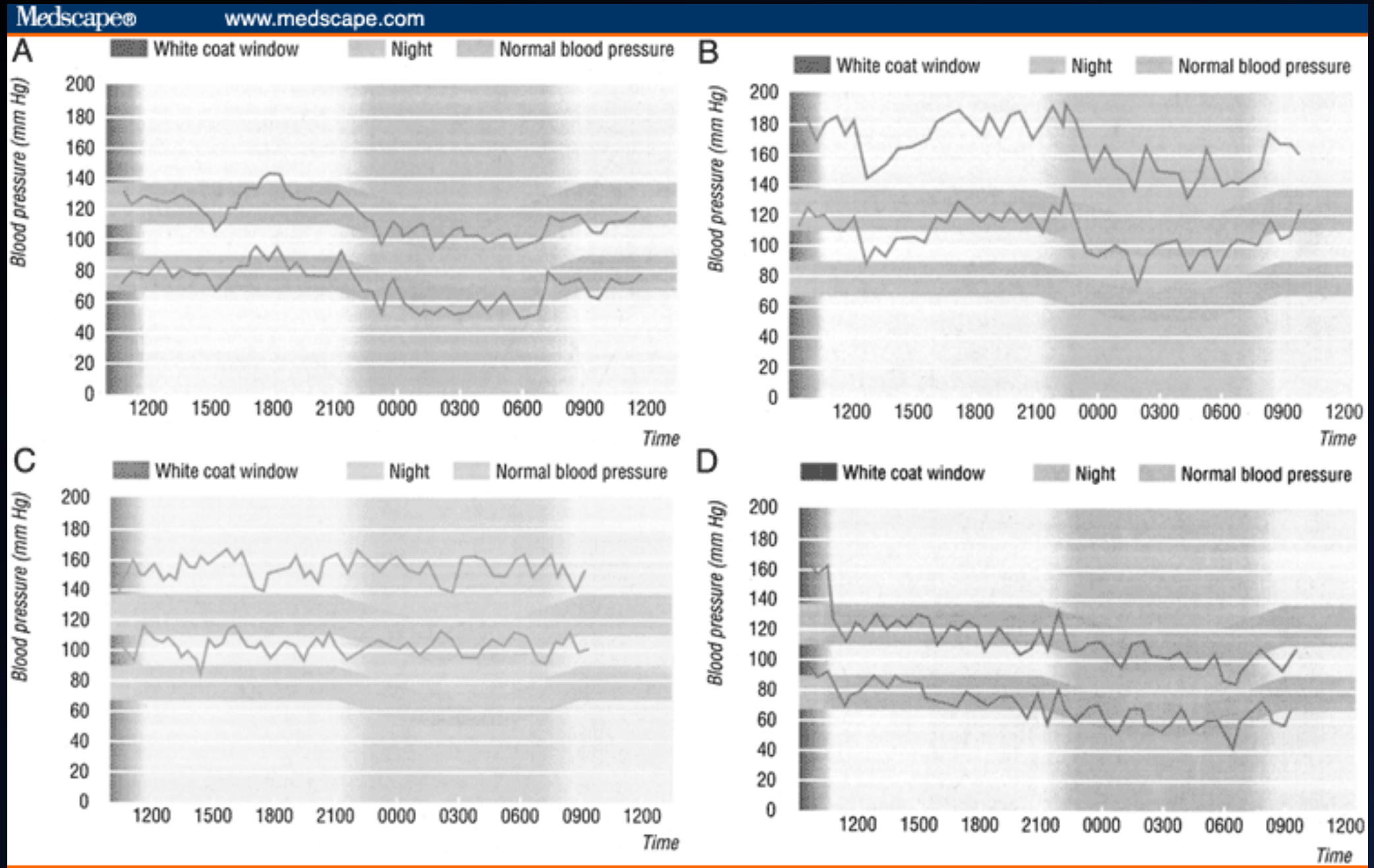
Australian

Ambulatory BP

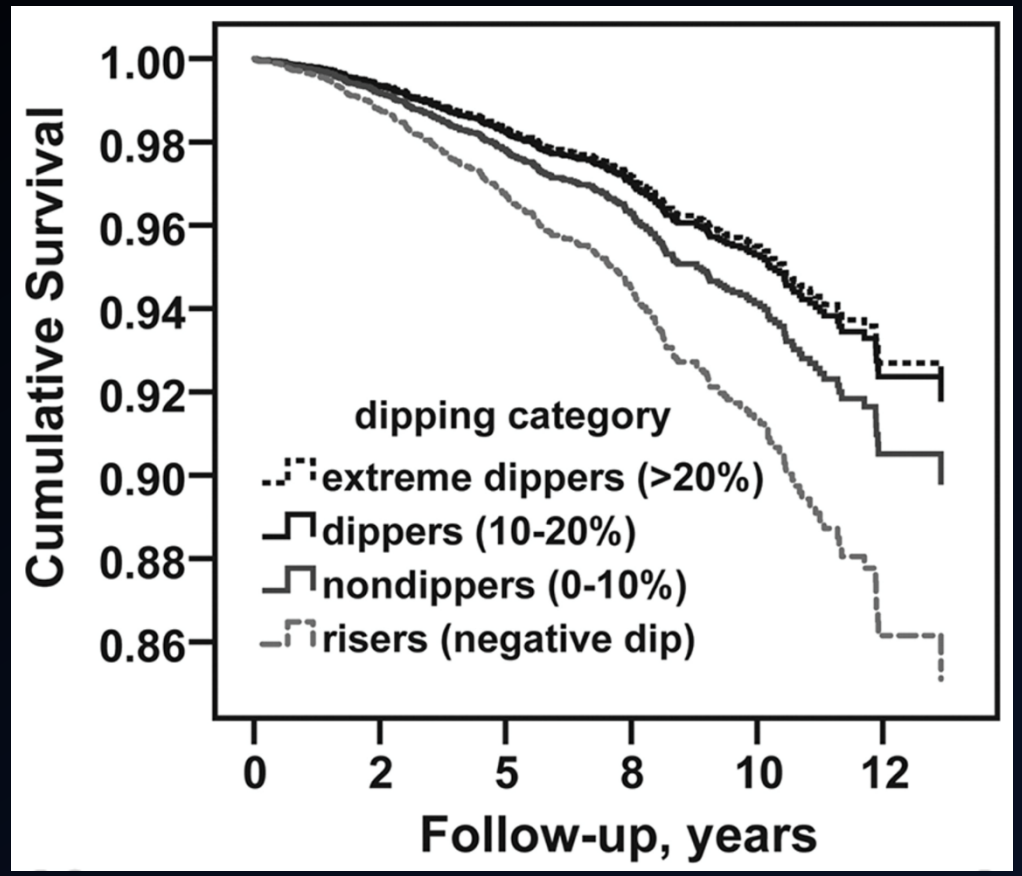
Table 4.2 Clinical indications for out-of-clinic blood pressure measurements

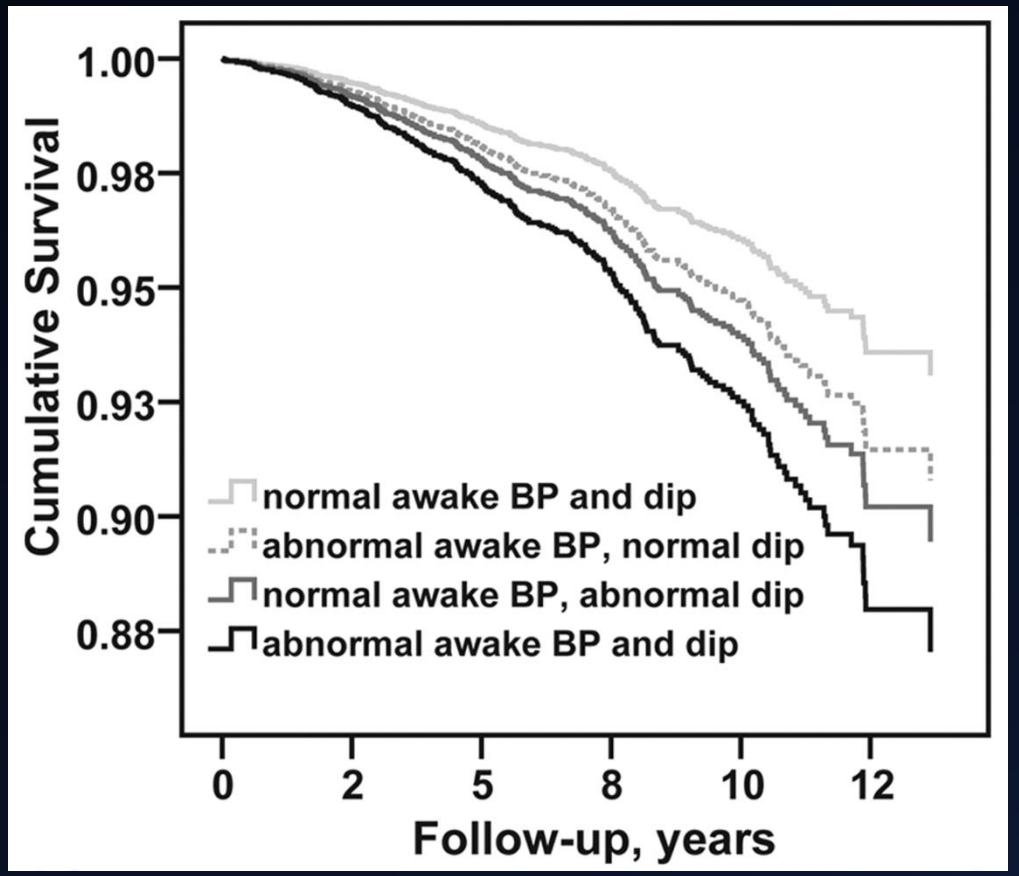
Clinical indications for out-of-clinic blood pressure measurements
Suspicion of white-coat hypertension
Suspicion of masked hypertension
Identified white-coat hypertension
Marked variability of clinic or clinic and home blood pressure measurements
Autonomic, postural, post-prandial and drug-induced hypotension
Identification of true resistant hypertension
Suspicion of nocturnal hypertension or absence of nocturnal dipping, for example in patients with sleep apnoea, chronic kidney disease or diabetes

Table adapted with permission from European Society of Hypertension guidelines[25] and Ambulatory blood pressure monitoring in Australia: 2011 consensus position statement.[23]


Medscape®
www.medscape.com
A
White coat window
Night
Normal blood pressure
Blood pressure (mm Hg)
200
180
160
140
120
100
80
60
40
20
0
1200
1500
1800
2100
0000
0300
0600
0900
1200
Time
B
White coat window
Night
Normal blood pressure
Blood pressure (mm Hg)
Time
C
White coat window
Night
Normal blood pressure
Blood pressure (mm Hg)
Time
D
White coat window
Night
Normal blood pressure
Blood pressure (mm Hg)
Time
Source: South Med J © 2003 Lippincott Williams & Wilkins

Nocturnal Blood pressure





Secondary HTN

Table I **Overview of the most common causes for secondary hypertension**

Secondary cause	Prevalence[a]	Prevalence[b]	History	Screening	Clinical findings	Laboratory findings
Obstructive sleep apnoea	>5–15%	>30%	Snoring, daytime sleepiness, morning headache, irritability	Screening questionnaire; polysomnography	↑ neck circumference; obesity; peripheral oedema	Not specific
Renal parenchymal disease	1.6–8.0%	2–10%	Loss of good BP-control; diabetes; smoking; generalized atherosclerosis; previous renal failure; nocturia	Creatinine, ultrasound of the kidney	Peripheral oedema; pallor; loss of muscle mass	↑ Creatinine, proteinuria; ↓ Ca^{2+}, ↑ K^{+}, ↑ PO_4
Renal artery stenosis	1.0–8.0%	2.5–20%	Generalized atherosclerosis; diabetes; smoking; recurrent flush pulmonary oedema	Duplex, or CT, or MRI, or angiography (drive by)	Abdominal bruits; peripheral vascular disease;	Secondary aldosteronism: ARR →; ↓ K^{+}; ↓ Na^{+}
Primary aldosteronism	1.4–10%	6–23%	Fatigue; constipation; polyuria, polydipsia	Aldosterone–renin ratio (ARR)	Muscle weakness	↓ K^{+}; ARR ↑
Thyroid disease	1–2%	1–3%	*Hyperthyreoidism*; palpitations, weight loss, anxiety, heat intolerance; *Hypothyreodism*; weight gain, fatigue, obstipation	TSH	*Hyperthyreodism*: tachycardia, AF; accentuated heart sounds; exophthalmus; *Hypothyreodism*; Bradycardia; muscle weakness; myxoedema	*Hyperthyreodism*: TSH↓; fT4 and/or fT3 ↑; *Hypothyreodism*: TSH ↑; fT4 ↓; cholesterol ↑
Cushing's Syndrome	0.5%	<1.0%	Weight gain; impotence; fatigue; psychological changes; polydypsia and polyuria	24 h urinary cortisol; dexamethasone testing	Obesity, hirsutism, skin atrophy, Striae rubrae, muscle weakness, osteopenia	24 h urinary; cortisol ↑; Glucose↑; Cholesterol ↑; K^{+}↓
Phaeochromocytoma	0.2–0.5%	<1%	Headache; palpitations; flushing; anxiety	Plasma-metanephrines; 24 h urinary catecholamine	The 5 'Ps'[c]: paroxysmal hypertension; pounding headache; perspiration; palpitations; pallor	metanephrines ↑
Coarctation of the aorta	<1%	<1%	Headache; nose bleeding; leg weakness or claudicatio	Cardiac ultrasound	Different BP (≥20/10 mmHg) between upper–lower extremities and/or between right–left arm; ↓ and delayed femoral pulsations; interscapular ejection murmur; rib notching on chest Rx	Not specific

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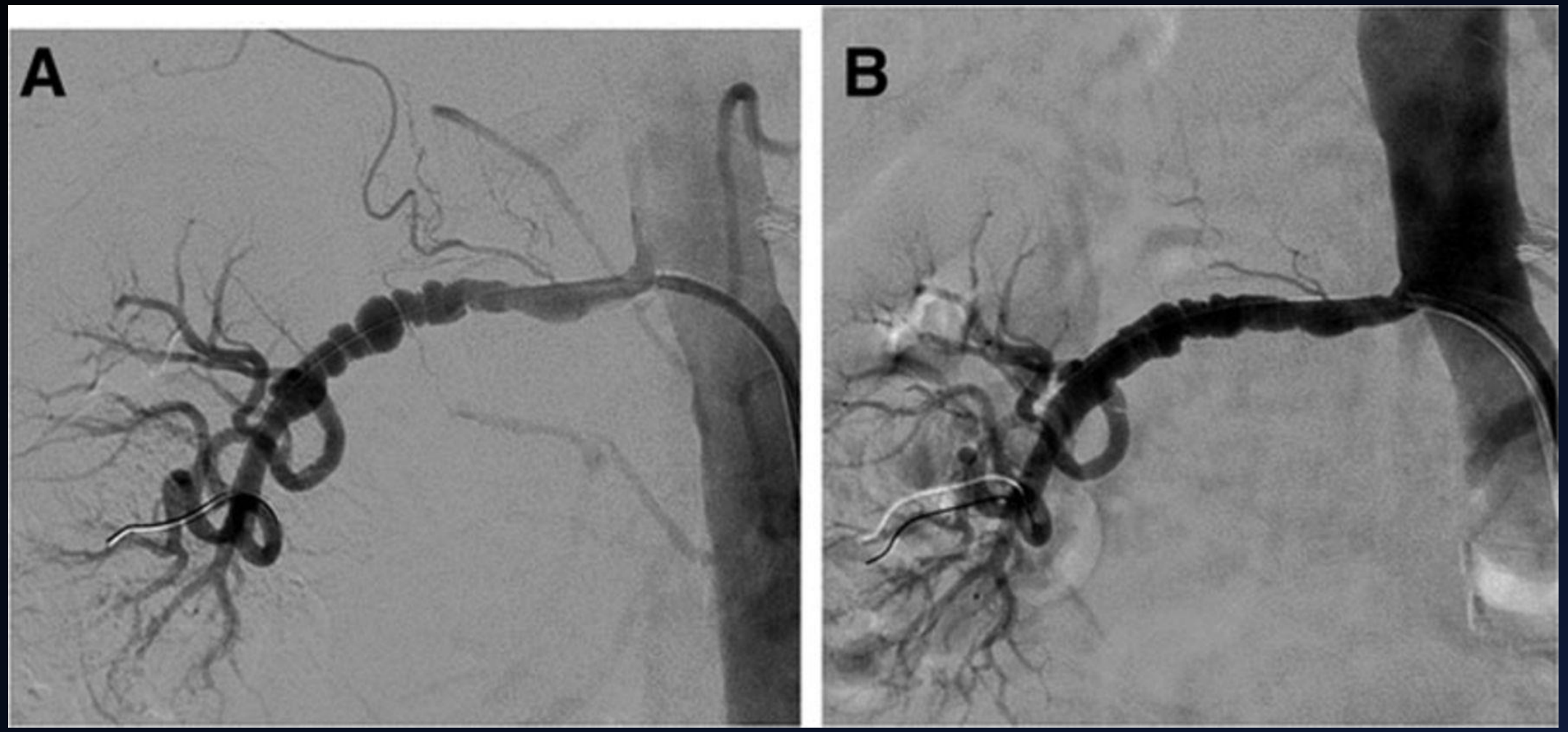
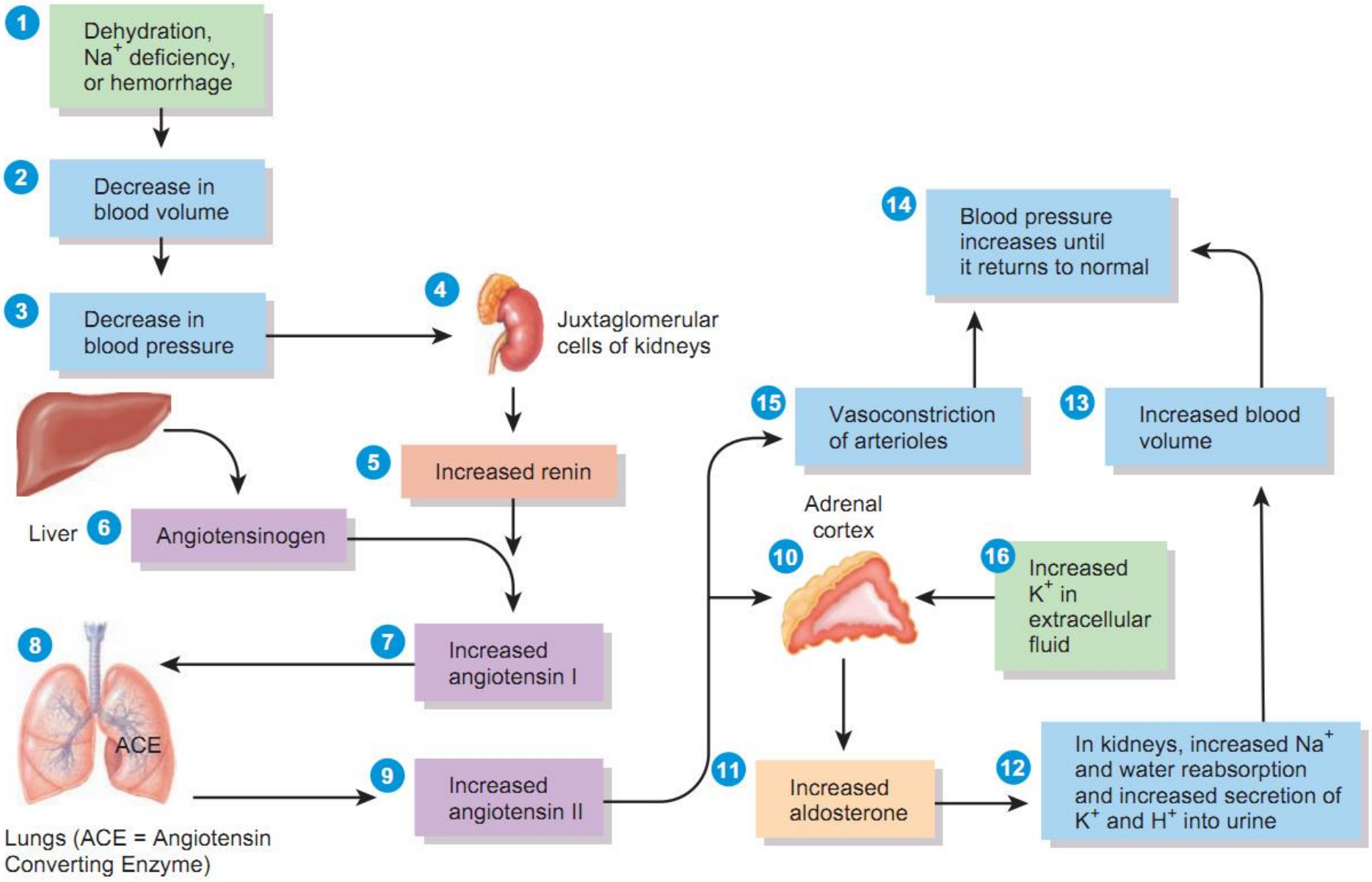


Regulation of aldosterone secretion by the renin–angiotensin–aldosterone (RAA) pathway.

Aldosterone helps regulate blood volume, blood pressure, and levels of Na^+, K^+, and H^+ in the blood.



Case 1

- 35 F, BP 149/98 mmHg, FHx father, brother. No significant PMHx
- Labs: CBC normal, Urea 4, Cr 56, Na 143, K 3.1, Cl 89, HCO3 30
- LFT Normal, TSH Normal
- US Kidneys: R kidney 11.2 cm, L kidney 12 cm, Dopplers Normal renal artery flow

ARR

Table 2. Conditions That May Affect the Aldosterone-Renin Ratio (ARR)[a]

Condition	Effect on PAC	Effect on PRA	Overall Effect on the ARR
Hypokalemia	Decreased	May be increased	Decreased
Potassium loading	Increased	May be decreased	Increased
Sodium restriction	Increased	Increased	Increased
Sodium loading	Decreased	Decreased	Decreased
Advanced age	Decreased	Decreased	Decreased
Renal impairment	Unchanged	Decreased	Increased
Pregnancy	Increased	Increased	Decreased
Luteal phase of menstrual cycle	Increased	Unchanged	Increased

ARR

Table. Impact of Medications on the Aldosterone/Renin Ratio (ARR)[1]

False-positive ARR	False-negative ARR
β-Adrenergic blockers	Potassium-wasting or -sparing diuretics
Central α2 agonists (eg, clonidine, α-methyldopa)	ACE inhibitors
NSAIDs	Angiotensin II type 1 receptor blockers
Renin inhibitors	Calcium blockers (eg, dihydropyridine)

NSAIDs, nonsteroidal anti-inflammatory drugs; ACE, angiotensin-converting enzyme.

ARR results should be interpreted in light of the patient's age, sample collection conditions (eg, time of day, posture and length of time in that posture, sodium and potassium status, and medications being taken), as well as the patient's clinical history.

PA Confirmatory tests

- Try to inhibit Aldosterone (demonstrate that it is regulated)
  - Oral salt loading (1 g po od x3days)
  - NS infusion (500 ml)
  - Captopril challenge
  - Fludrocortisone + Na

PA testing

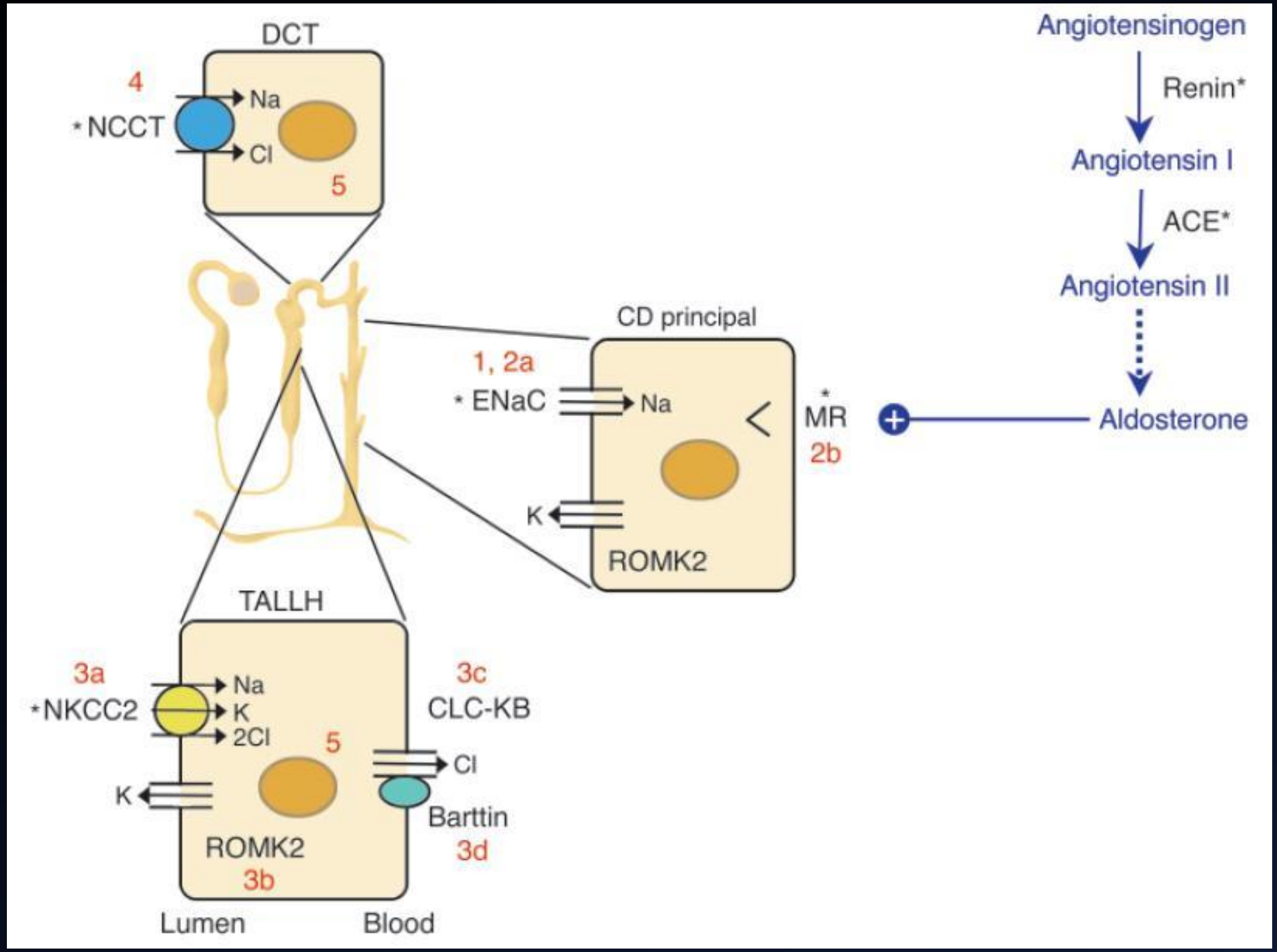
- Imaging
- Venous sampling

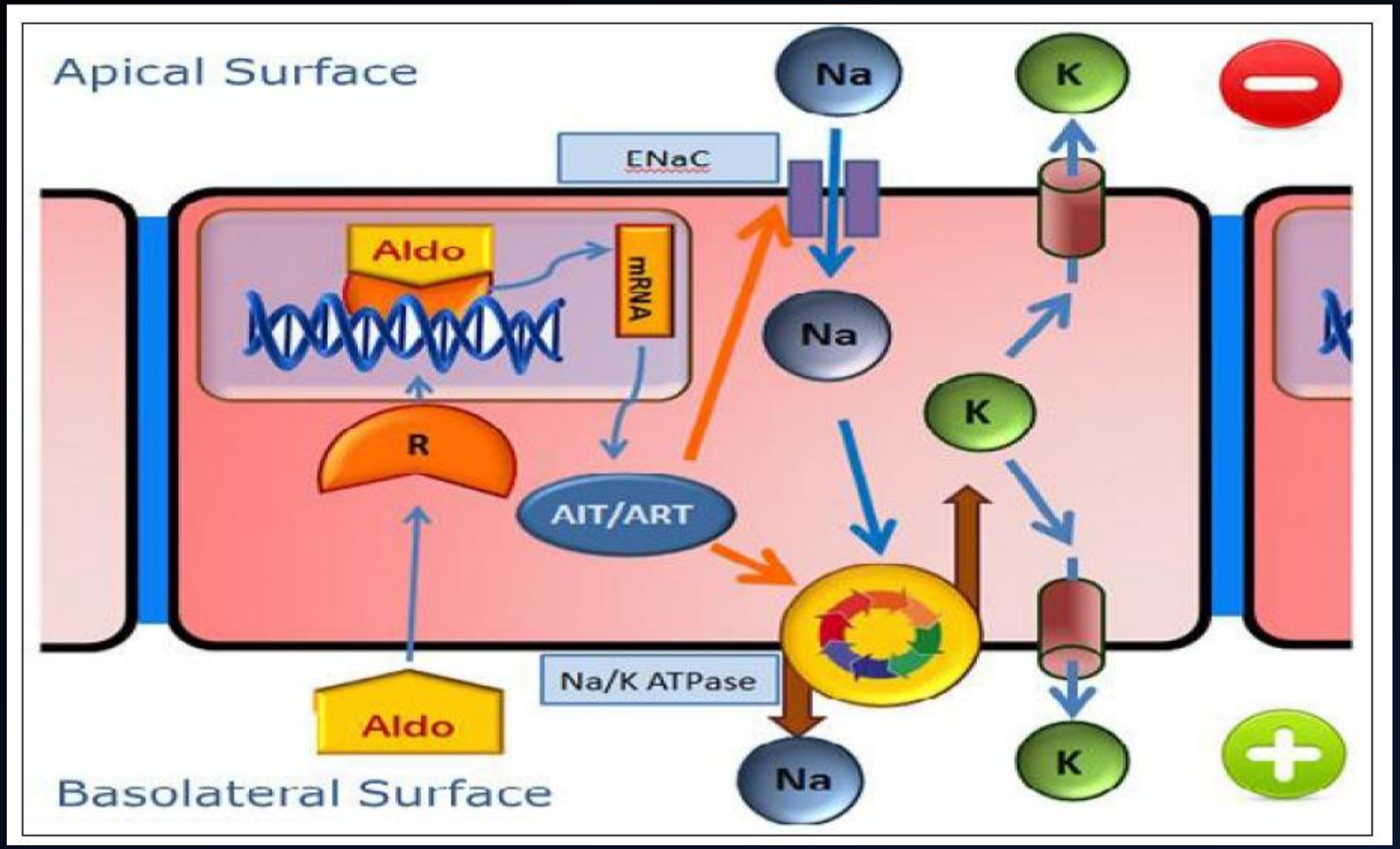
Case 1

- Results:
  - Low Aldosterone
  - Low Renin
  - CT Abdomen: No adenoma, normal adrenal glands
  - What to do next?

Case 1

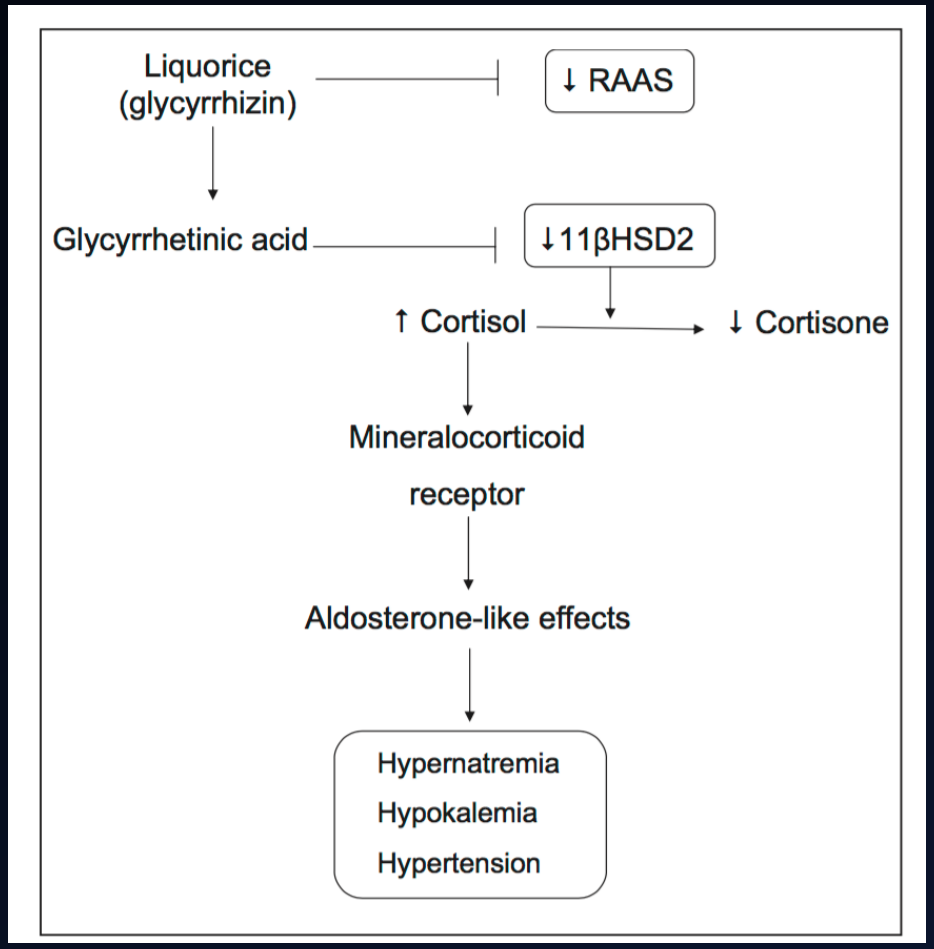
- 24 hour K excretion: high


DCT
4
*NCCT
Na
Cl
5
CD principal
1, 2a
*ENaC
Na
K
ROMK2
*MR
2b
Angiotensinogen
Renin*
Angiotensin I
ACE*
Angiotensin II
Aldosterone
TALLH
3a
*NKCC2
Na
K
2Cl
5
K
ROMK2
3b
3c
CLC-KB
Cl
Barttin
3d
Lumen
Blood


Apical Surface
Na
K
ENaC
Aldo
mRNA
Na
K
R
AIT/ART
Na/K ATPase
Aldo
Na
K
Basolateral Surface

Liqorice

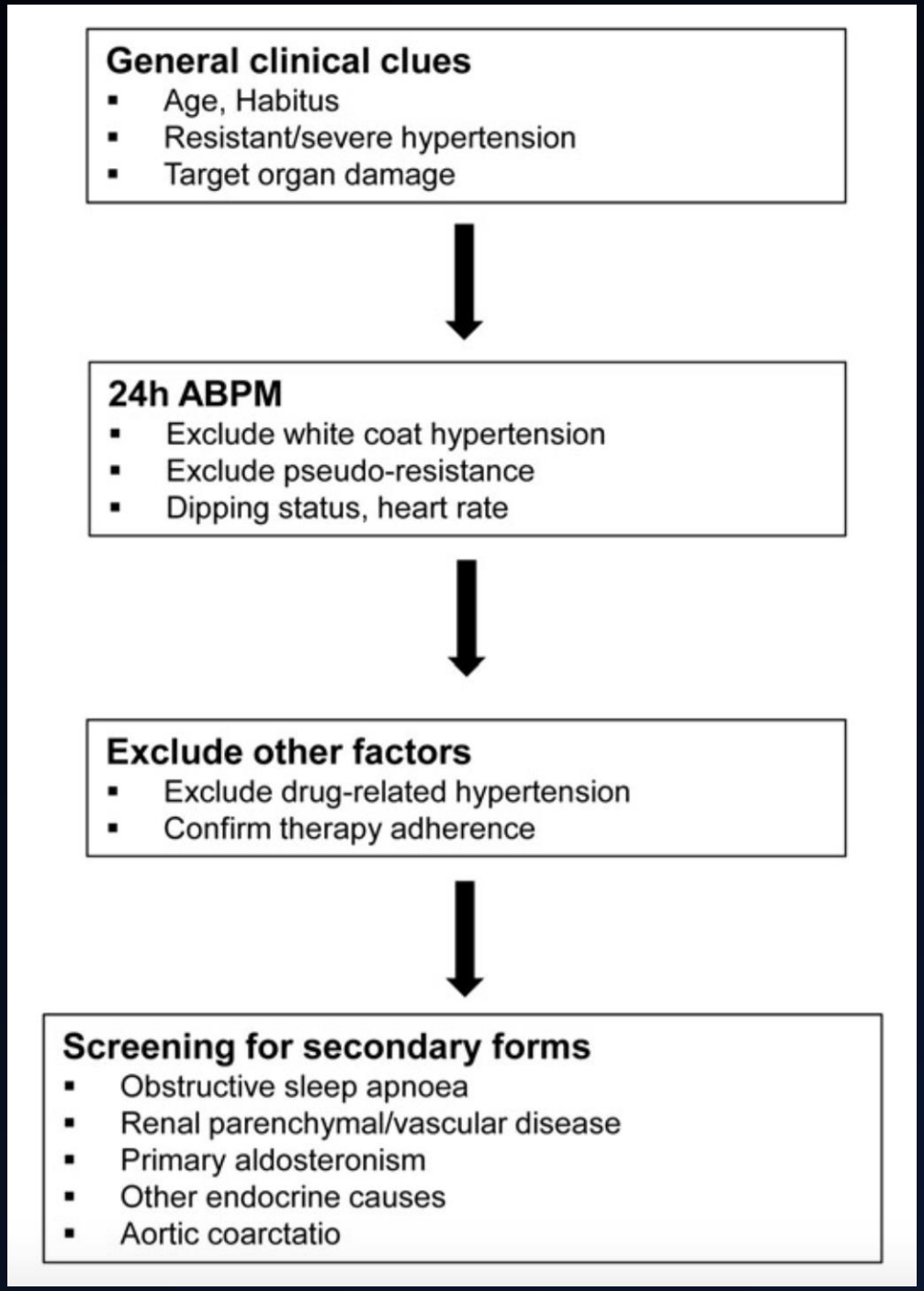

L.M. GOOD
Fruits of the Harvest
Old Fashion
RED LICORICE
Nutrition Facts
I.M. GOOD, INC.
CANTON, OHIO 44706
www.imgoodsnacks.com
Net Wt. 14 Oz. (397g)


Liquorice (glycyrrhizin)
↓ RAAS
Glycyrrhetinic acid
↓11βHSD2
↑ Cortisol
↓ Cortisone
Mineralocorticoid receptor
Aldosterone-like effects
Hypernatremia
Hypokalemia
Hypertension

Treatment?

- Block ENaC

Summary


General clinical clues
Age, Habitus
Resistant/severe hypertension
Target organ damage
24h ABPM
Exclude white coat hypertension
Exclude pseudo-resistance
Dipping status, heart rate
Exclude other factors
Exclude drug-related hypertension
Confirm therapy adherence
Screening for secondary forms
Obstructive sleep apnoea
Renal parenchymal/vascular disease
Primary aldosteronism
Other endocrine causes
Aortic coarctatio

Summary

General clinical characteristics suggestive of secondary hypertension
Early onset of hypertension (i.e. <30 years) in patients without other risk factors (i.e. family history, obesity, etc.); increased BP in prepubertal children
Resistant hypertension (>140/90 mmHg despite three antihypertensive drugs including a diuretic)
Severe hypertension (>180/110 mmHg) or hypertensive emergencies
Sudden increase of BP in a previously stable patient
Non-dipping or reverse dipping during 24 h ambulatory BP monitoring
Presence of target organ damage (i.e. LVH, hypertensive retinopathy, etc.)