

# Hypertension

**Miklós Fagyas, M.D. PhD. MSc.**

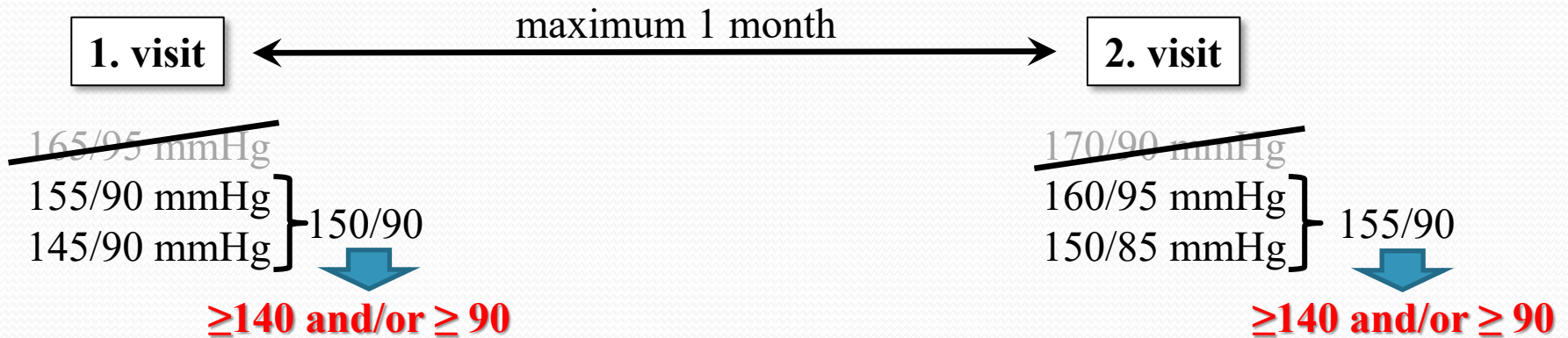
**University of Debrecen**

**Department of Cardiology**

**Division of Clinical Physiology**

# Hypertension

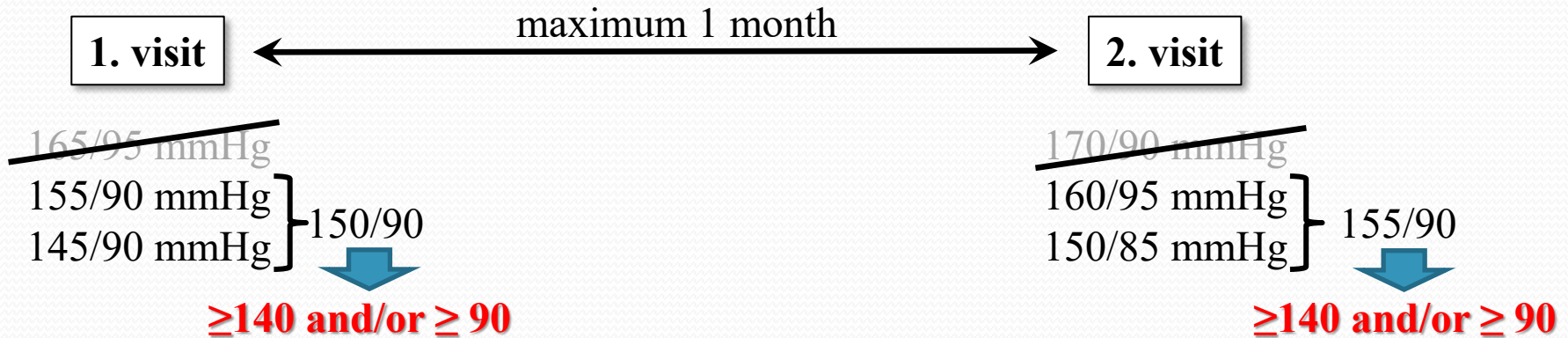
## Definition/diagnostics\*



\* Guideline of The Hungarian Society of Hypertension, Hypertonia és Nephrologia, 2025;29(Suppl. 4) S1-64.

# Hypertension

## Definition/diagnostics\*



Category	Systolic (mmHg)		Diastolic (mmHg)
<b>Optimal blood pressure</b>	< 120	and	< 80
<b>Normal blood pressure</b>	120 - 129	and	80 - 84
<b>High-normal blood pressure</b>	130 - 139	and / or	85 - 89
<b>Grade 1 hypertension</b>	140 - 159	and / or	90 - 99
<b>Grade 2 hypertension</b>	160 - 179	and / or	100 - 109
<b>Grade 3 hypertension</b>	≥ 180	and / or	≥ 110
<b>Isolated systolic hypertension</b>	≥ 140	and	< 90
<b>Isolated diastolic hypertension</b>	< 140	and	≥ 90

# WARNING!

Whelton PK, et al.

2017 High Blood Pressure Clinical Practice Guideline

## 2017 ACC/AHA/AAPA/ABC/ACPM/AGS/APhA/ASH/ASPC/NMA/PCNA Guideline for the Prevention, Detection, Evaluation, and Management of High Blood Pressure in Adults

A Report of the American College of Cardiology/American Heart Association Task Force on  
Clinical Practice Guidelines

**Table 6. Categories of BP in Adults\***

BP Category	SBP		DBP
Normal	<120 mm Hg	and	<80 mm Hg
Elevated	120–129 mm Hg	and	<80 mm Hg
<b>Hypertension</b>			
Stage 1	130–139 mm Hg	or	80–89 mm Hg
Stage 2	≥140 mm Hg	or	≥90 mm Hg

\*Individuals with SBP and DBP in 2 categories should be designated to the higher BP category.

BP indicates blood pressure (based on an average of ≥2 careful readings obtained on ≥2 occasions, as detailed in Section 4); DBP, diastolic blood pressure; and SBP systolic blood pressure.

Please cite this article as: Whelton PK, Carey RM, Aronow WS, Casey Jr DE, Collins KJ, Dennison Himmelfarb C, DePalma SM, Gidding S, Jamerson KA, Jones DW, MacLaughlin EJ, Munther P, Ovbigele B, Smith Jr SC, Spencer CC, Stafford RS, Taler SJ, Thomas RJ, Williams Sr KA, Williamson JD, Wright Jr JT, 2017 ACC/AHA/AAPA/ABC/ACPM/AGS/APhA/ASH/ASPC/NMA/PCNA Guideline for the Prevention, Detection, Evaluation, and Management of High Blood Pressure in Adults, *Journal of the American College of Cardiology* (2017), doi: 10.1016/j.jacc.2017.11.006.

# Epidemiology

**Prevalence:** 30-45 % in the population (~1.28 billion patients)  
35 % in the Hungarian adult population  
2.5 % in the Hungarian adolescent population

## **Significance:**

- +1 mmHg increase of BP → +1.5% excess in cardiovascular mortality.
- HT causes 58% of coronary heart disease, and 75-90% of stroke.
- Effective HT treatment can reduce cardiovascular mortality by 21%.
- Lowering systolic blood pressure (SBP) by 10 mmHg would reduce the relative risk of stroke by 30%.

# Types of Hypertension

```
graph TD; A[Types of Hypertension] --> B[Essential]; A --> C[Secondary]; B --- D((85-95%)); C --- E((5-15%)); D --- F["A general practice includes ~ 1800 individuals"]; F --> G["~630 hypertensive patients"]; G --> H["~567 patients suffer from essential hypertension"]; E --- I["A general practice includes ~ 1800 individuals"]; I --> J["~630 hypertensive patients"]; J --> K["~63 patients suffer from secondary hypertension"];
```

## Essential

85-95%

A general practice includes ~ 1800 individuals

↓  
~630 hypertensive patients

↓  
~567 patients suffer from essential hypertension

## Secondary

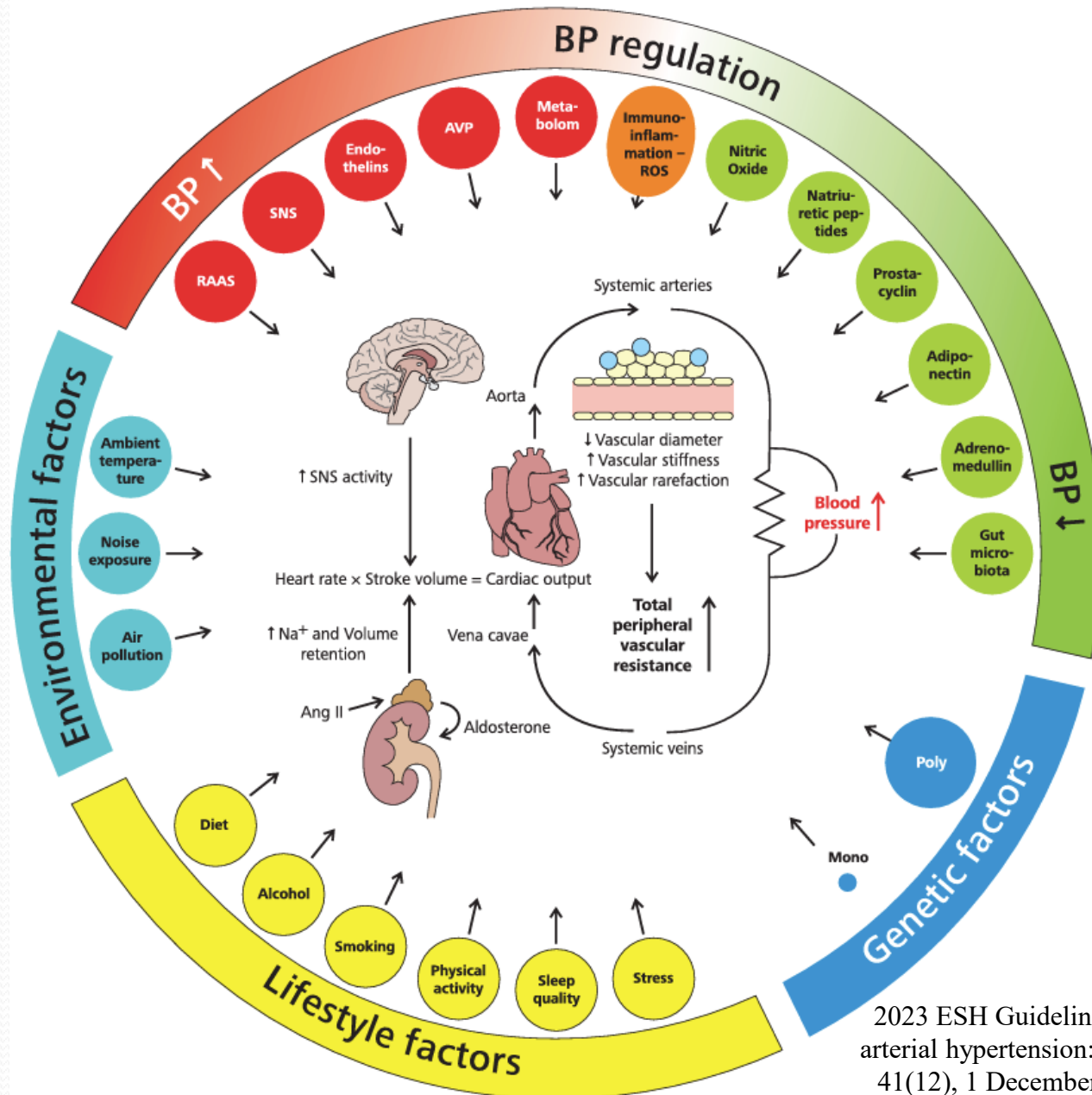
5-15%

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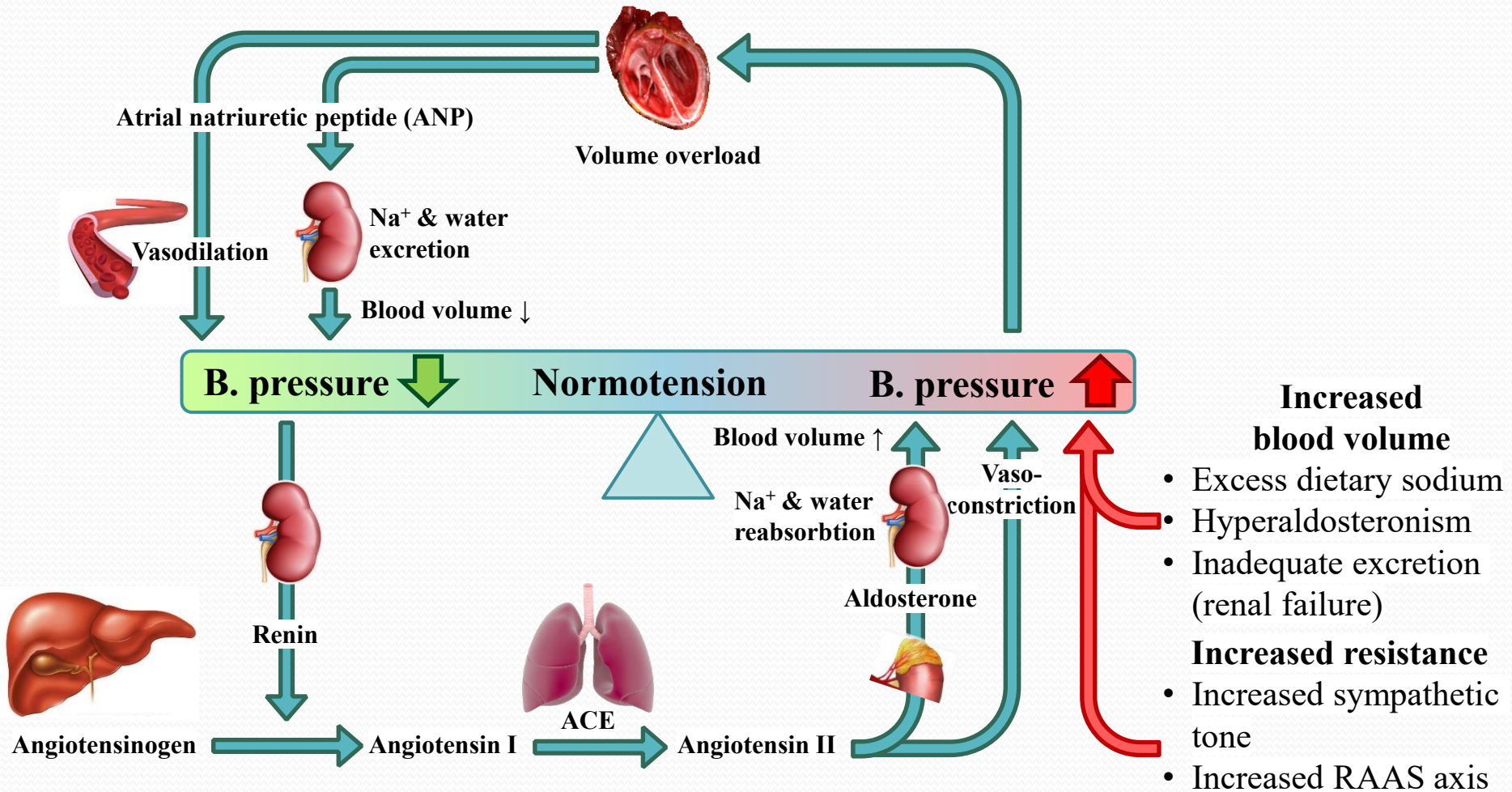
↓  
~63 patients suffer from secondary hypertension

# Pathomechanism of essential hypertension



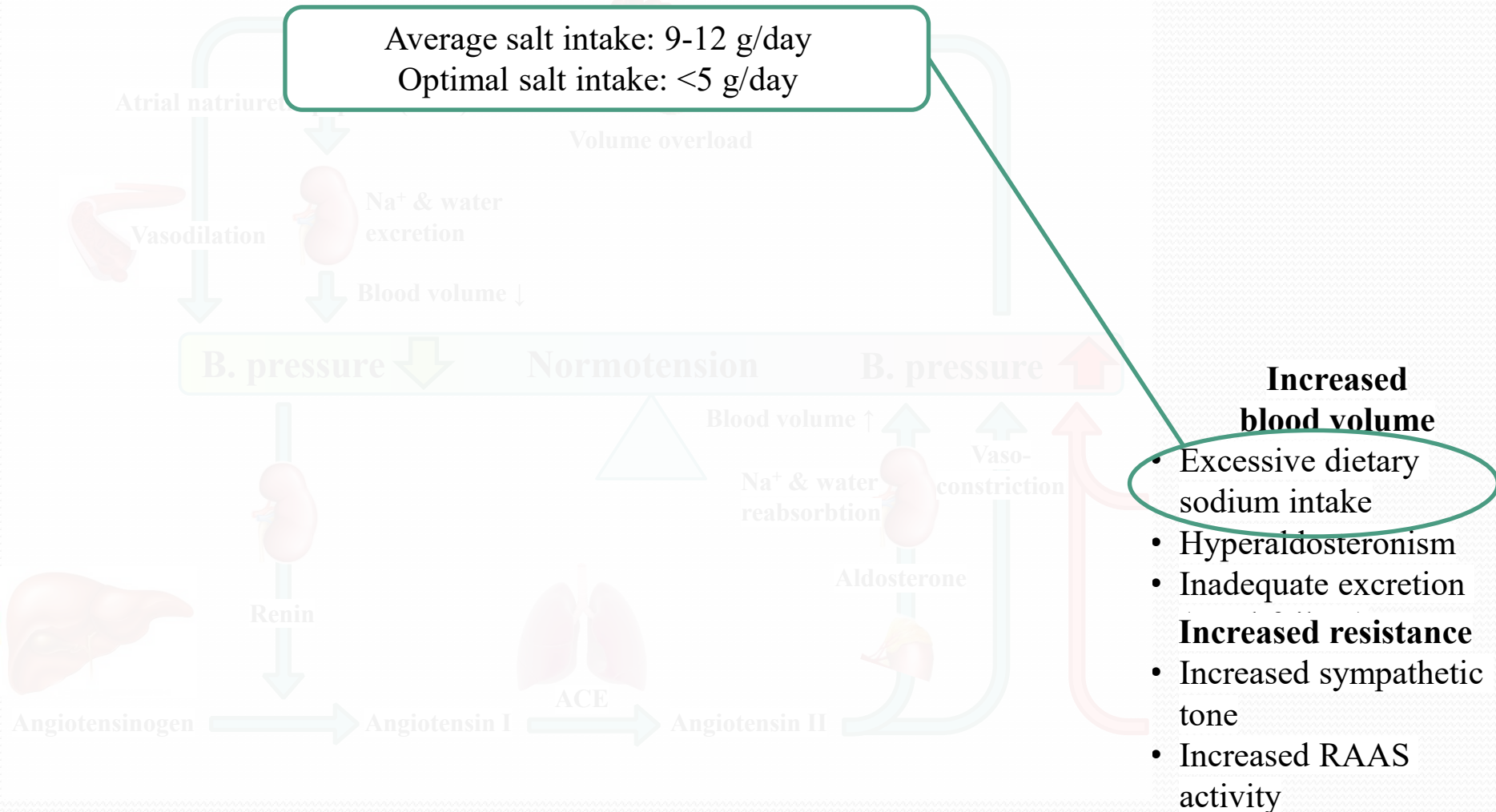
# Essential hypertension

**Blood pressure = Cardiac output x Total peripheral resistance**



# Essential hypertension

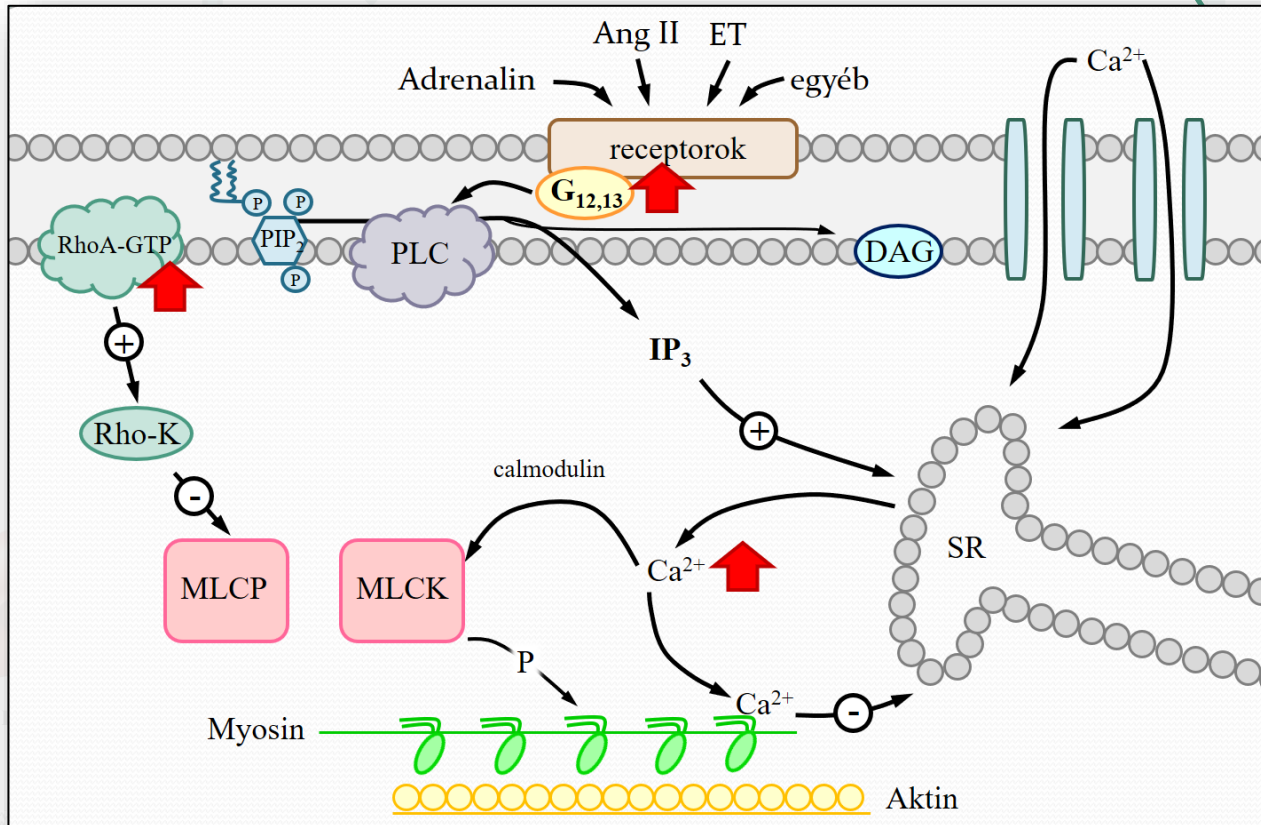
**Blood pressure = Cardiac output x Total peripheral resistance**



# Essential hypertension

**Blood pressure = Cardiac output x Total peripheral resistance**

Average salt intake: 9-12 g/day  
Optimal salt intake: <5 g/day



**Increased blood volume**

- Excessive dietary sodium intake
- Hyperaldosteronism
- Inadequate excretion
- Increased resistance**
- Increased sympathetic tone
- Increased RAAS activity

# Essential hypertension

**Blood pressure = Cardiac output x Total peripheral resistance**

Average salt intake: 9-12 g/day  
Optimal salt intake: <5 g/day

- Increased sympathetic tone in 50% of hypertensive cases
- Increased renin secretion
- Increased renal tubular Na<sup>+</sup> reabsorption
- Renal vasoconstriction
- Hyperkinetic blood circulation
- Increased resting heart rate
- Increased cardiac output
- Elevated norepinephrin level

## Increased blood volume

- Excessive dietary sodium intake
- Hyperaldosteronism
- Inadequate excretion

## Increased resistance

- Increased sympathetic tone
- Increased RAAS activity

# Prevalence of risk factors

Age

Gender

Obesity

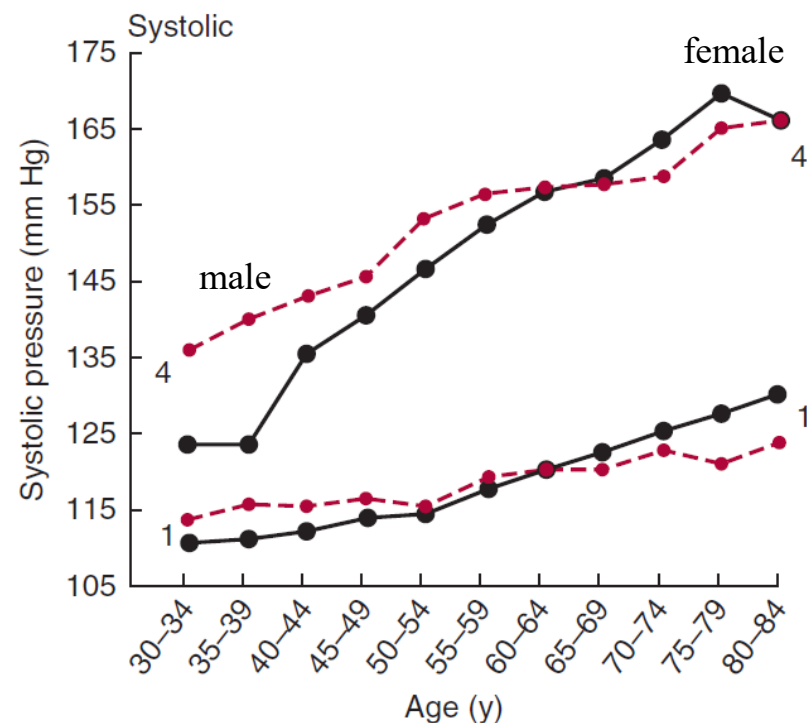
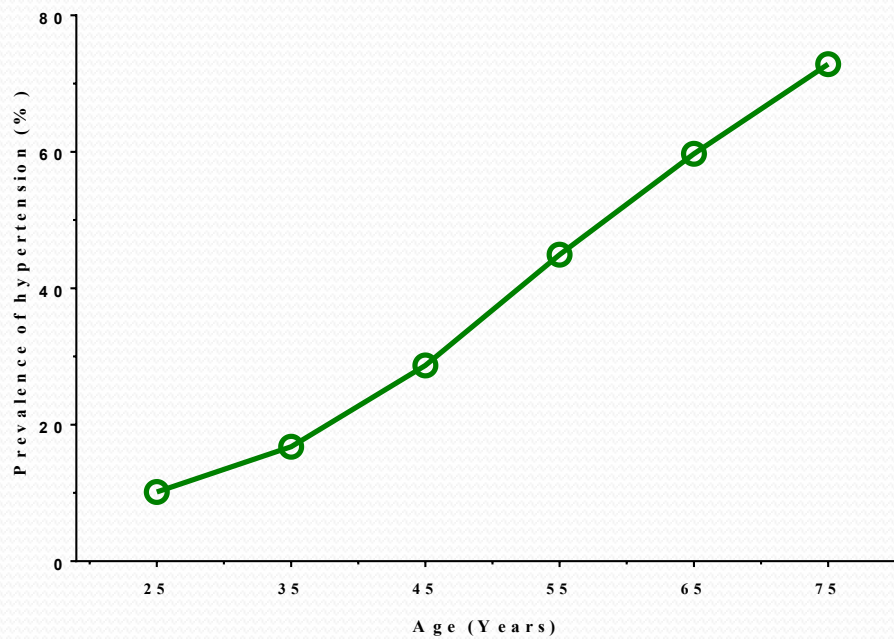
Diabetes

Genetic factors

Geography

Sociodemographic factors

Others



# Prevalence of risk factors

Age

Gender

Obesity

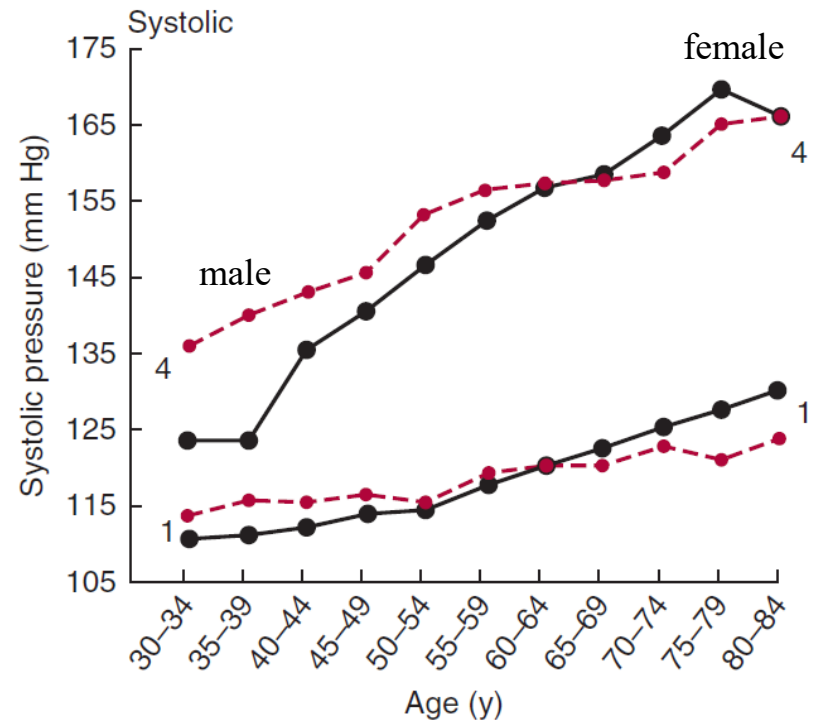
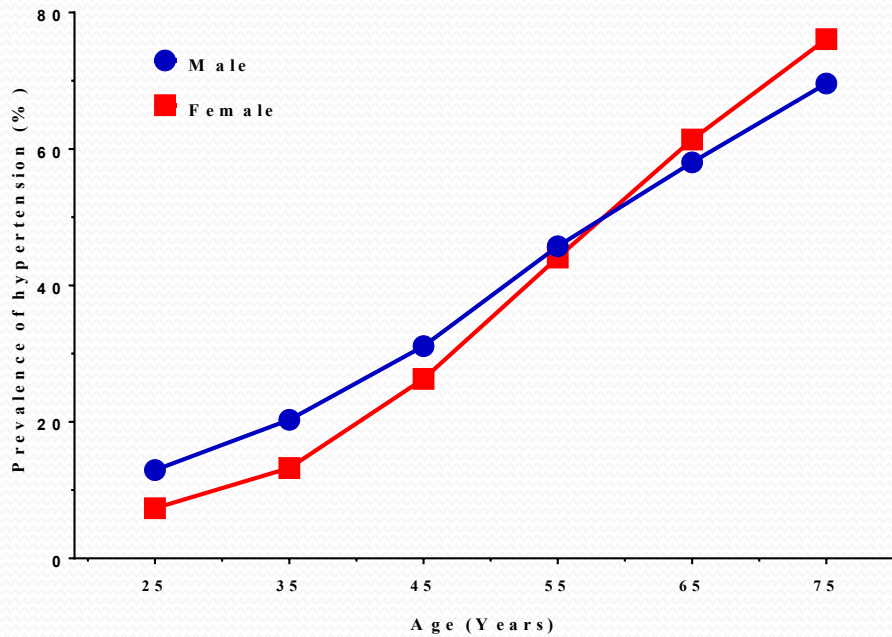
Diabetes

Genetic factors

Geography

Sociodemographic factors

Others



# Prevalence of risk factors

Age	Gender	Obesity	Diabetes
Genetic factors	Geography	Sociodemographic factors	Others

- Abdominal type of obesity
- $+1 \text{ kg/m}^2 \text{ BMI} \rightarrow +12\% \text{ increased HT risk}$
- $+10 \text{ kg weight gain} \rightarrow +3 \text{ mmHg systolic BP}$  and  $+2.2 \text{ mmHg diastolic BP}$
- 42.2% of patients diagnosed with HT is overweight (BMI: 25-30), 34.5% is obese (BMI  $> 30$ )



# Prevalence of risk factors

Age	Gender	Obesity	Diabetes
Genetic factors	Geography	Sociodemographic factors	Others

Diabetic patients have twice the prevalence of HT.

# Prevalence of risk factors

Age

Gender

Obesity

Diabetes

Genetic factors

Geography

Sociodemographic factors

Others

## Cardiovascular risk\*

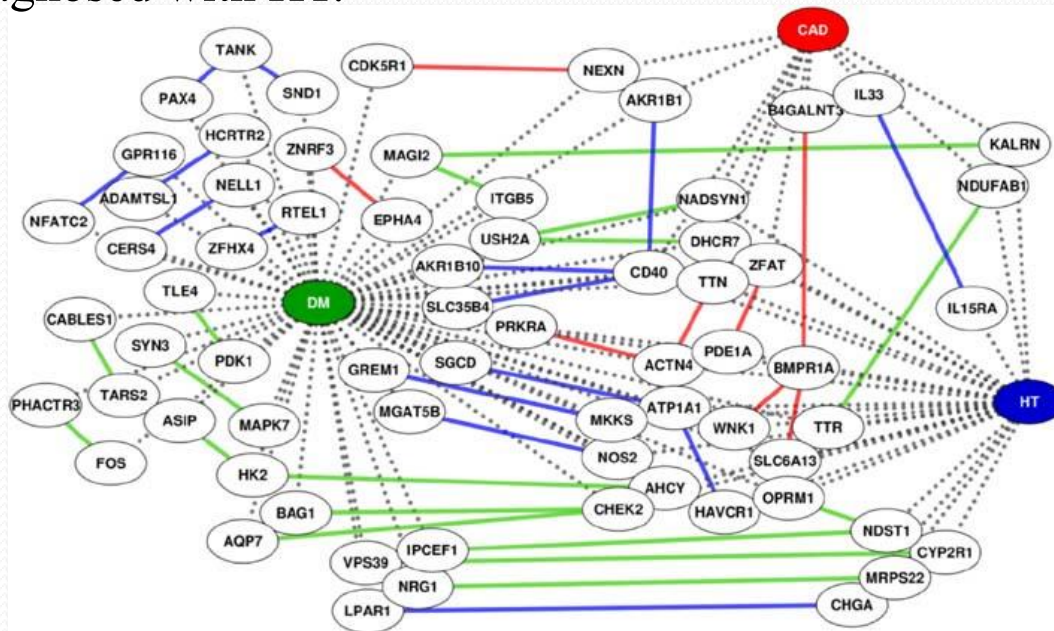
Risk factors (RF), asymptomatic organ damage	Blood pressure (mmHg)			
	High normal 130-139 / 85-89	Grade 1 HT 140-159 / 90-99	Grade 2 HT 160-179 / 100-109	Grade 3 HT ≥180 / ≥110
No other RF	Low (<1%)	Low	Moderate (1-5%)	High
1-2 RF	Low	Moderate	Moderate - High	High
≥ 3 RF	Low - Moderate	Moderate - High	High	High
Organ damage, CKD stage 3 or diabetes	Moderate - High	High (5-10%)	High	High - Very high
Symptomatic CVD, CKD stage ≥4 or diabetes with organ damage	Very high (>10%)	Very high	Very high	Very high

\*The risk of mortality due to CV (not just coronary) diseases over 10 years.

# Prevalence of risk factors

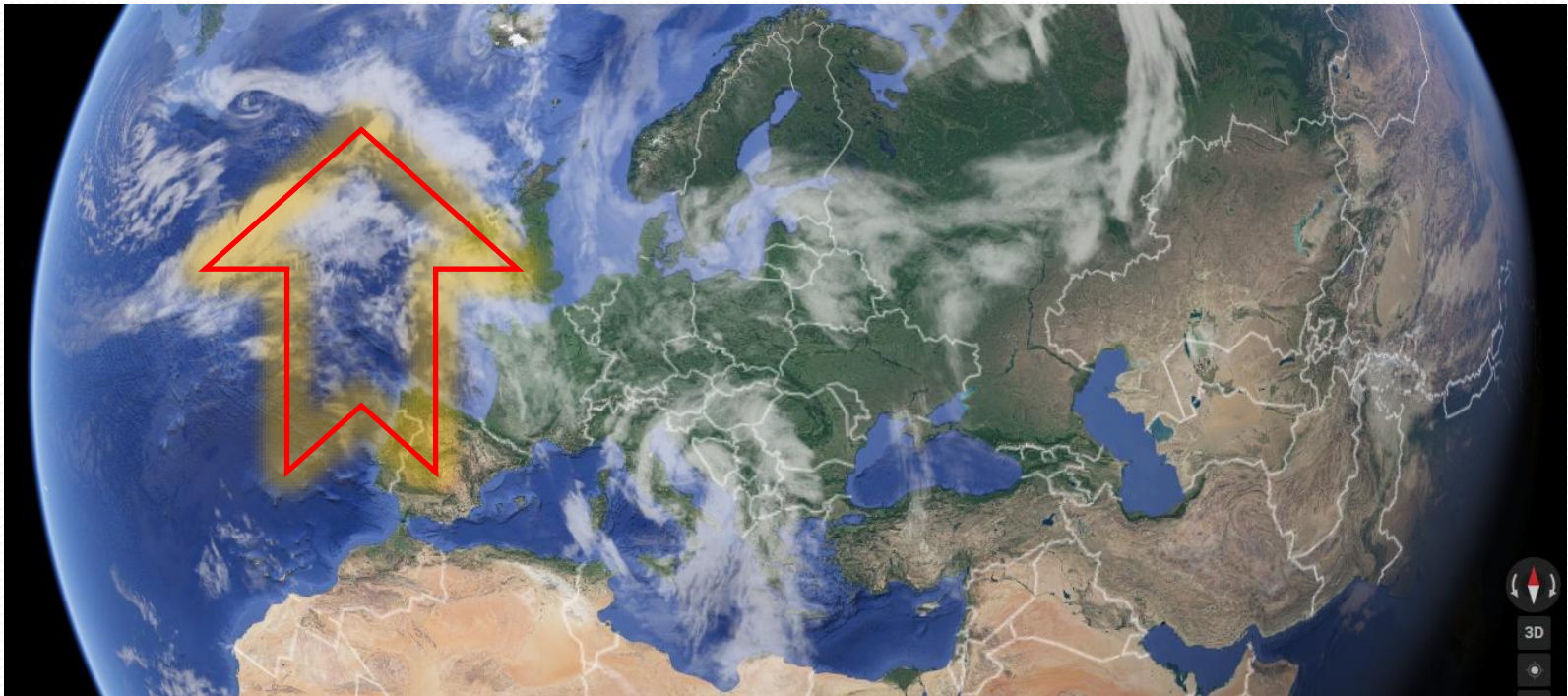
Age	Gender	Obesity	Diabetes
Genetic factors	Geography	Sociodemographic factors	Others

- The prevalence of HT is higher in those adolescents whose parents suffer from HT.
- HT of the child is more positively correlated with maternal HT, than with paternal HT.
- When one of the monozygotic twins has HT, probably the other will also be diagnosed with HT.



# Prevalence of risk factors

Age	Gender	Obesity	Diabetes
Genetic factors	<b>Geography</b>	Sociodemographic factors	Others



# Prevalence of risk factors

Age	Gender	Obesity	Diabetes
Genetic factors	Geography	<b>Sociodemographic factors</b>	Others



**Urbanized people**  
prevalence: 41%



**Non-urbanized people**  
prevalence: 26,8%

# Prevalence of risk factors

Age	Gender	Obesity	Diabetes
Genetic factors	Geography	Sociodemographic factors	Others

- Physical inactivity: increases risk for HT by 30%
- Low income women: +33%
- Hypertension is twice as common in African Americans than in Caucasians



# Types of Hypertension

Essential

85-95%

A general practice includes ~ 1800 individuals

↓  
~630 hypertensive patients

↓  
~567 patients suffer from essential hypertension

Secondary

5-15%

A general practice includes ~ 1800 individuals

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# Types of Hypertension

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graph TD; A[Types of Hypertension] --> B[Essential]; A --> C[Secondary];
```

Essential

85-95%

Secondary

5-15%

## **A secondary etiology may be suggested:**

- History, the results of physical examination and the laboratory investigation suggest secondary causes of HT
- Treatment-resistant HT (3-drug combinations at maximum tolerated dose)
- Sudden progression of previously well-controlled HT
- The degree of target organ damage (TOD) is not proportional to the severity of HT
- Negative family history of HT
- Early onset before 40 years of age

# Types of Hypertension

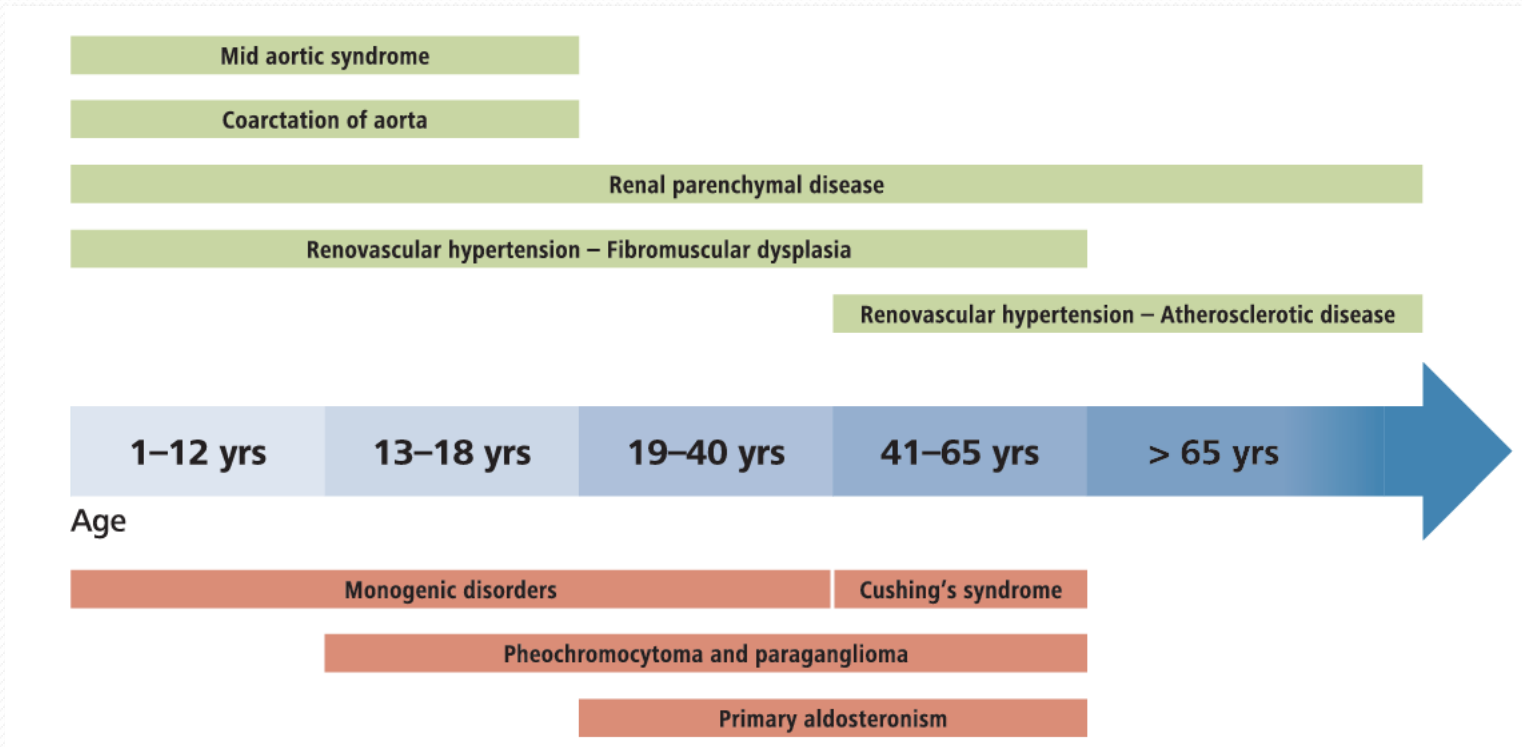


Essential

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Secondary

5-15%

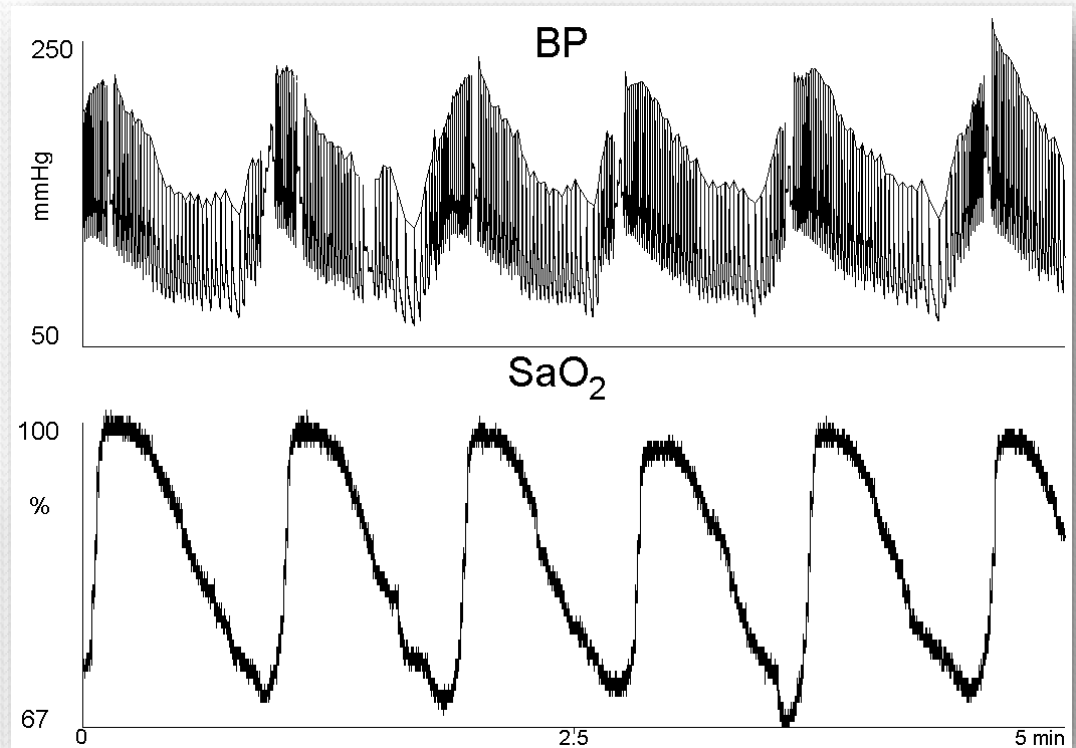
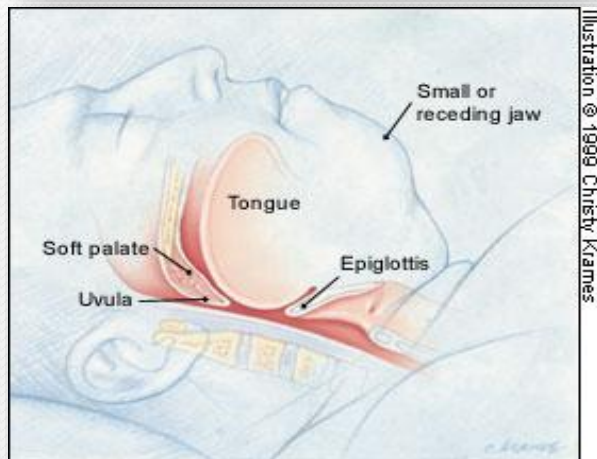


# 'Frequent' causes behind secondary hypertension

	<b>Cause</b>	<b>Prevalence in hypertensive patients</b>
<b>Airway cause</b>	Obstructive sleep apnoea	5-10%
<b>Kidney causes</b>	Renal parenchymal disease	2-10%
	Renovascular disease	1-10%
<b>Endocrin causes</b>	Primary hyperaldosteronism	5-15%
	Phaeocromocytoma	<1%
	Chusing's syndrome	<1%
	Hyper- or hypothyroidism	1-2%
	Hyperparathyroidism	<1%
<b>Medication/ substance</b>	oral contraceptive pill, diet pills, stimulant drugs (amphetamine) etc	
<b>Other causes</b>	Preeclampsia, eclampsia	
	Coarctation of the aorta	
	Increased intracranial pressure	

# Secondary hypertension

Airway cause, obstructive sleep apnoea:



# Secondary hypertension

## Airway cause, obstructive sleep apnoea:

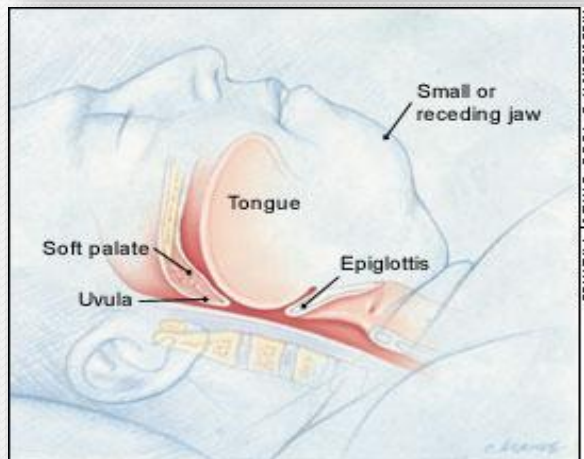
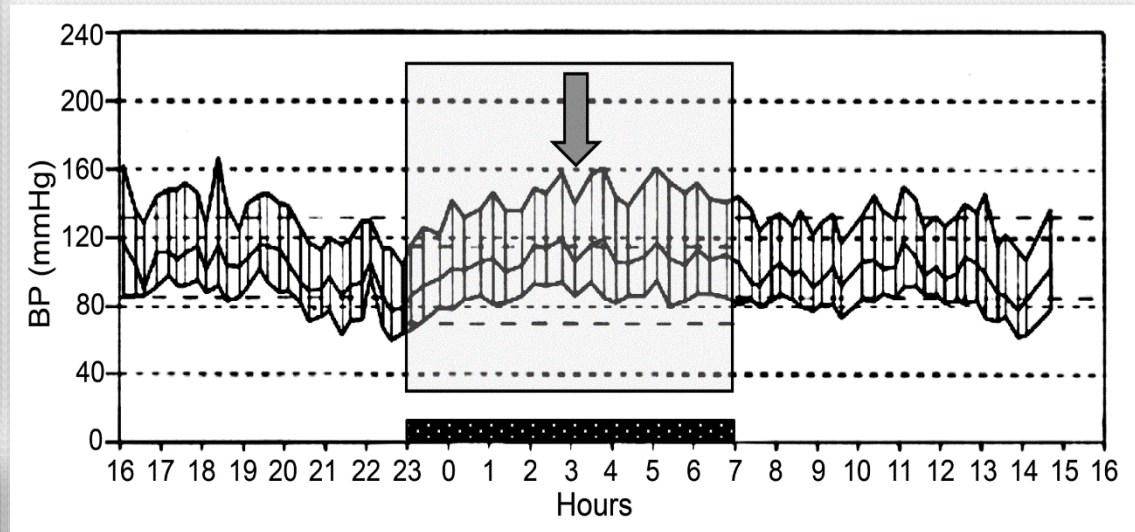


Illustration © 1999 Christy Krames



# Secondary hypertension

Airway cause, obstructive sleep apnoea:



# Secondary hypertension

## Renal causes:

- **Renoparenchymal** (chronic glomerulonephritis, chronic pyelonephritis, etc.)

2-10% of HT patients

*Pathomechanism:*

The number of functioning nephrons ↓



Na<sup>+</sup> and water excretion ↓

(in addition: peripheral vascular resistance ↑, baroreflex activity ↓, dyslipidaemia and significant atherosclerosis)

- **Renovascular**

1-10% of HT patients

*Pathomechanism:*

Significant stenosis  
of the renal artery



Renal blood perfusion ↓



RAAS ↑

Causes: atherosclerosis (2/3), fibromuscular dysplasia (1/3), other: aneurysm, etc.

# Secondary hypertension

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- **Renoparenchymal** (chronic glomerulonephritis, chronic pyelonephritis, etc.)

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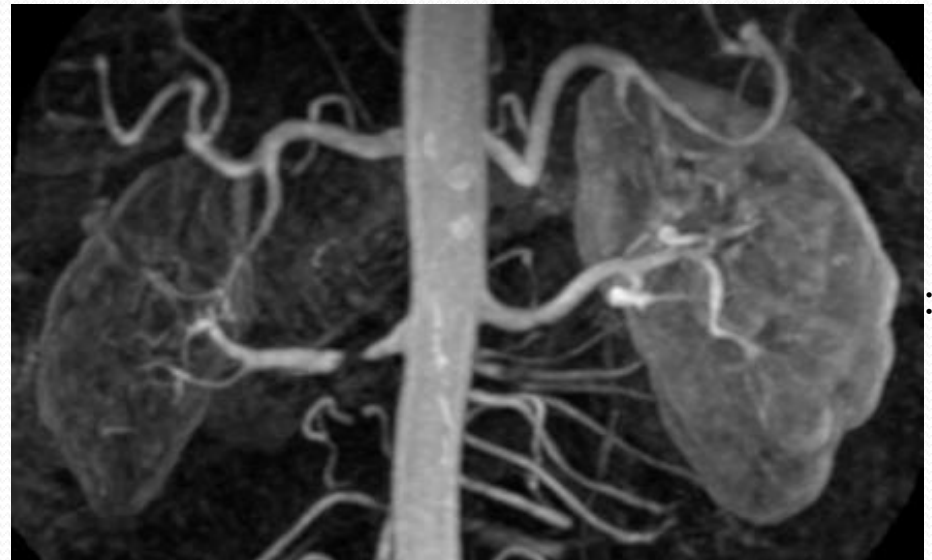
Significant stenosis  
of the renal artery



Renal blood perfusion ↓



RAAS ↑



# Secondary hypertension

## Endocrine disorders:

- **Primary hyperaldosteronism**

5-15% of HT patients

Causes:

bilateral adrenal hyperplasia (60%)

unilateral adrenal adenoma (35%)

- **Cushing's syndrome/disease**

<1% of HT patients

Causes:

Renal mineralocorticoid receptors  
are sensitive to glucocorticoids.

- **Hypo/hyperthyroidism**

Complex pathomechanism:

TPR ↑ (hypothyroidism)

Increased protein synthesis (hyperthyroidism)

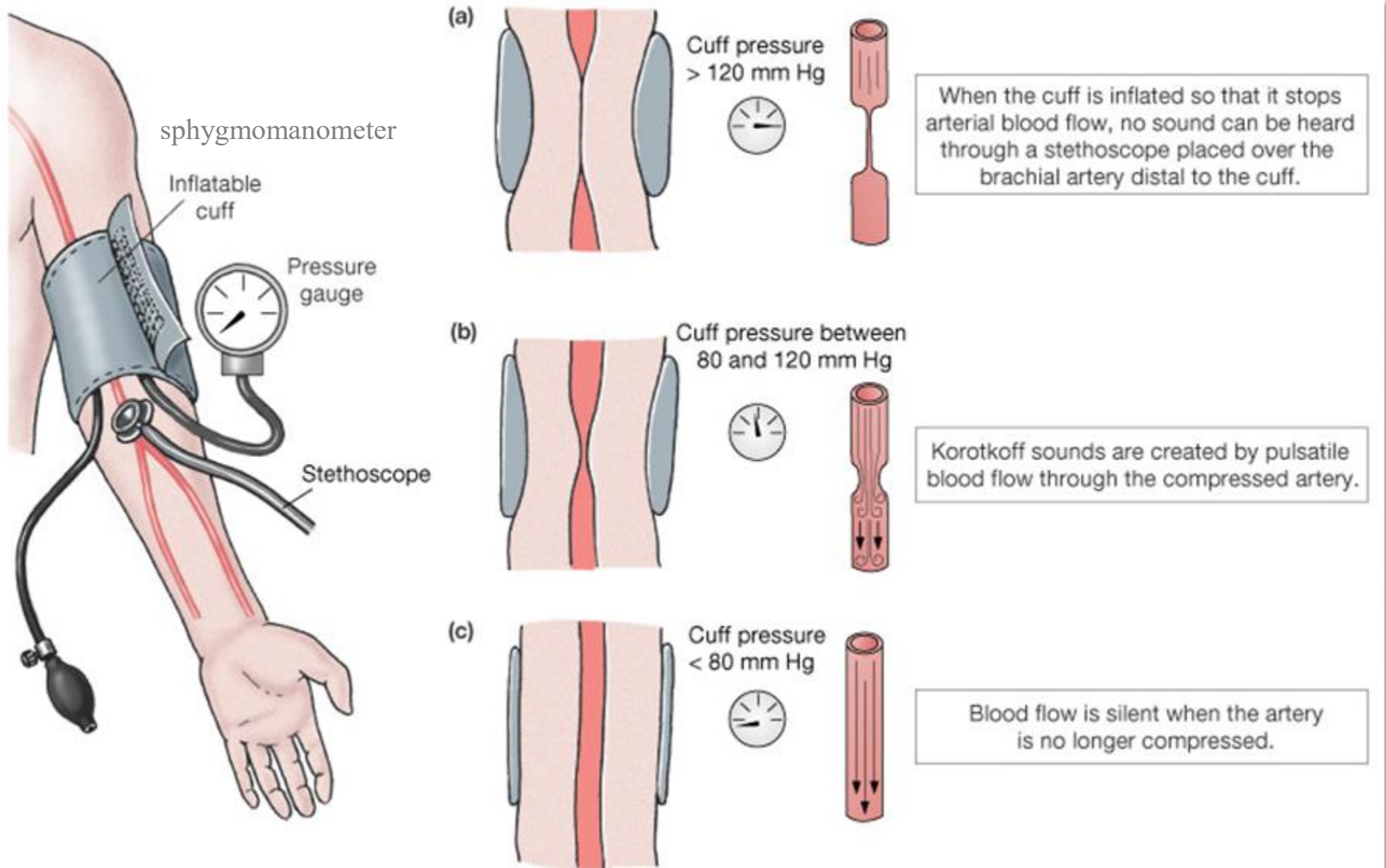
- **Pheochromocytoma**

Prevalence: 0.05-0.1%

Causes:

Hormon producing  
adenomas/adrenocortical cancer  
epinephrine ↑, norepinephrine ↑,  
(dopamine ↑)

# Measurement of blood pressure



# Measurement of blood pressure

**Site of measurement:** wrap cuff around the upper arm free of clothing with the lower border of the cuff approximately 2-3 cm above the elbow band.



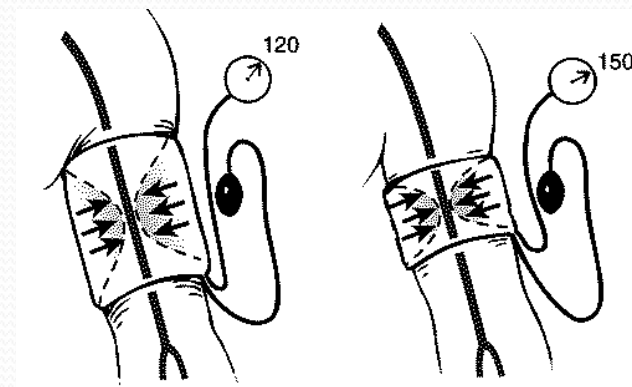
**Caution!** Regular use of these devices are not recommended!



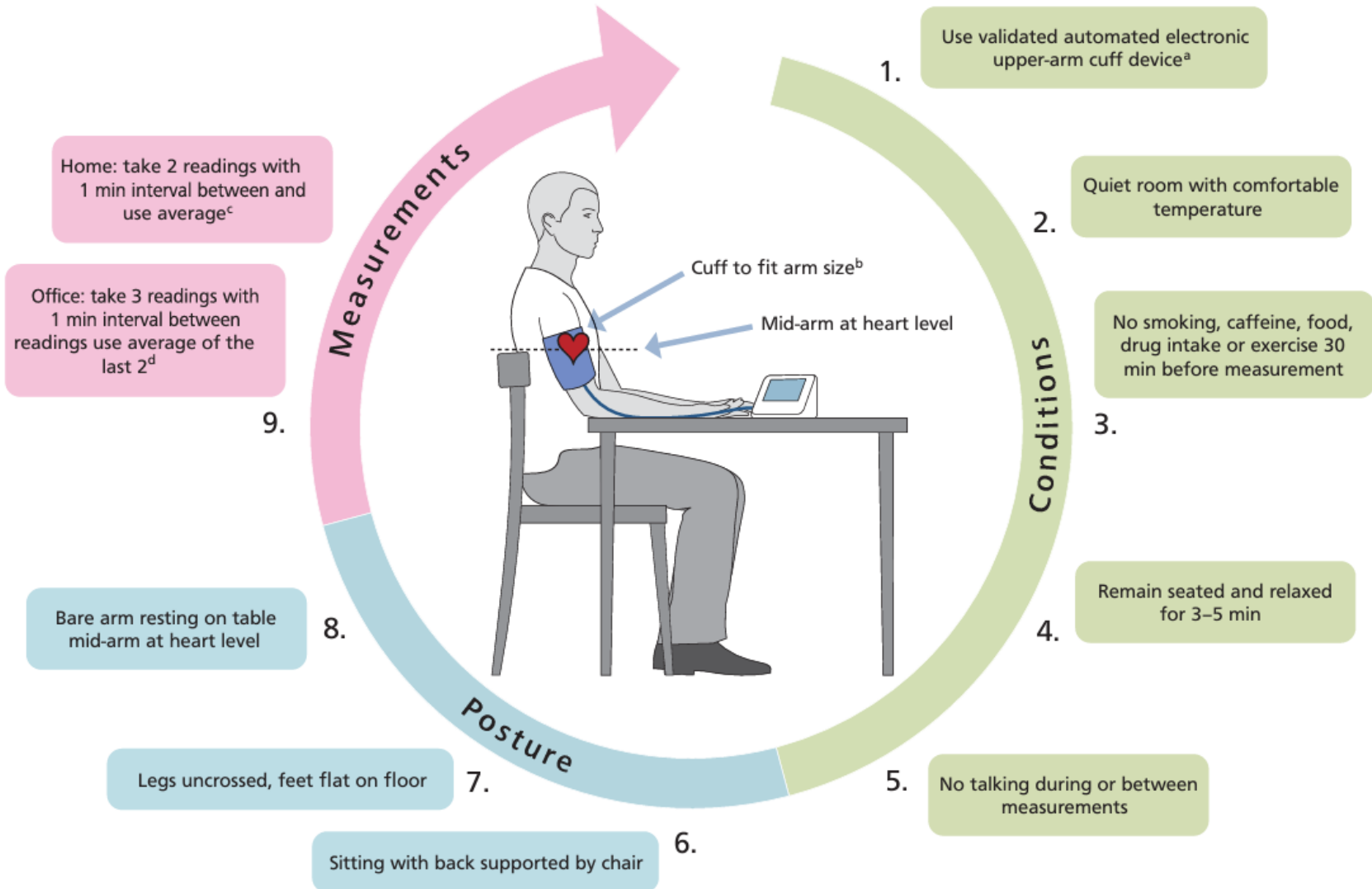
# Measurement of blood pressure

**Cuff size:** too tight or too short cuff +20-30 mmHg

Mid-upper arm circumference	Cuff size	
10 cm	4 x 8 cm	Newborn size
15 cm	6 x 12 cm	Infant size
22 cm	9 x 18 cm	Child size
22-26 cm	12 x 22 cm	Small adult size
27-34 cm	16 x 30 cm	Regular adult size
35-44 cm	16 x 36 cm	Large adult size
45-52 cm	16 x 42 cm	Adult thigh size



# Measurement of blood pressure



# Measurement of blood pressure

## Measurement conditions:

- Ø coffee, Ø alcohol, Ø smoking 30 minutes before the measurement!
- Patient should be seated and relaxed at least 5 minutes before reading and during the procedure! (room temperature, quiet, empty bladder)!
- Both patient and examiner should refrain from talking during the measurement!
- Patient should be seated with legs uncrossed!

Crossing the legs increases systolic BP with +2-6 mmHg.

- Patient should be seated with back supported, muscles relaxed!
- The lower arm should be level with the heart supported on a pillow, slightly flexed at elbow!

Each 2.5 cm difference between heart level and site of measurement results in a 2 mmHg deviation.

- At least 2-3 readings should be taken, with a 1-2-minute intervals and take the average of multiple readings!
- In immobilized patients diastolic BP may be lower with 5 mmHg.

# Treatment of hypertension

## Lifestyle modifications

Treatment strategies	Recommendation	Effect of treatment on systolic BP
Weight loss	Reach or maintain normal BMI (<25kg/m <sup>2</sup> )	- 5-20 mmHg / 10 kg weight loss
Reduced sodium intake	Reduced sodium intake <5 g/day	- 2-8 mmHg
Mediterranean diet (DASH* diet)	Legume, fruits, low fat dairy products, decreased consumption of saturated fatty acids, increased intake of K <sup>+</sup> , Ca <sup>2+</sup>	- 8-10 mmHg
Physical activity	Regular physical activity (30-60 min/day) every day	- 4-9 mmHg
Alcohol consumption	Maximum 2 beverages/day/man (25g alcohol), or 1 beverages/day/woman (12.5g alcohol)	- 2-10 mmHg

\*Dietary Approaches to Stop Hypertension

# Treatment of hypertension

## Antihypertensive medications

Clinical feature	Recommended antihypertensive drug
<b>Target organ damage</b>	
Left ventricular hypertrophy	<b>ACE-inhibitor/ARB</b> , calcium-antagonist, diuretics
Asymptomatic atherosclerosis	<b>Calcium-antagonist</b> , ACE-inhibitor/ARB
Microalbuminuria	ACE-inhibitor/ARB
Renal dysfunction	ACE-inhibitor/ARB
<b>Comorbidities</b>	
Stroke/TIA	Any antihypertensive drugs
After myocardial infarction	<b>β-blocker</b> , ACE-inhibitor/ARB
Atrial fibrillation	ACE-inhibitor/ARB, β-blocker, aldosterone antagonist, non dihidropiridin calcium-antagonist
Aorta aneurism	β-blocker, non dihidropiridin calcium-antagonist
Diabetes mellitus	ACE-inhibitor/ARB, calcium-antagonist, diuretics, imidazolin-receptor-antagonist
<b>Other conditions</b>	
Isolated systolic hypertension	<b>Diuretics</b> , calcium-antagonist
Etc.	Etc.

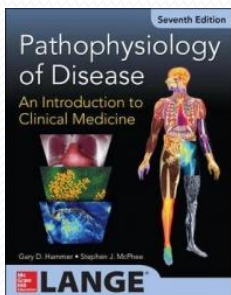
# Literature



A Magyar Hypertónia Társaság Szakmai Irányelve:  
Egészségügyi szakmai irányelv a magasvérnyomás-betegség ellátásáról  
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