Hypertension

Miklós Fagyas, M.D. PhD. MSc.

University of Debrecen
Department of Cardiology
Division of Clinical Physiology

1

Hypertension

Definition/diagnostics*

1. visit ↔ 1 week ↔ 2. visit ↔ 1 week ↔ 3. visit

1. visit	2. visit	3. visit
~~165/95 mmHg~~	~~170/90 mmHg~~	~~165/95 mmHg~~
155/90 mmHg, 145/90 mmHg → 150/90	160/95 mmHg, 150/85 mmHg → 155/90	155/85 mmHg, 165/95 mmHg → 160/90
≥140 and/or ≥ 90	≥140 and/or ≥ 90	≥140 and/or ≥ 90

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

2

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
Hypertension			
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, Muntner P, Ovbiagele 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.

3

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%.

4

Types of Hypertension

Essential
85-95%

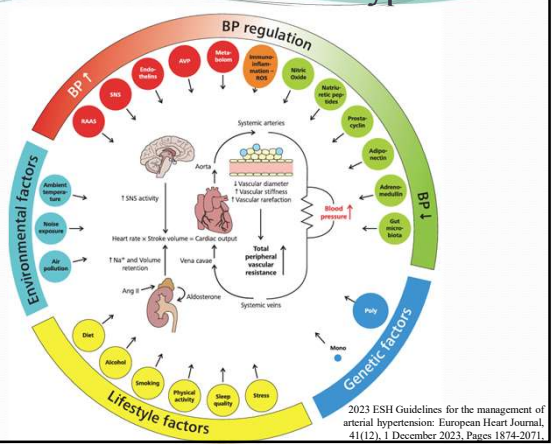
A general practice includes ~ *1800* individuals
↓
~630 hypertensive patients
↓
~567 patients suffer from essential hypertension

Secondary
5-15%

A general practice includes ~ *1800* individuals
↓
~630 hypertensive patients
↓
~63 patients suffer from secondary hypertension

5

Pathomechanism of essential hypertension

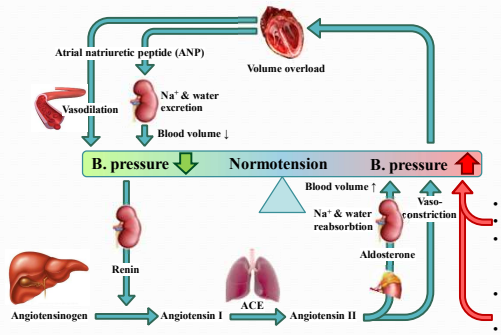


2023 ESH Guidelines for the management of arterial hypertension: European Heart Journal, 41(12), 1 December 2023, Pages 1874-2071,

6

Essential hypertension

Blood pressure = Cardiac output x Total peripheral resistance



Increased blood volume
- Excess dietary sodium
- Hyperaldosteronism
- Inadequate excretion (renal failure)

Increased resistance
- Increased sympathetic tone
- Increased RAAS axis

7

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

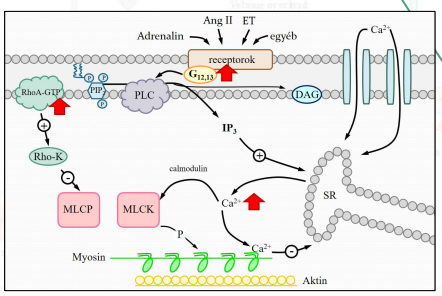
Increased resistance
- Increased sympathetic tone
- Increased RAAS activity

8

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

9

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^+ reabsorption
- Renal vasoconstriction
- Hyperkinetic blood circulation
- Increased resting heart rate
- Increased cardiac output
- Elevated norepinephrin level

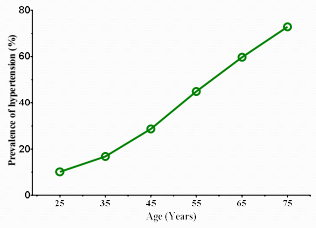
Increased blood volume
- Excessive dietary sodium intake
- Hyperaldosteronism
- Inadequate excretion

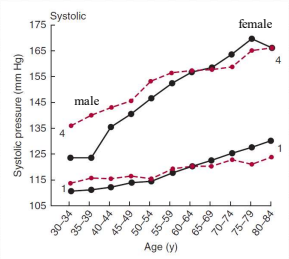
Increased resistance
- Increased sympathetic tone
- Increased RAAS activity

10

Prevalence of risk factors

Age

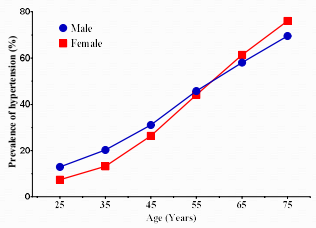


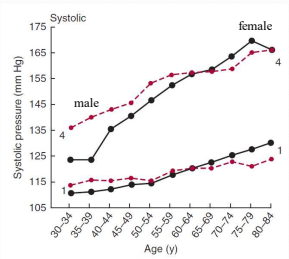


11

Prevalence of risk factors

Age **Gender**





12

Prevalence of risk factors

Age | Gender | **Obesity**

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

Forrás: dreamstime.com

13

Prevalence of risk factors

Age | Gender | Obesity | **Diabetes**

Diabetic patients have twice the prevalence of HT.

14

Prevalence of risk factors

Age | Gender | Obesity | Diabetes

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

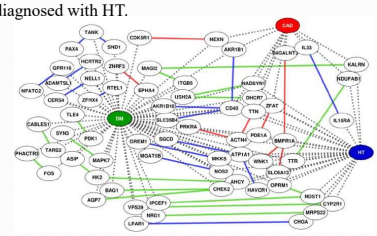
*The risk of mortality due to CV (not just coronary) diseases over 10 years.

15

Prevalence of risk factors

Age	Gender	Obesity	Diabetes
Genetic factors			

- 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.

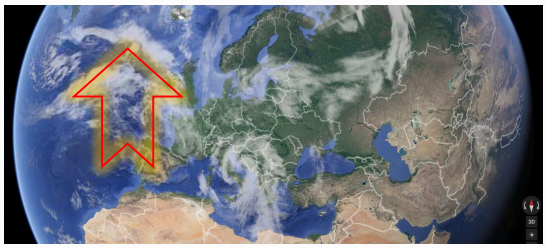


genominfo.org
https://doi.org/10.5808/GI.2014.12.4.181

16

Prevalence of risk factors

Age	Gender	Obesity	Diabetes
Genetic factors	**Geography**		



Google Earth

17

Prevalence of risk factors

Age	Gender	Obesity	Diabetes
Genetic factors	Geography	**Sociodemographic factors**	

Urbanized people
prevalence: 41%

Non-urbanized people
prevalence: 26,8%

http://www.americantower.com; http://kep.cdn.index.hu

18

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

19

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
↓
~630 hypertensive patients
↓
~63 patients suffer from secondary hypertension

20

Types of Hypertension

Essential
85-95%

Secondary
5-15%

A secondary etiology may be suggested:

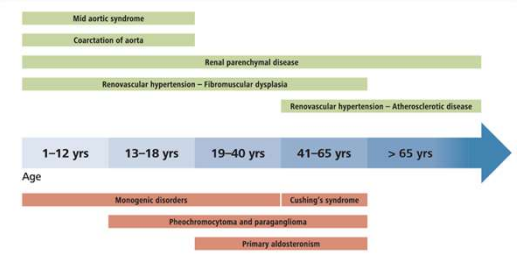
- History, the results of physical examination and the laboratory investigation suggest secondary causes of HT
- Treatment-resistant HT (3-drug combinations at maximum tolerated dose)
- Sudden progression of previously well-controlled HT
- The degree of target organ damage (TOD) is not proportional to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

21

Types of Hypertension

Essential
85-95%

Secondary
5-15%



22

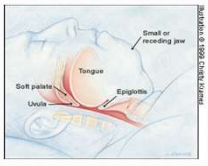
'Frequent' causes behind secondary hypertension

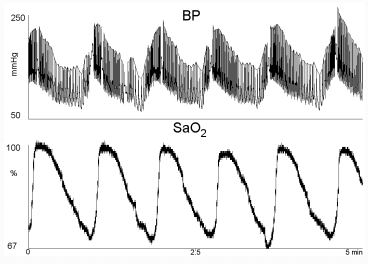
	Cause	Prevalence in hypertensive patients
Airway cause	Obstructive sleep apnoea	5-10%
Kidney causes	Renal parenchymal disease	2-10%
	Renovascular disease	1-10%
Endocrin causes	Primary hyperaldosteronism	5-15%
	Phaeocromocytoma	<1%
	Chusing's syndrome	<1%
	Hyper- or hypothyroidism	1-2%
	Hyperparathyroidism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

23

Secondary hypertension

Airway cause, obstructive sleep apnoea:

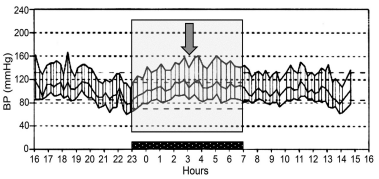


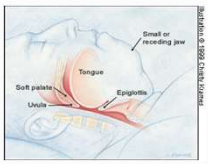


24

Secondary hypertension

Airway cause, obstructive sleep apnoea:





25

Secondary hypertension

Renal causes:

- **Renoparenchymal** (chronic glomerulonephritis, chronic pyelonephritis, etc.)
  2-10% of HT patients
  Pathomechanism:

  The number of functioning nephrons ↓
  ↓
  Na^+ 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.

26

Secondary hypertension

Renal causes:

- **Renoparenchymal** (chronic glomerulonephritis, chronic pyelonephritis, etc.)
  2-10% of HT patients
  Pathomechanism:

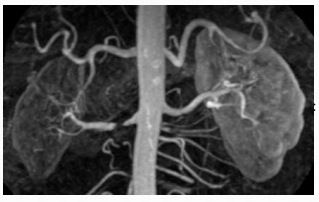
  The number of functioning nephrons ↓
  ↓
  Na^+ and water excretion ↓

  (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 ↑



27

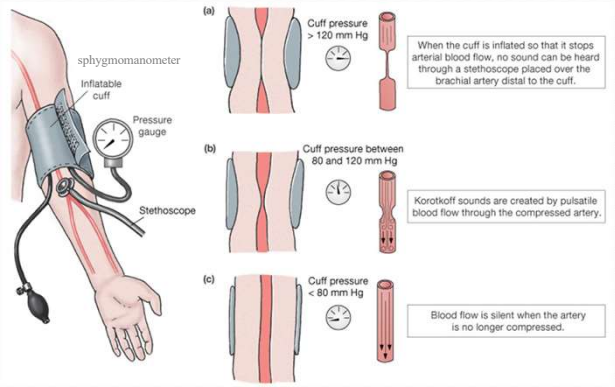
Secondary hypertension

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 ↑, (domapine ↑)

28

Measurement of blood pressure



29

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.

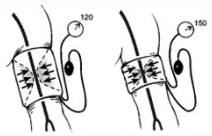
Caution! Regulare use of these devices are not recommended!

30

Measurement of blood pressure

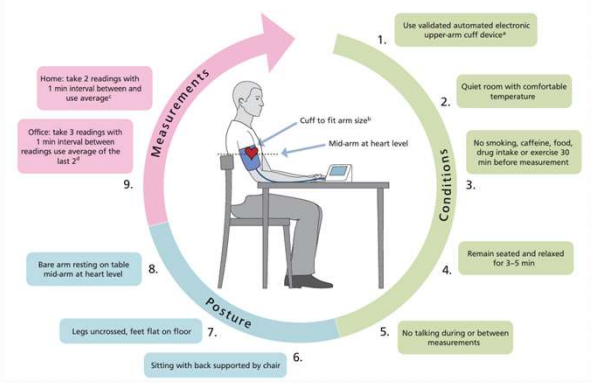
Cuff size: too tight or too short cuff +20-30 mmHg

Mid-upper arm cirumference	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



31

Measurement of blood pressure



2023 ESH Guidelines for the management of arterial hypertension: European Heart Journal, 41(12), 1 December 2023, Pages 1874-2071,

32

Measurement of blood pressure

Measurement conditions:

- Ø coffein, 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 lack of back support results in a +6 mmHg increase in diastolic blood pressure.
- 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.

33

Treatment of hypertension

Lifestyle modifications

Treatment strategies	Recommendation	Effect of treatment on systolic BP
Weight loss	Reach or maintain normal BMI (<25kg/m^2)	- 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 diary products, decreased consumption of saturated fatty acids, increased intake of K^+, Ca^{2+}	- 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

34

Treatment of hypertension

Antihypertensive medications

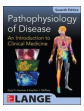
Clinical feature	Recommended antihypertensive drug
Target organ damage	
Left ventricular hypertrophy	**ACE-inhibitor/ARB**, calcium-antagonist, diuretics
Asymptomatic atherosclerosis	**Calcium-antagonist**, ACE-inhibitor/ARB
Microalbuminuria	ACE-inhibitor/ARB
Renal disfunction	ACE-inhibitor/ARB
Comorbidities	
Stroke/TIA	Any antihypertensive drugs
After myocardial infarction	**β-blocker**, 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
Other conditions	
Isolated systolic hypertension	**Diuretics**, calcium-antagonist
Etc.	Etc.

35

Literature

A Magyar Hypertónia Társaság Szakmai Irányelve:
A hypertoniabetegség ellátásának irányelvei
Hypertonia és Nephrologia, 2018;22 (Suppl. 5) S1-S36.

2023 ESH Guidelines for themanagement of arterial hypertension
European Heart Journal, Volume 41, Issue 12, 1 December 2023, Pages 1874-2071,
https://doi.org/10.1097/HJH.0000000000003480.
Published: 26 September 2023



Pathophysiology of Diseases: An introduction to clinical medicine 7th edition
Gary D . Hammer, Stephen J. McPhee
Pages: 298-299; 310-314, 458-459,

36