Odessa National Medical University
Internal Medicine Department 2 with postgraduate education

Lecture for 4th years students

Topic: ARTERIAL HYPERTENSION

2024-2025 ed.y.

Lecturer:
Tykhonova Susanna,
MD, PhD, Professor

Consideration questions

1. Definition of hypertension (HTN), BP classification and prevalence of HTN
2. Principles of HTN pathophysiology
3. Confirming the diagnosis of HTN
4. BP measurment & monitoring (*standard office BP measurement, home BP monitoring, ambulatory BP monitoring*)
5. Patient work-up
6. Differential diagnosis
7. Principles of HTN management

ESH Guidelines

2023 ESH Guidelines for the management of arterial hypertension

The Task Force for the management of arterial hypertension of the European Society of Hypertension Endorsed by the European Renal Association (ERA) and the International Society of Hypertension (ISH)

Mancia, Kreutz et al. J Hypertens 41:000–000
DOI:10.1097/HJH.0000000000003480

ESC
European Society of Cardiology
European Heart Journal (2024) **00**, 1–107
https://doi.org/10.1093/eurheartj/ehae178

ESC GUIDELINES

2024 ESC Guidelines for the management of elevated blood pressure and hypertension

Developed by the task force on the management of elevated blood pressure and hypertension of the European Society of Cardiology (ESC) and *endorsed by the European Society of Endocrinology (ESE) and the European Stroke Organisation (ESO)*

2024 Guidelines contain a number of new and revised recom mendation

1. Measuring blood pressure (BP)
2. Definition and classification of elevated BP and hypertension (HTN), and cardiovascular disease risk (CVR) assessment
3. Diagnosing HTN and investigating underlying causes
4. Preventing and treating elevated BP
5. Managing specific patient groups or circumstances (*Young adults, HTN in pregnancy, Older and frail patients, Chronic kidney disease, Other conditions, Renovascular HTN*)
6. Acute and short-term lowering of BP
7. Patient-centred care in HTN

Prevalence of HTN

HTN is the most prevalent CV disorder in the world and according to the WHO, **it affects 1.28 billion adults aged 30–79 years worldwide**, two-thirds living in low-income and middle-income countries

In 2019, the global age-standardized average prevalence of HTN in adults aged 30–79 years was reported to be **34% in men** and **32% in women**

At younger ages (<50 years), HTN is more prevalent in men, whereas a steeper increase of SBP in women from their third decade (and more so following menopause) makes the prevalence of HTN greater in women in older age categories (>65 years)

SBP increases progressively with age while DBP rises only until the age of 50–60 years. This results in an increase of pulse pressure (difference between SBP and DBP) with age

Recommendations for categorizing BP

Recommendation	Class[a]	Level[b]
It is recommended that BP be categorized as non-elevated BP, elevated BP, and hypertension to aid treatment decisions.[116,121,122,131–138]	I	B

BP, blood pressure.
[a]Class of recommendation.
[b]Level of evidence.

New BP category:

Elevated BP, which is defined as an office systolic BP of 120–139 mmHg or diastolic BP of 70–89 mmHg.

Non-elevated BP is defined as a systolic BP of <120 mmHg and a dia stolic BP of <70 mmHg.

Blood pressure classification

Non-elevated blood pressure	Elevated blood pressure	Hypertension
Office BP	**Office BP**	**Office BP**
SBP <120 mmHg and DBP <70 mmHg	SBP 120–139 mmHg or DBP 70–89 mmHg	SBP ≥140 mmHg or DBP ≥90 mmHg
HBPM	**HBPM**	**HBPM**
SBP <120 mmHg and DBP <70 mmHg	SBP 120–134 mmHg or DBP 70–84 mmHg	SBP ≥135 mmHg or DBP ≥85 mmHg
ABPM	**ABPM**	**ABPM**
Daytime SBP <120 mmHg and Daytime DBP <70 mmHg	Daytime SBP 120–134 mmHg or Daytime DBP 70–84 mmHg	Daytime SBP ≥135 mmHg or Daytime DBP ≥85 mmHg
Insufficient evidence confirming the efficacy and safety of BP pharmacological treatment	Risk stratify to identify individuals with high cardiovascular risk for BP pharmacological treatment	Cardiovascular risk is sufficiently high to merit BP pharmacological treatment initiation

Blood pressure categories:

ABPM, ambulatory blood pressure monitoring;
DBP, diastolic blood pressure; **SBP**, systolic blood pressure.
HBPM, home blood pressure monitoring

Definition & classification of elevated BP & HTN, and cardiovascular disease risk assessment

The 2024 Guidelines define hypertension as a **confirmed office sys tolic BP of ≥140 mmHg or diastolic BP of ≥90 mmHg**

For this diagnosis to be made, confirmation is recommended with out-of-office measure ments (HBPM or ABPM) or at least one repeat office measurement at a subsequent visit

Pathophysiology of elevated BP & HTN

Persistently high BP in systemic arteries is the hallmark of HTN, which is the most important modifiable risk factor for all-cause and CVD morbidity and mortality globally.

Most patients with HTN have **essential or primary HTN, where the exact cause remains unknown**, while an estimated 10% have **secondary HTN**

There are two major physiological components of BP:

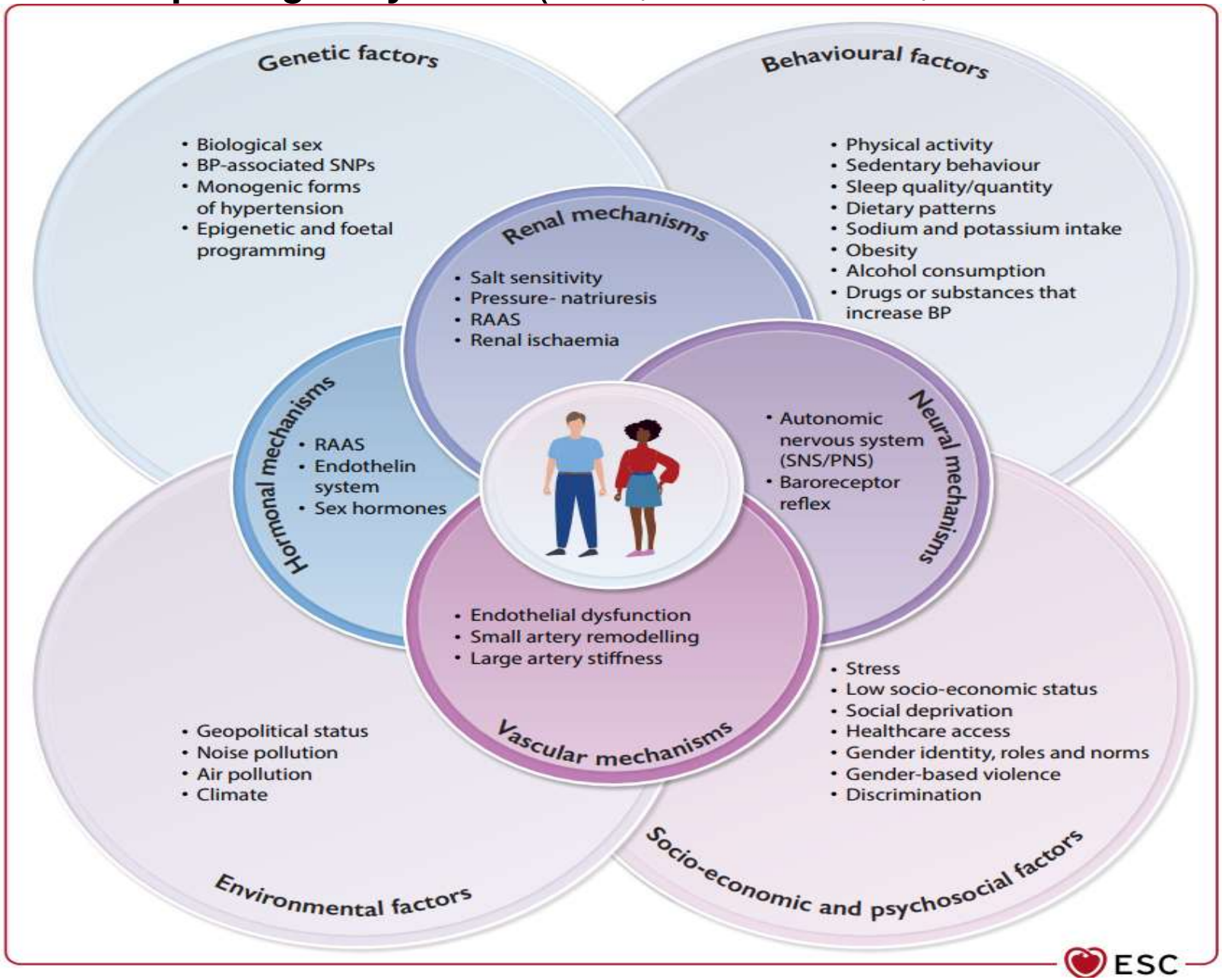
- **a static compo nent**, mainly determined by peripheral vascular resistance
- **a pulsatile compo nent**, which depends on aortic elastic properties.

Both components are regulated by a number of physiological pathways, including:

- ***renal*** (sodium: volume homeostasis),
- ***neural*** (sympathetic nervous system),
- ***hormona***l (renin–angiotensin–aldosterone system (RAAS) and others)
- ***vascu lar mechanisms***.

Dysregulation of these processes can lead to BP eleva tion, which over time results in hypertension-mediated organ damage (HMOD) and adverse cardiovascular outcome.

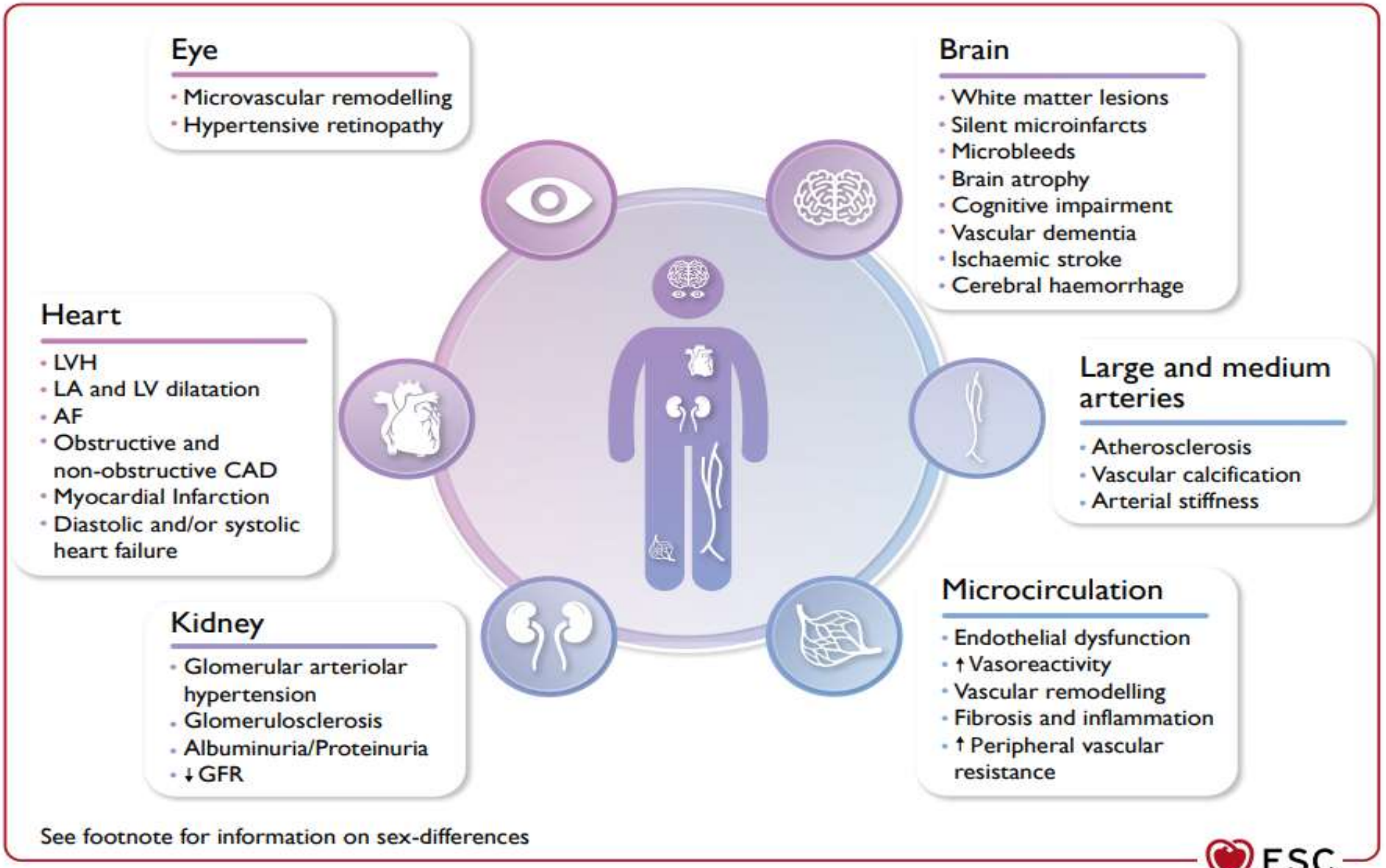
The pathophysiology of HTN involves complex interactions between environmental and behavioural factors, genes, hormonal net works, and multiple organ systems *(renal, cardiovascular, and central nervous system)*



Dysfunction of these processes leads to HTN. The contribution of these factors to elevated BP and HTN may differ among males and females.

PNS, parasympathetic nervous system; RAAS, renin-angiotensin-aldosterone system; SNP, single-nucleotide polymorphism; SNS, sympathetic nervous system.

Persistently elevated BP & HTN lead to hypertension-mediated organ damage and cardiovascular disease



AF, atrial fibrillation; CAD, coronary artery disease; GFR, glomerular filtration rate; LA, left atrial; LV, left ventricular; LVH, left ventricular hypertrophy

Role of cardiovascular disease risk assessment

The risk of adverse CVD outcomes increases log-linearly with constant increments in systolic BP and diastolic BP

Concurrently, at higher BP, there is clustering of additional CVD risk factors

Consequently, many patients with hypertension will have an estimated 10-year risk for CVD events of ≥10%

Role of cardiovascular disease risk assessment

The risk of adverse CVD outcomes increases log-linearly with constant increments in systolic BP and diastolic BP

Concurrently, at higher BP, there is clustering of additional CVD risk factors

Consequently, many patients with hypertension will have an estimated 10-year risk for CVD events of ≥10%

Role of cardiovascular disease risk assessment: 10-year cardiovascular disease risk-prediction models

ESC endorses the use of:

- **SCORE2** for individuals aged 40–69 years
- **SCORE2–Older Persons (SCORE2-OP)** for individuals aged ≥70 years

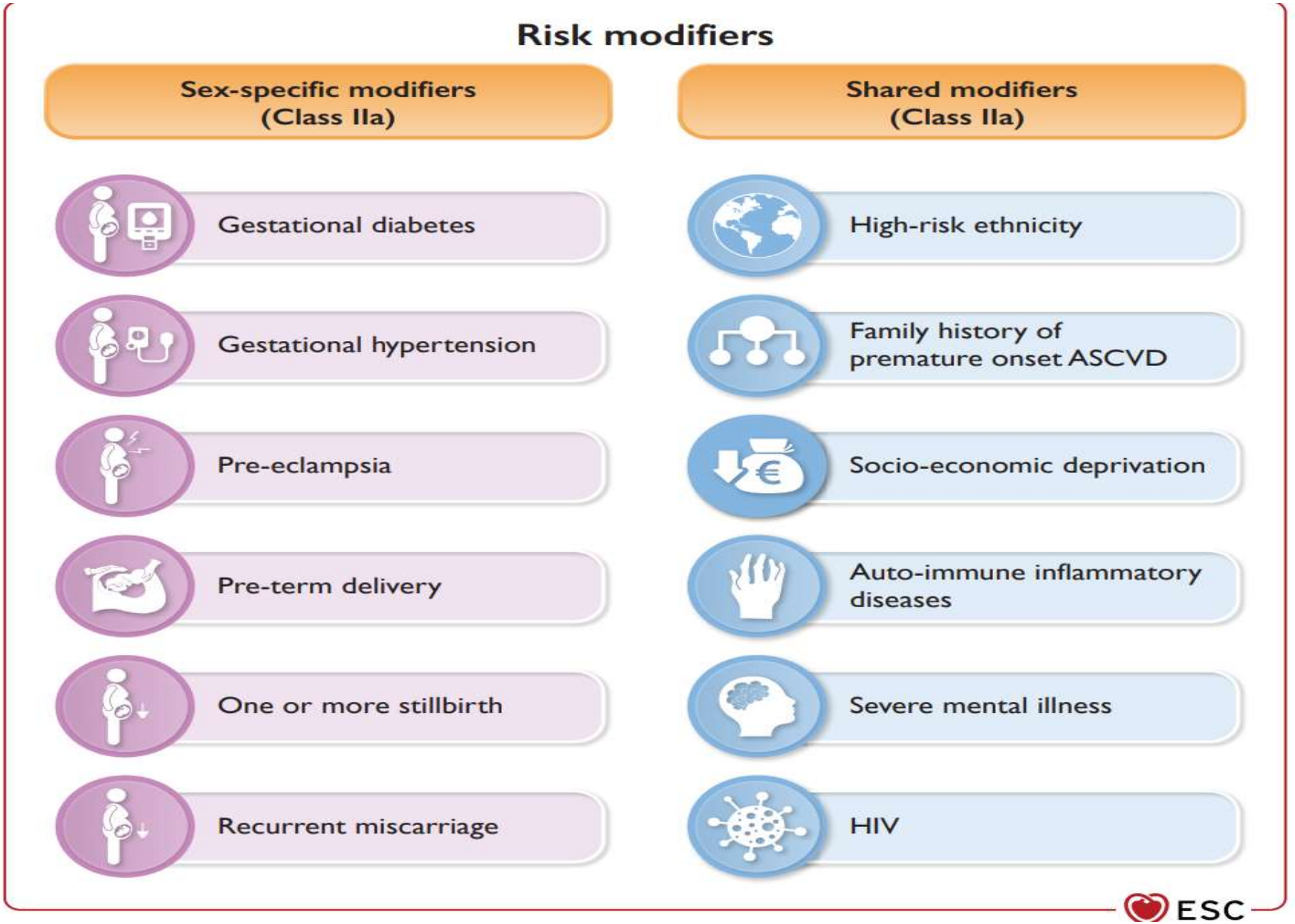
for predicting 10-year global risk of fatal and non-fatal CVD events (stroke or myocardial infarction).

Refining cardiovascular disease risk estimation beyond risk models

The SCORE2 and SCORE2-OP risk-prediction models incorporate traditional risk factors such as:
age,
sex,
systolic BP,
cholesterol values,
smoking status

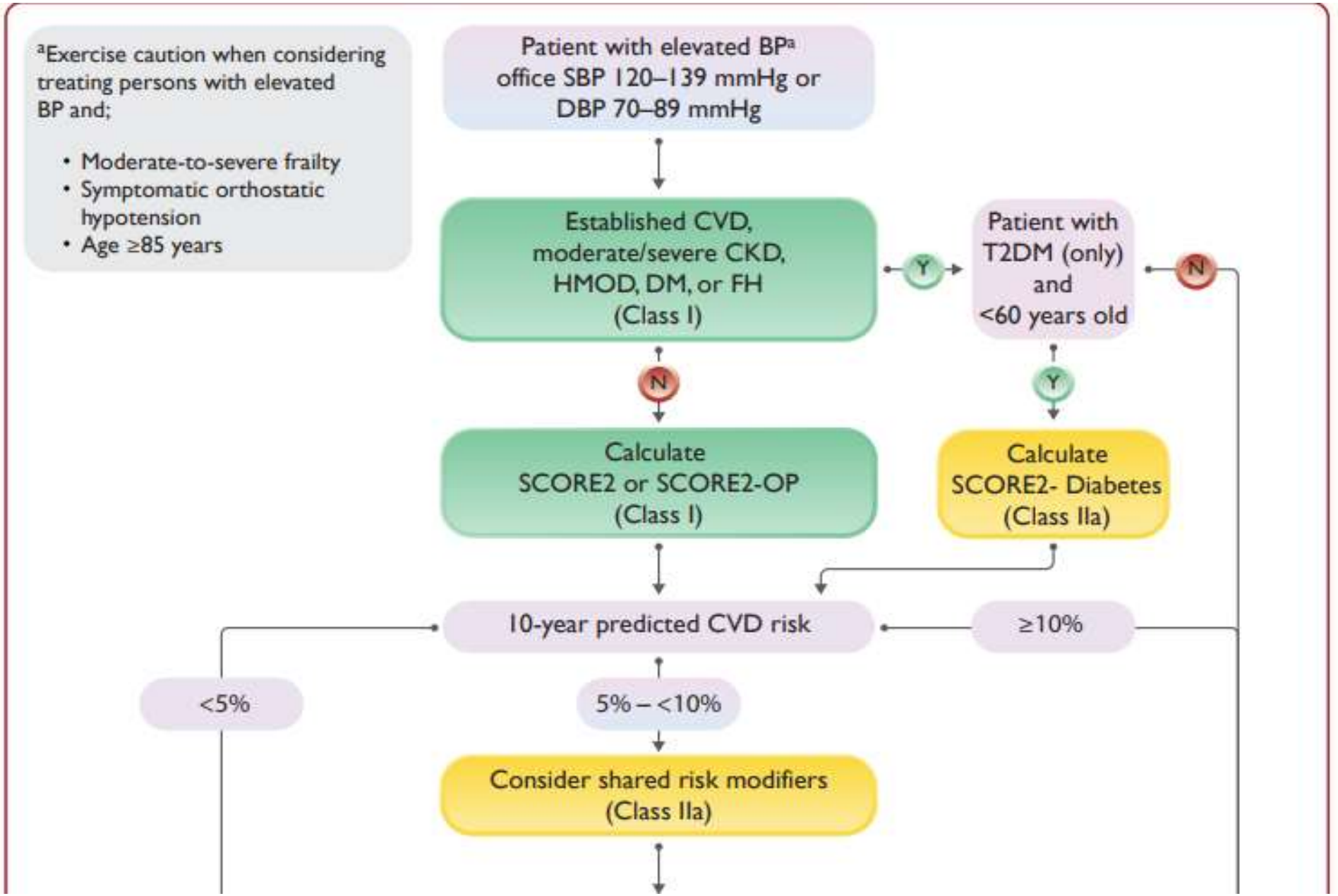
However,
they do not include ‘non-traditional’ CVD risk factors (termed ’risk modifier')

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

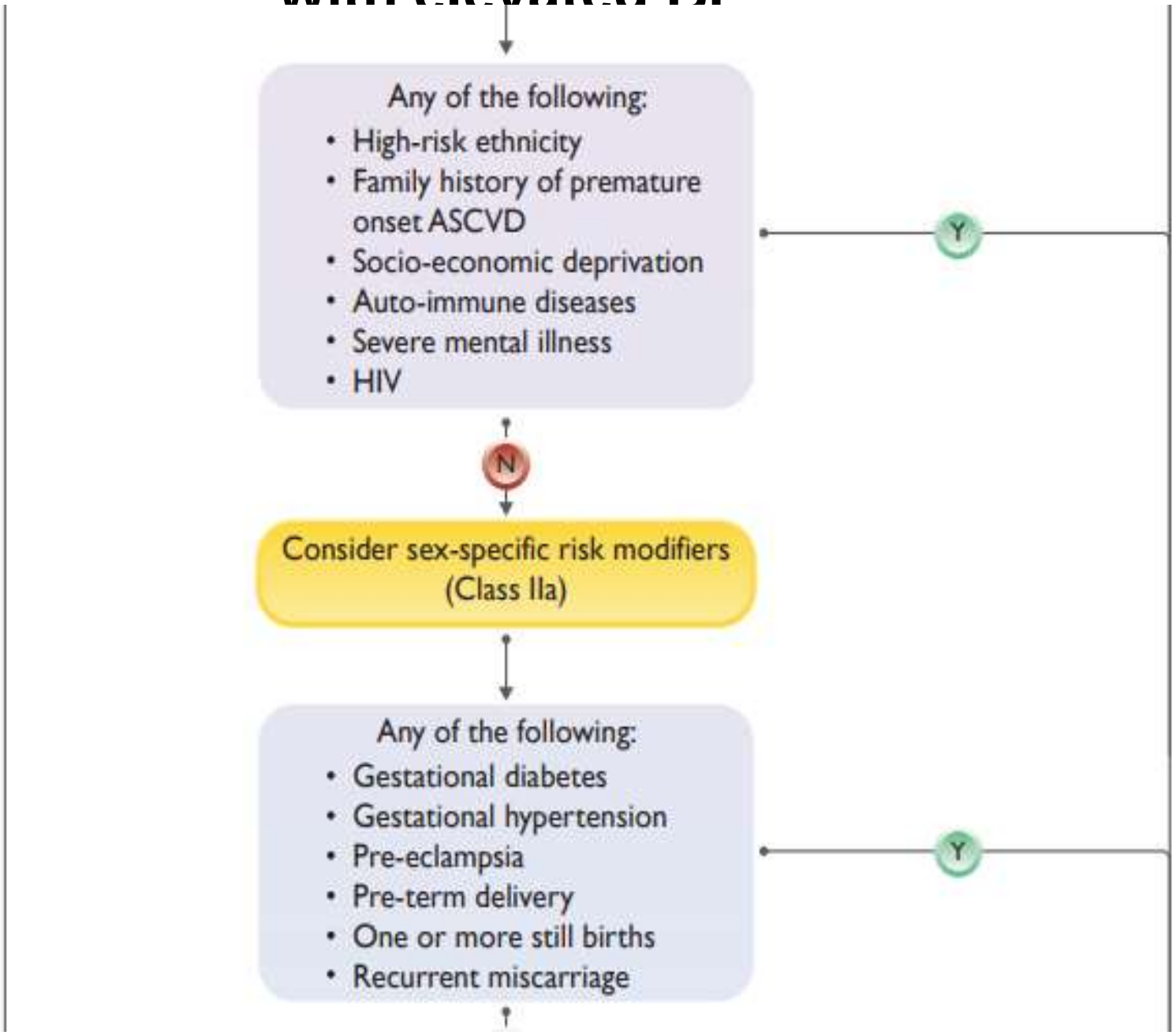


ASCVD, atherosclerotic cardiovascular disease; HIV, human immunodeficiency virus.

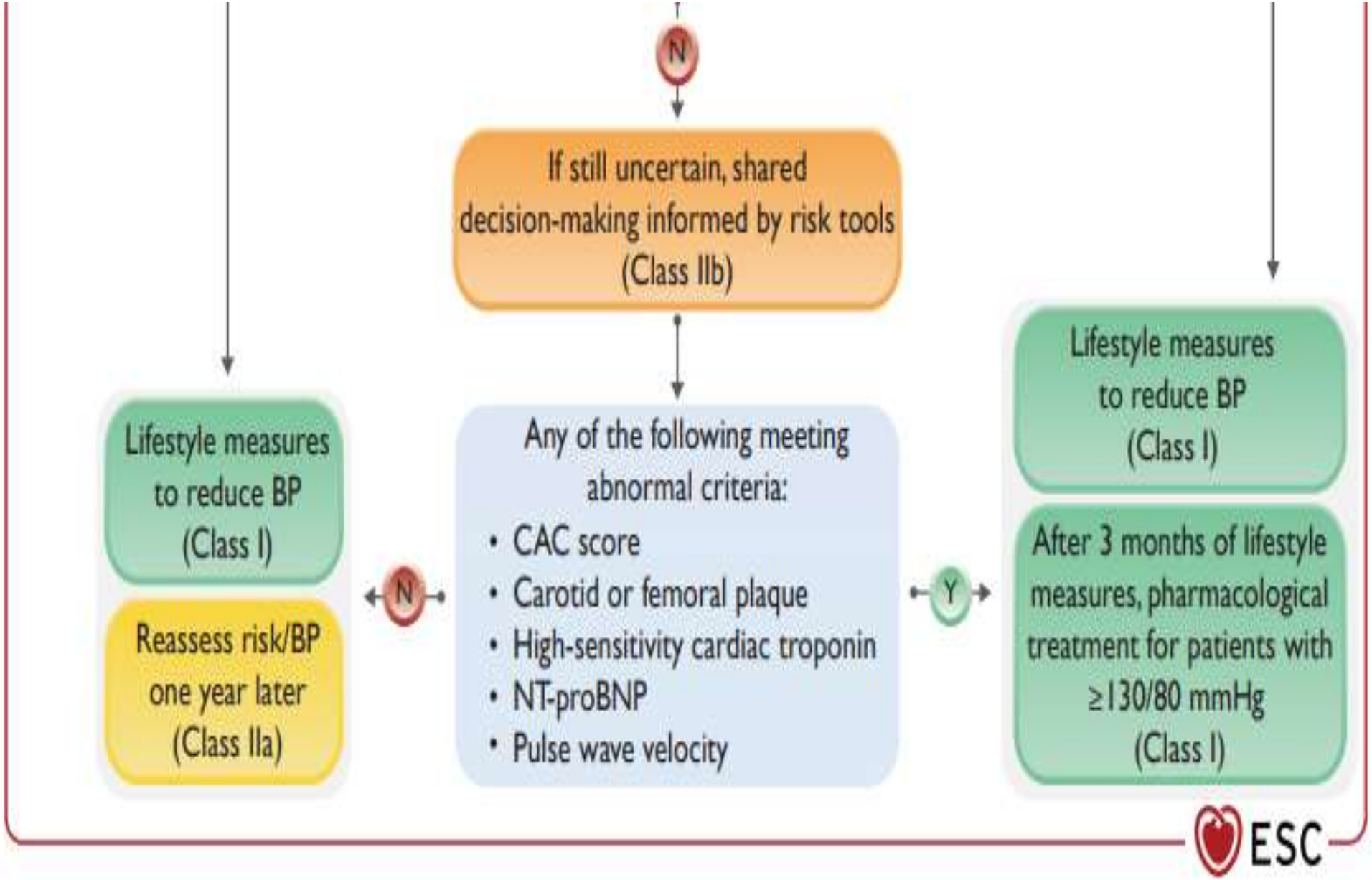
Summary of cardiovascular disease risk-stratification approach for BP treatment in adults with elevated BP



Summary of cardiovascular disease risk-stratification approach for BP treatment in adults with elevated BP



Summary of cardiovascular disease risk-stratification approach for BP treatment in adults with elevated BP

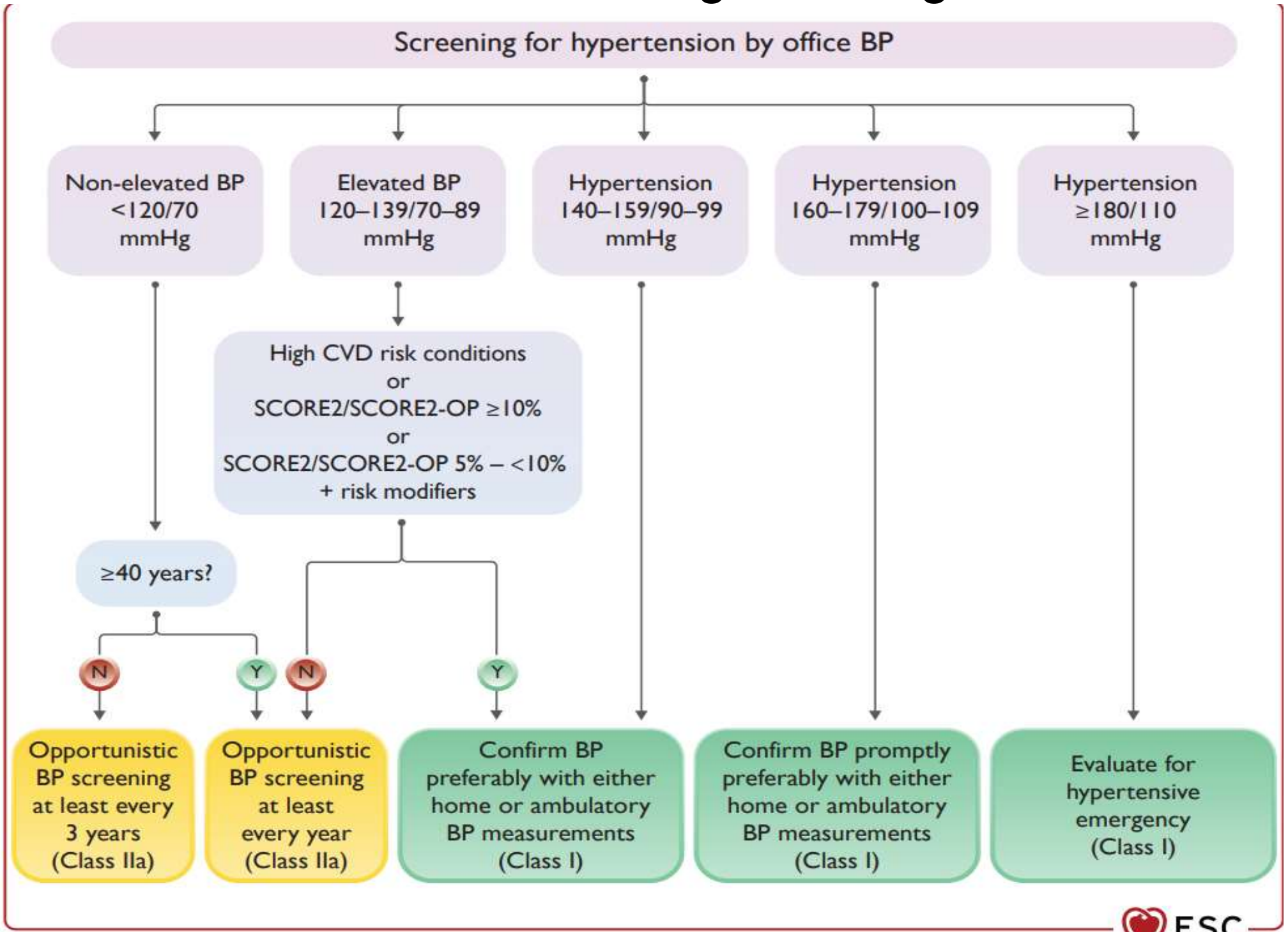


Diagnosing hypertension and investigating underlying causes

HTN is predominantly an asymptomatic condition that is typ ically detected by systematic or opportunistic screening in a healthcare setting. Systematic screening refers to any process where individuals invited to a healthcare setting solely to measure their BP and CVD risk profile.

Recommendation	Class[a]	Level[b]
Opportunistic screening for elevated BP and hypertension should be considered at least every 3 years for adults aged <40 years.[236,237]	IIa	C
Opportunistic screening for elevated BP and hypertension should be considered at least annually for adults aged ≥40 years.[231,237]	IIa	C
In individuals with elevated BP who do not currently meet risk thresholds for BP-lowering treatment, a repeat BP measurement and risk assessment within 1 year should be considered.	IIa	C

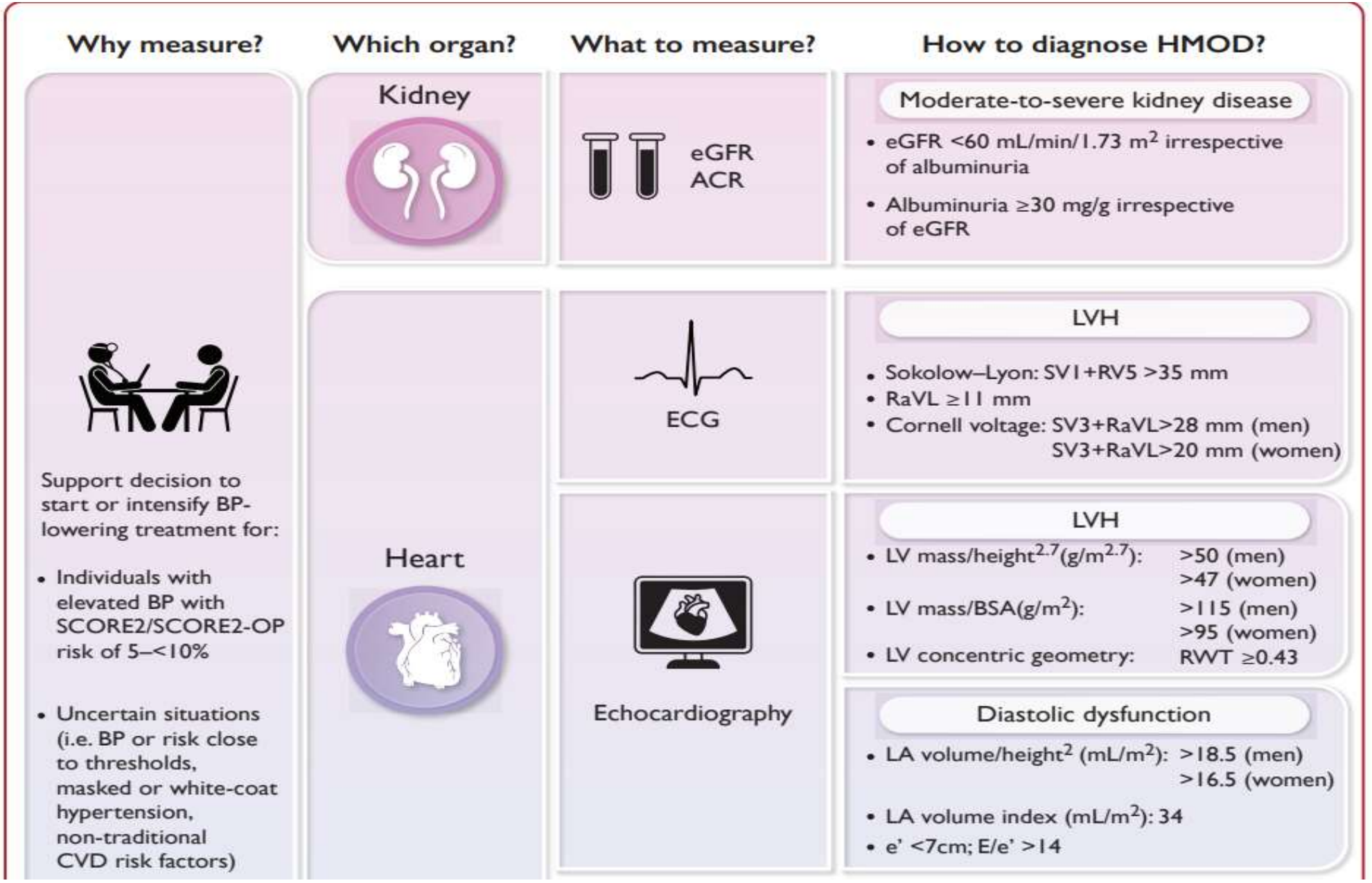
Protocol for confirming HTN diagnosis



Optional tests that may be used as clinically indi cated in the initial work-up of a patient with elevated BP or HTN to assess hypertension-mediated organ damage or established cardiovascular disease

Optional test	Clinical utility
Echocardiography	Assessing HMOD (hypertensive heart disease) Assessing established CVD (previous acute myocardial infarction, heart failure) Assessing thoracic aorta dilation
CAC by cardiac CT or carotid or femoral artery ultrasound imaging	Assessing HMOD (atherosclerotic plaque)
Large artery stiffness (carotid–femoral or brachial–ankle PWV)	Assessing HMOD (arterial stiffness)
High-sensitivity cardiac troponin and/or NT-proBNP	Assessing HMOD
Ankle–brachial index	Assessing established CVD (lower-extremity arterial disease)
Abdominal ultrasound	Assessing established CVD (abdominal aneurysm)
Fundoscopy	Assessing HMOD (hypertensive retinopathy) Diagnosing hypertensive emergency/ malignant hypertension (haemorrhages and exudates, papilloedema)

Tests and criteria for defining hypertension-mediated organ damage and considerations for their use in clinical practice



Tests and criteria for defining hypertension-mediated organ damage and considerations for their use in clinical practice

Why measure?	Which organ?	What to measure?	How to diagnose HMOD?
• Individuals <40 years old with elevated blood pressure • Assistance overcoming patient and physician inertia		Cardiac biomarkers	• hs-cTnT or I >99th percentile upper reference limit • NT-proBNP >125 pg/mL if age <75 years or >450 pg/mL if ≥75 years
	Arteries 	Carotid or femoral ultrasound	Plaque (focal wall thickening >1.5 mm)
		Pulse wave velocity	• Carotid-femoral PWV >10 m/s • Brachial-ankle PWV >14 m/s
		Cardiac CT	Coronary artery calcium score >100 Agatston units

ESC

Secondary HTN: when to screen/further investigations

Secondary HTN is more prevalent than previously thought

The prevalence of secondary HTN is 10%–35% in all hypertensive patients and up to 50% of patients with resistant HTN

Patient characteristics that should raise the suspicion of secondary HTN

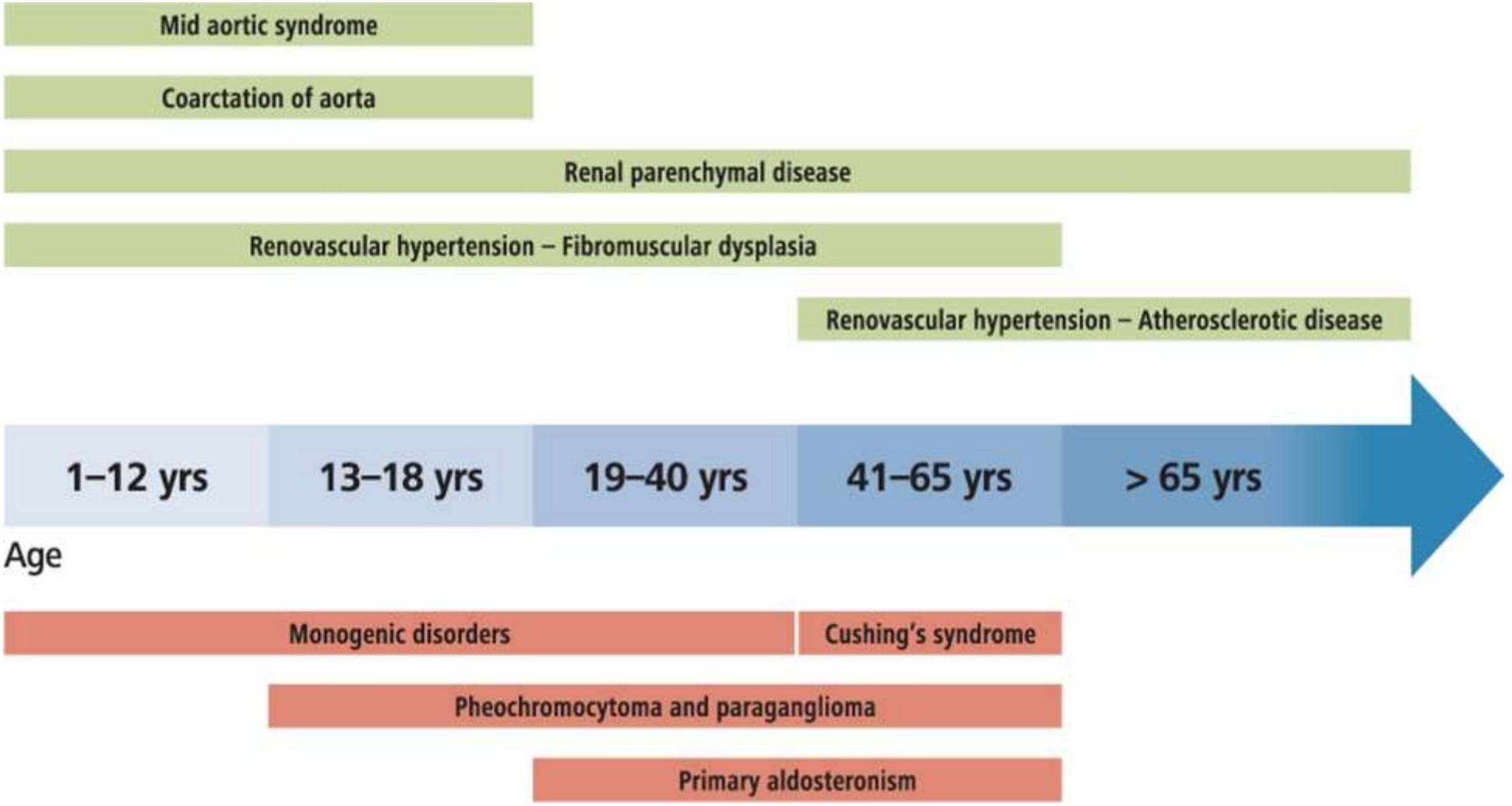
Younger patients (<40 years) with grade 2 or 3 HTN or HTN of any grade in childhood
Sudden onset of HTN in individuals with previously documented normotension
Acute worsening of BP control in patients with previously well controlled by treatment
True resistant HTN
Hypertensive emergency
Severe (grade 3) or malignant HTN
Severe and/or extensive HMOD, particularly if disproportionate for the duration and severity of the BP elevation
Clinical or biochemical **features suggestive of endocrine causes of HTN**
Clinical features **suggestive of renovascular HTN or fibromuscular dysplasia**
Clinical features suggestive of **obstructive sleep apnea**

Severe HTN in pregnancy (>160/110 mmHg) or acute worsening of BP control in pregnant women with preexisting HTN

Optional tests that should be used to screen for secondary HTN in the presence of suggestive signs, symptoms, or medical history

Cause of secondary hypertension	Screening test
Primary aldosteronism	Aldosterone-to-renin ratio Helpful information can also be provided by reviewing prior potassium levels (hypokalaemia increases the likelihood of coexistent primary hyperaldosteronism)
Renovascular hypertension	Renal doppler ultrasound Abdominal CT angiogram or MRI
Phaeochromocytoma/paraganglioma	24 h urinary and/or plasma metanephrine and normetanephrine
Obstructive sleep apnoea syndrome	Overnight ambulatory polysomnography
Renal parenchymal disease	Plasma creatinine, sodium, and potassium eGFR Urine dipstick for blood and protein Urinary albumin-to-creatinine ratio Renal ultrasound
Cushing's syndrome	24 h urinary free cortisol Low-dose dexamethasone suppression test
Thyroid disease (hyper- or hypothyroidism)	TSH
Hyperparathyroidism	Parathyroid hormone Calcium and phosphate
Coarctation of the aorta	Echocardiogram Aortic CT angiogram

Incidence of selected forms of secondary HTN according to age



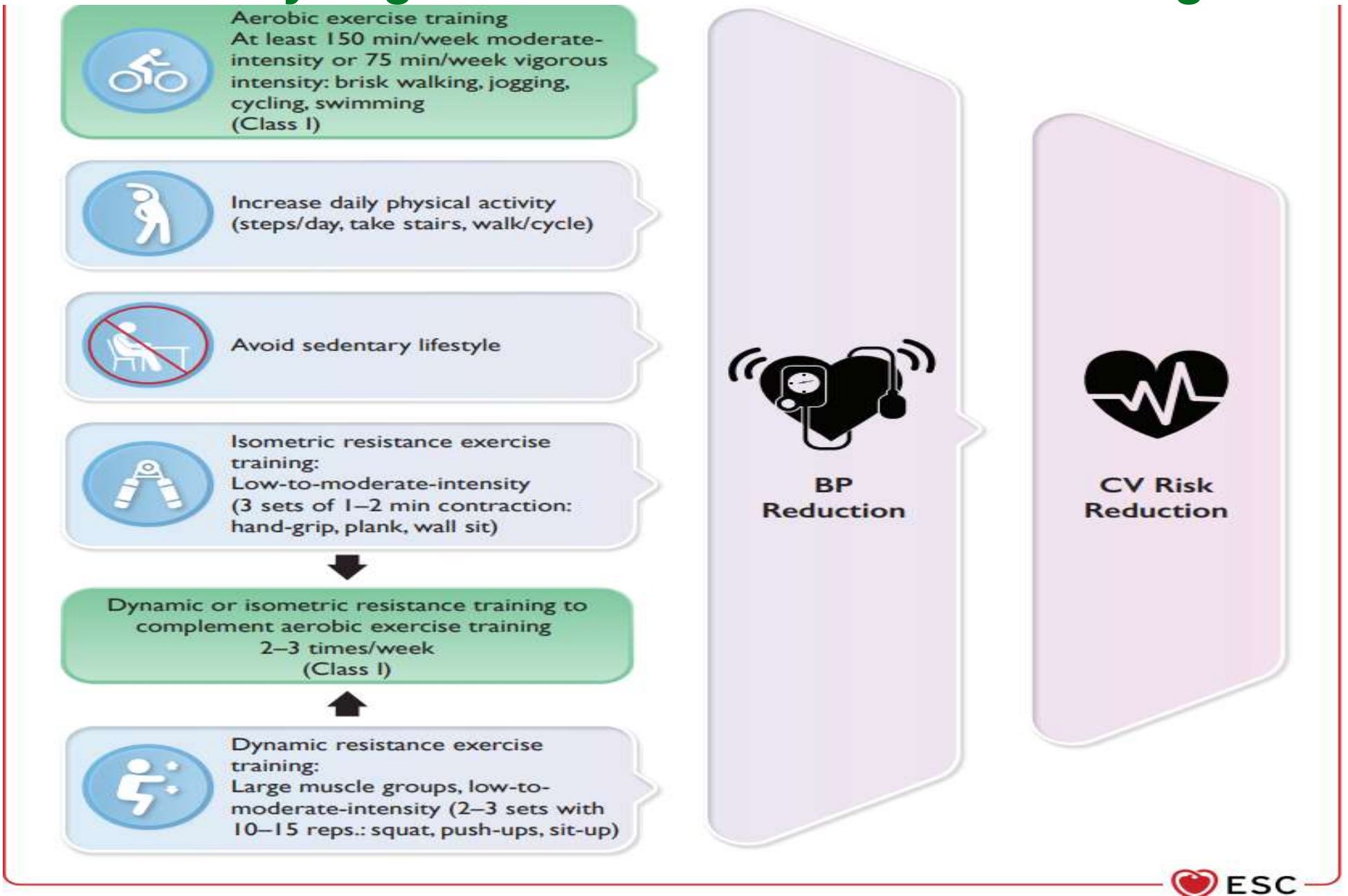
Preventing and treating elevated BP & HTN

The ultimate goal of preventing and treating elevated BP and HTN is to reduce CVD, to improve quality of life, and to prevent prema ture death.

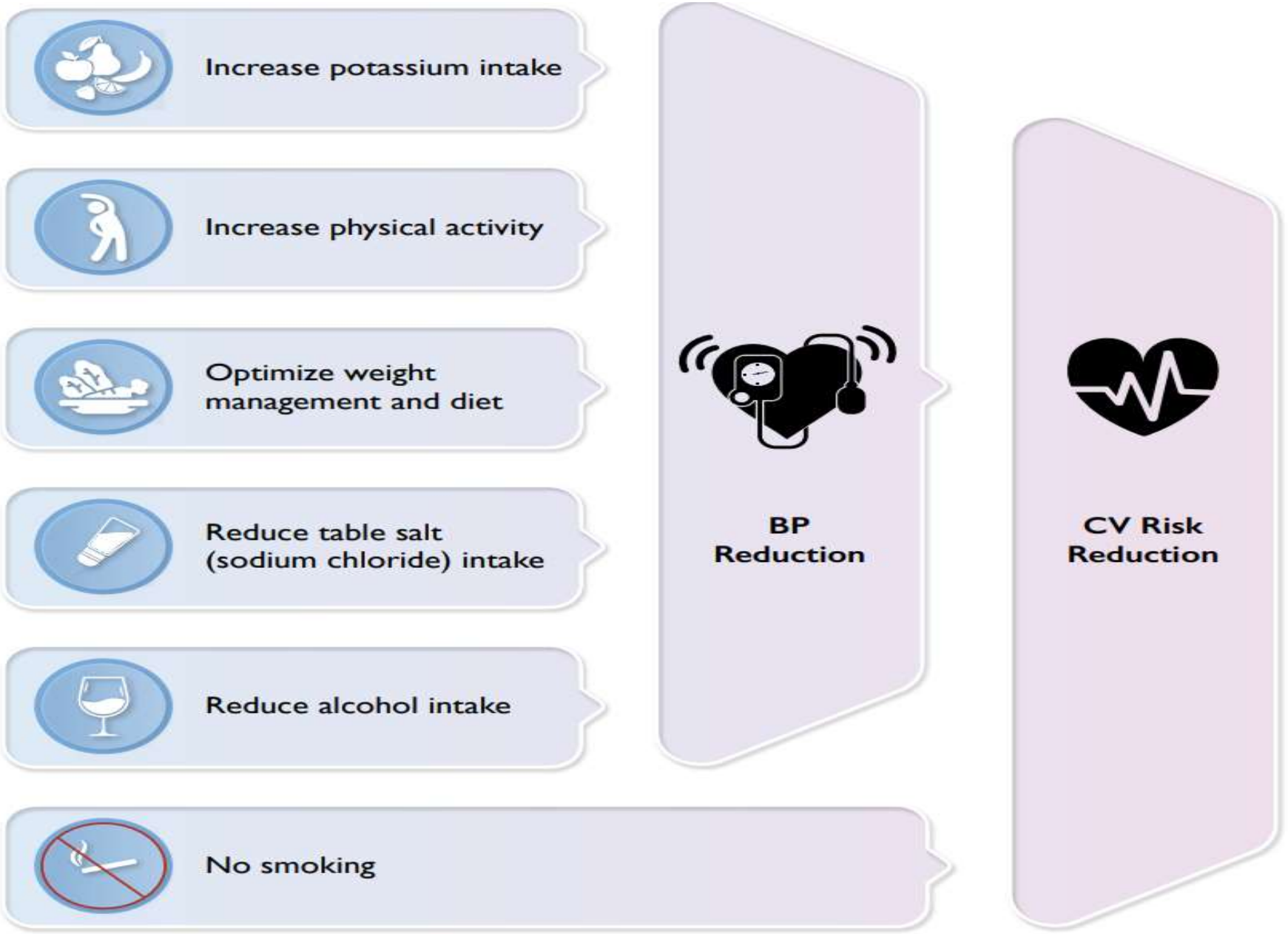
Crucially, besides BP, other CVD risk factors need to be comprehensively addressed (e.g. smoking, glucose, dyslipidaemia) as de tailed in the 2021 ESC Guidelines on cardiovascular disease prevention in clinical practice.

Physical activity according to different types of exercise and reduction of BP and overall cardiovascular disease risk.

Priority is given to aerobic exercise training



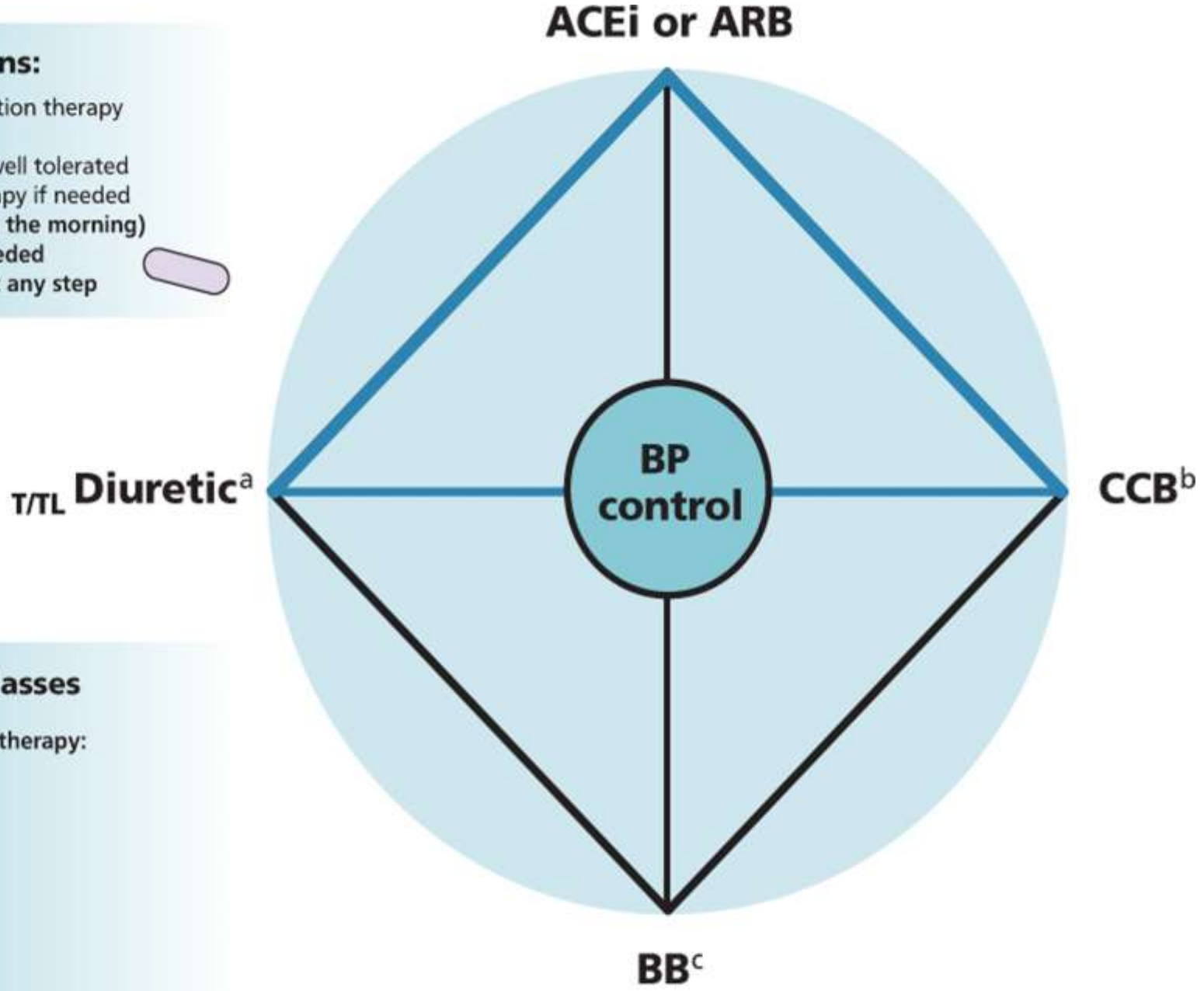
Effects of main lifestyle factors on BP and cardiovascular risk reduction



Drug classes for BP-lowering therapy

Prescribing patterns:

- Start with dual combination therapy in most patients
- Uptitrate to maximum well tolerated doses and to triple therapy if needed
- **Once daily (preferred in the morning)**
- **Add further drugs if needed**
- **Preferred use of SPCs at any step**



Additional drug classes

General antihypertensive therapy:

- Steroidal MRA
- Loop Diuretic
- Alpha-1 Blocker
- Centrally acting agent
- Vasodilator

Special comorbidities:

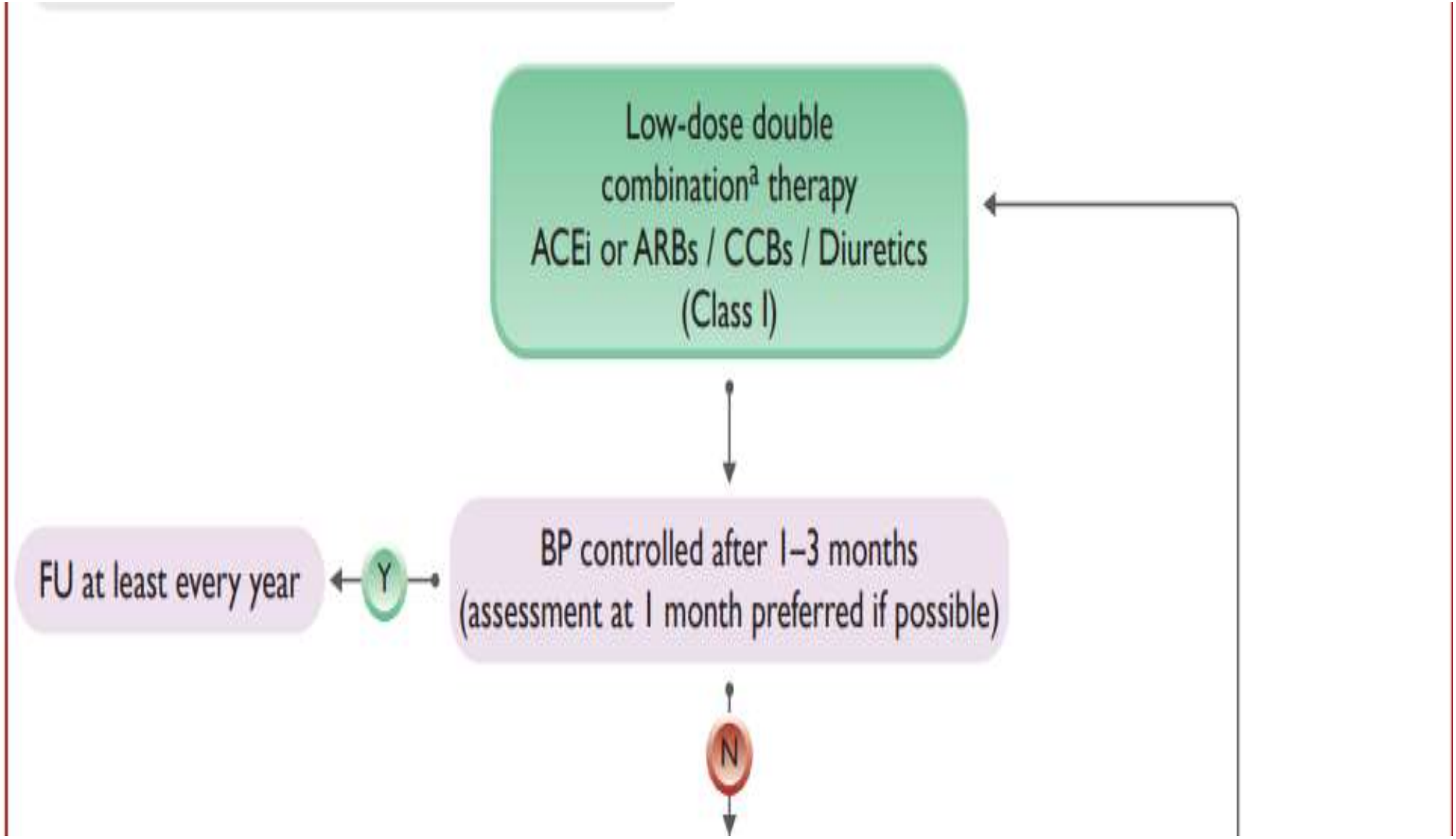
- ARNi
- SGLT2i
- Non-Steroidal MRA

Practical algorithm for pharmacological BP lowering

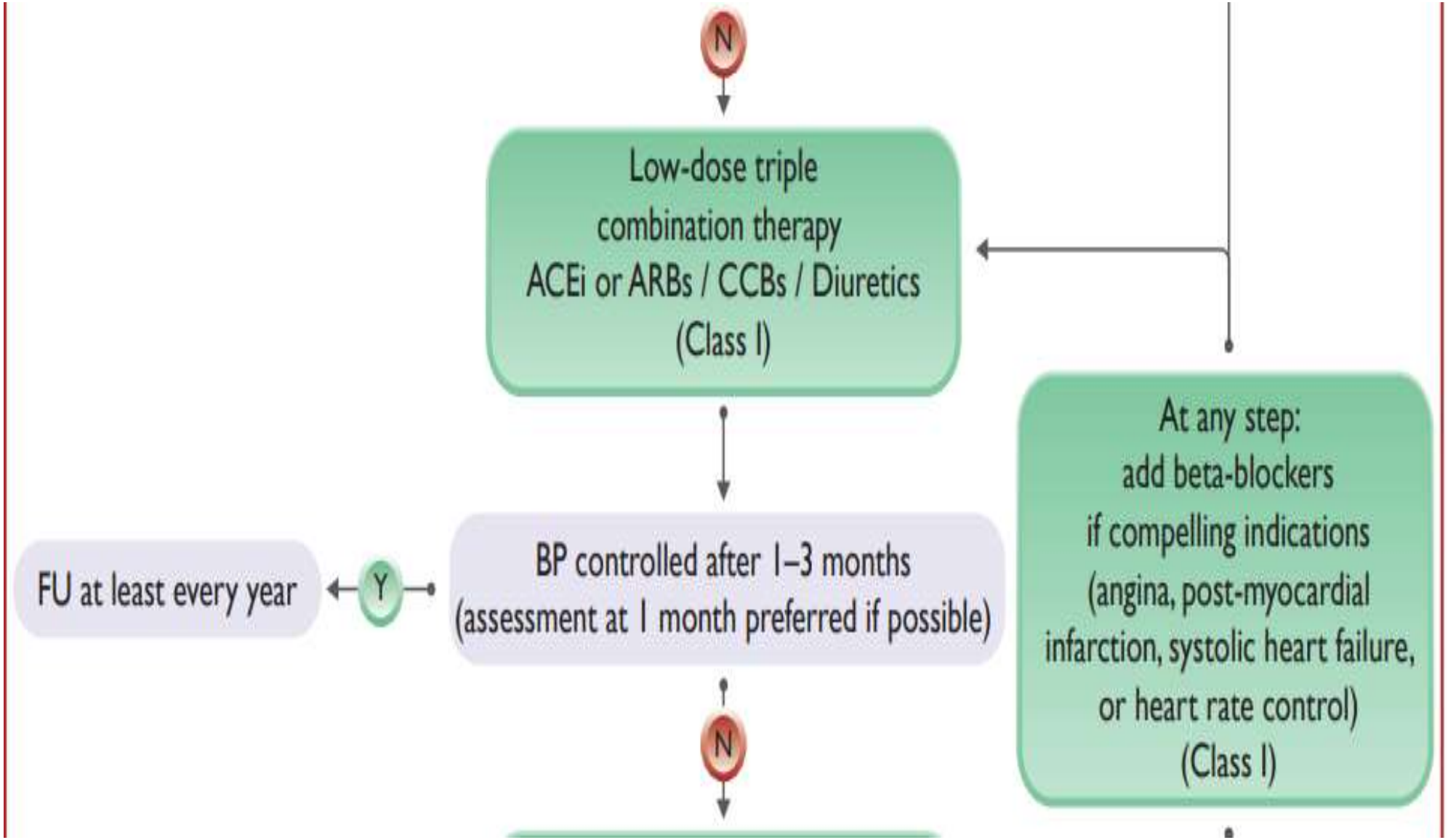
[a]Initial monotherapy preferred

- Elevated BP category (120/70–139/89 mmHg)
- Moderate-to-severe frailty
- Symptomatic orthostatic hypotension
- Age ≥85 years

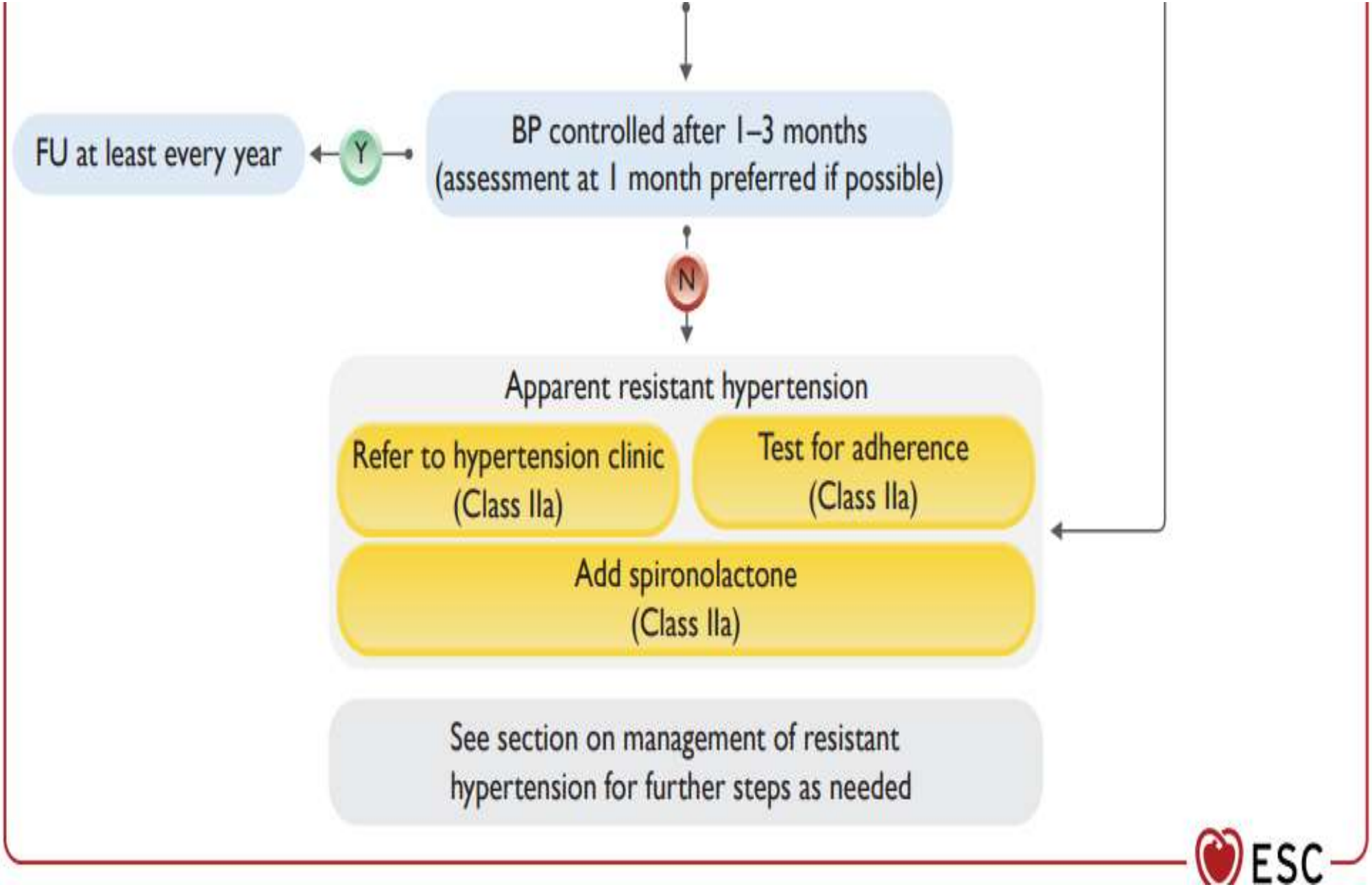
Practical algorithm for pharmacological BP lowering



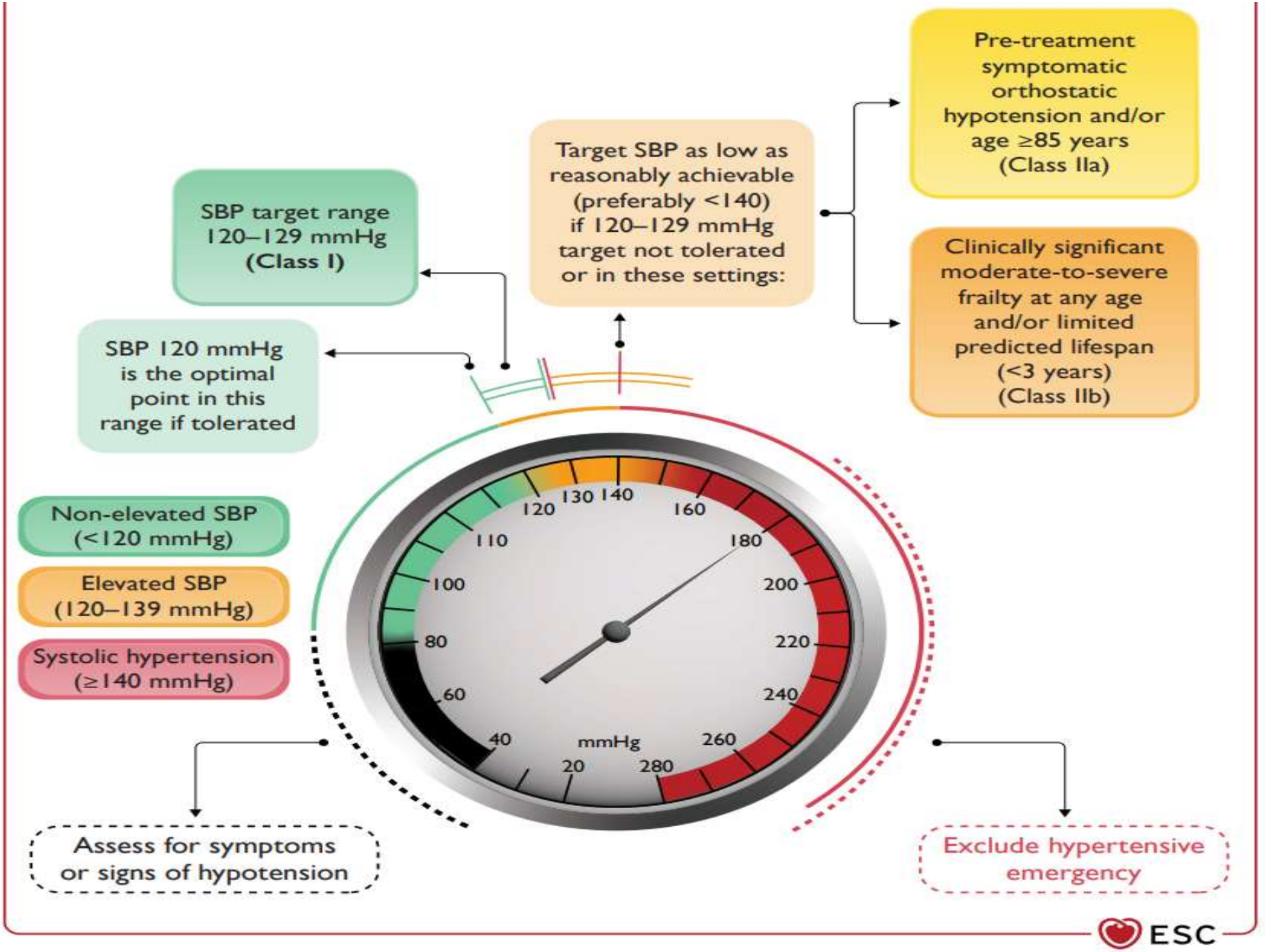
Practical algorithm for pharmacological BP lowering



Practical algorithm for pharmacological BP lowering



Systolic BP categories and treatment target range



DEVICE-BASED TREATMENT OF HTN

Renal denervation (RDN)

Increased activity of the SNS is one of the important factors in the pathophysiology of HTN, especially in obesity, OSA and CKD.

Efferent sympathetic nerves to the kidneys increase renin release via beta1-adrenergic receptor activation at the level of the juxta-glomerular cells, decrease renal perfusion and GFR, increase tubular reabsorption of sodium and induce a rightward shift of the BP-natriuresis curve.

Conversely, increased afferent sensory nerve signaling to the central nervous system in response to kidney ischemia, injury or inflammatory, fibrotic processes and other alterations of the tissue environment leads to reflex sympathetic activation, with peripheral vasoconstriction, increased BP and aggravation of HMOD

The rationale of RDN is to modulate the overactive signaling between the kidneys and the central SNS, which may be at least partly responsible for the sympathetic hyperactivity of resistant hypertension

DEVICE-BASED TREATMENT OF HTN

Use of renal denervation

Recommendations and statements	CoR	LoE
RDN can be considered as a treatment option in patients an eGFR >40 ml/min/1.73m^2 who have uncontrolled BP despite the use of antihypertensive drug combination therapy, or if drug treatment elicits serious side effects and poor quality of life.	II	B
RDN can be considered as an additional treatment option in patients with resistant hypertension if eGFR is >40 ml/min/1.73m^2.	II	B
Selection of patients to whom RDN is offered should be done in a shared decision-making process after objective and complete patient's information.	I	C
Renal denervation should only be performed in experienced specialized centers to guarantee appropriate selection of eligible patients and completeness of the denervation procedure.	I	C

Challenges of long-term follow-up

HTN requires lifelong therapy.

Therefore, long-term FU is needed, and a proper FU organization is essential. In practice, **the vast majority of hypertensive patients are taken care of by primary or family physicians** and only a small percentage is seen and followed by specialists.

Physicians involved in long-term hypertension FU should build **patients' records that include**:

- the trajectories of office and, if available, the out-of-office BP profile,
- the history of the treatment strategies and of their inconveniences,
- the CV risk factor profile, the diagnoses at discharge from hospital and the HMOD dynamic status.