

Table 1. AHA/ACC 2025 GL on hypertension. Recommendations for Secondary Forms of Hypertension

1	C-EO	1. In adults with hypertension, screening for specific forms of secondary hypertension is recommended when clinical suspicion is present (Table 10, Figure 5) to increase rates of detection, diagnosis, and specific targeted therapy.
1	B-NR	2. In adults with resistant hypertension, screening for primary aldosteronism is recommended regardless of whether hypokalemia is present to increase rates of detection, diagnosis, and specific targeted therapy. ^{1,2}
2a	C-EO	3. In adults who have a positive screening test for a form of secondary hypertension, referral to a clinician who has expertise in that form of hypertension is reasonable for diagnostic confirmation and treatment.

Table 2. ESC 2024 GL on hypertension.

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

Recommendations for screening for secondary hypertension

It is recommended that patients with hypertension presenting with suggestive signs, symptoms or medical history of secondary hypertension are appropriately screened for secondary hypertension. ^{312,314,315,323,339}	I	B
Screening for primary aldosteronism by renin and aldosterone measurements should be considered in all adults with confirmed hypertension (BP ≥140/90 mmHg). ^{313,316,323,339}	IIa	B

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

CT, computed tomography; eGFR, estimated glomerular filtration rate; MRI, magnetic resonance imaging; TSH, thyroid-stimulating hormone.

Table 3. AHA/ACC 2025 GL on hypertension.

Causes of Secondary Hypertension With Indications for Additional Testing and Diagnostic Screening Tests

	Prevalence	Indications for Additional Testing	Physical Examination Findings	Screening Tests	Confirmatory Tests
Common causes					
OSA ⁶⁻⁷	25%-50%	Snoring, choking, gasping during sleep; daytime sleepiness; resistant hypertension	Obesity, large neck size (eg, >17 inches [men]; >16 inches [women], Mallampati class 3-4; loss of normal nocturnal BP fall	STOP-Bang Questionnaire ¹⁵ ; Berlin Questionnaire ¹⁶ ; overnight oximetry	Referral for polysomnography or home sleep apnea testing if no suspicion of nonrespiratory sleep disorders (eg, narcolepsy)
CKD ^{17,18}	14%	Diabetes, obstruction, hematuria; urinary frequency and nocturia; urinary incontinence, analgesic abuse; family history of polycystic kidney disease; elevated serum creatinine; abnormal urinalysis	Abdominal mass or large palpable kidneys (polycystic kidney disease); skin pallor	Electrolytes, including sodium, potassium, chloride, and bicarbonate, serum creatinine, urinalysis, urine microalbumin, serum cystatin C, renal ultrasound	Tests to evaluate cause of CKD
Primary aldosteronism ^{1-3,9,19}	5%-25%	Resistant hypertension; hypertension with hypokalemia (spontaneous or diuretic induced); hypertension and muscle cramps or weakness; hypertension and incidentally discovered adrenal mass; hypertension and obstructive sleep apnea; hypertension and family history of early-onset hypertension or stroke	Arrhythmias (with hypokalemia); especially AF	Electrolytes, including sodium and potassium, plasma aldosterone/renin activity ratio (correction of hypokalemia and withdrawal of MRA for 4-6 wks)	Oral sodium loading test (with 24-h urine aldosterone) or IV saline infusion test with plasma aldosterone at 4 h of infusion or captopril suppression test (in patients not on ACEi or ARB treatment), adrenal CT scan, adrenal vein sampling
Drug or alcohol induced ¹¹	2%-20%	Sodium-containing antacids; antidepressants; nicotine (smoking); alcohol; NSAIDs; oral contraceptives; cyclosporine or tacrolimus; sympathomimetics (decongestants, anorectics); cocaine, amphetamines and other illicit drugs; neuropsychiatric agents; erythropoiesis-stimulating agents; cancer treatment (VEGF inhibitors, Bruton tyrosine kinase inhibitors and others), clonidine withdrawal; herbal agents (Ma Huang, ephedra)	Fine tremor, tachycardia, sweating (cocaine, ephedrine, MAO inhibitors); acute abdominal pain (cocaine)	Urinary drug screen (illicit drugs)	Response to withdrawal of suspected agent
Renovascular hypertension ¹⁰	0.1%-5%	Resistant hypertension; hypertension of abrupt onset or worsening or increasingly difficult to control; flash pulmonary edema (atherosclerotic); early-onset hypertension, especially in women (fibromuscular hyperplasia)	Abdominal systolic-diastolic bruit; bruits over other arteries (carotid, femoral)	Electrolytes, including sodium, potassium, chloride, and bicarbonate, renal duplex Doppler ultrasound; magnetic resonance arteriography; abdominal CT arteriography	Bilateral selective renal intra-arterial angiography
Uncommon causes					
Hypothyroidism ²⁰	<1%	Dry skin; cold intolerance; constipation; hoarseness; weight gain	Delayed ankle reflex; periorbital edema; coarse skin; cold skin; slow movement; goiter	Thyroid-stimulating hormone; free thyroxine	None
Hyperthyroidism ²⁰	<1%	Warm, moist skin; heat intolerance; nervousness; tremulousness; palpitations, insomnia; weight loss; diarrhea; proximal muscle weakness	Lid lag; fine tremor of the outstretched hands; warm, moist skin, goiter, thyroid nodule	Thyroid-stimulating hormone; free thyroxine	Radioactive iodine uptake and scan
Pheochromocytoma/paraganglioma ^{21,22}	<0.6%	Resistant hypertension; paroxysmal hypertension or crisis superimposed on sustained hypertension; "spells" BP lability, headache, sweating, palpitations, piloerection; positive family history of pheochromocytoma/paraganglioma; adrenal incidentaloma	Skin stigmata of neurofibromatosis (café-au-lait spots; neurofibromas); orthostatic hypotension	24-h urinary fractionated metanephrines or plasma metanephrines under standard conditions (supine position with indwelling IV cannula)	CT or MRI scan of abdomen/pelvis, Ga-DOTATATE PET/CT scan

	Prevalence	Indications for Additional Testing	Physical Examination Findings	Screening Tests	Confirmatory Tests
Aortic coarctation (undiagnosed or repaired) ²³	0.1%	Young adult with hypertension (age <30 y)	BP higher in upper extremities than in lower extremities; absent femoral pulses; continuous murmur over patient's back, chest, or abdominal bruit; left thoracotomy scar (postoperative)	Echocardiogram	Thoracic and abdominal CT angiogram or magnetic resonance arteriography
Cushing syndrome ²⁴	<0.1%	Rapid weight gain, especially with central distribution; proximal muscle weakness; depression; hyperglycemia	Central obesity, "moon" face, dorsal and supraclavicular fat pads, wide (1 cm) violaceous striae, hirsutism	Overnight 1-mg dexamethasone suppression test	24-h urinary free cortisol excretion (preferably multiple); midnight salivary cortisol
Primary hyperparathyroidism ²⁰	Rare	Hypercalcemia	Usually none	Serum calcium	Serum parathyroid hormone
Congenital adrenal hyperplasia ²⁰	Rare	Hypertension and hypokalemia; virilization (11-beta-hydroxylase deficiency [11-beta-OH]); incomplete masculinization in men and primary amenorrhea in women (17-alpha-hydroxylase deficiency [17-alpha-OH])	Signs of virilization (11-beta-OH) or incomplete masculinization (17-alpha-OH)	Hypertension and hypokalemia with low or normal aldosterone and renin	11-beta-OH: elevated DOC, 11-deoxycortisol, and androgens; 17-alpha-OH: decreased androgens and estrogen but elevated DOC and corticosterone
Mineralocorticoid excess syndromes other than primary aldosteronism ²⁰	Rare	Early-onset hypertension; resistant hypertension; hypokalemia or hyperkalemia	Arrhythmias (with hypokalemia)	Low aldosterone and renin	Urinary cortisol metabolites; genetic testing
Acromegaly ²⁵	Rare	Acral features, enlarging shoe, glove, or hat size; headache, visual disturbances; diabetes	Acral features; large hands and feet; frontal bossing	Serum growth hormone ≥ 1 ng/mL during oral glucose load	Elevated age- and sex-matched IGF-1 level; MRI scan of the pituitary

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ACEi indicates angiotensin-converting enzyme inhibitors; ARB, angiotensin receptor blockers; BP, blood pressure; AF, atrial fibrillation; CKD, chronic kidney disease; CT, computed tomography; DOC, 11-deoxycorticosterone; h, hour; IGF-1, insulin-like growth factor-1; IV, intravenous; MAO, monoamine oxidase; mg, milligrams; MRI, magnetic resonance imaging; NSAIDs, nonsteroidal anti-inflammatory drugs; OH, hydroxylase; OSA, obstructive sleep apnea; RCT, randomized clinical trial; VEGF, vascular endothelial growth factor; wk, week; and y, years.

Table 4. AHA/ACC 2025 GL on hypertension.**Recommendations for Secondary Forms of Hypertension**

1	C-EO	1. In adults with hypertension, screening for specific forms of secondary hypertension is recommended when clinical suspicion is present (Table 10, Figure 5) to increase rates of detection, diagnosis, and specific targeted therapy.
1	B-NR	2. In adults with resistant hypertension, screening for primary aldosteronism is recommended regardless of whether hypokalemia is present to increase rates of detection, diagnosis, and specific targeted therapy. ^{1,2}
2a	C-EO	3. In adults who have a positive screening test for a form of secondary hypertension, referral to a clinician who has expertise in that form of hypertension is reasonable for diagnostic confirmation and treatment.

Screening for secondary hypertension. Selected List of Frequently Used Medications and Other Substances That May Cause Elevated Blood Pressure With Recommendations for Management*

Agent	Possible Management Strategy
Nonprescription drugs/substance	
Alcohol	Options include abstinence or limit alcohol to ≤1 drink daily for women and ≤2 drinks daily for men ^{26,27}
Caffeine ²⁸	Limit caffeine intake to <300 mg/d Avoid more than 1 cup daily in patients with severe uncontrolled hypertension
Decongestants (eg, phenylephrine, pseudoephedrine)	Use for shortest duration possible and avoid in severe or uncontrolled hypertension Consider alternative therapies (eg, nasal saline, intranasal corticosteroids, antihistamines) as appropriate
Herbal supplements (eg, Ma Huang, ephedra, St. John's wort [with MAO inhibitors, yohimbine])	Avoid use
Black licorice ²⁹	Avoid use
NSAIDs; acetaminophen	Avoid systemic NSAIDs when possible Limit acetaminophen to less than 4 g/d ¹² Consider alternative analgesics (eg, topical NSAIDs), depending on indication and risk
Recreational drugs (eg, "bath salts" [MDPV], cocaine, methamphetamine, etc)	Discontinue or avoid use
Prescription drugs	
Sudden withdrawal of central-acting sympatholytic drugs such as clonidine and tizanidine	Recommend avoiding oral clonidine for treatment of hypertension whenever possible and tapering upon discontinuation ³⁰ ; use cyclobenzaprine or other muscle relaxants instead of tizanidine ³¹
Amphetamines [†] (eg, amphetamine, methylphenidate, dexmethylphenidate, dexamfetamine, lisdexamfetamine, dextroamphetamine)	Discontinue or decrease dose Consider behavioral therapies or nonstimulants (such as guanfacine) for ADHD ³²
Antidepressants [†] (eg, MAOIs, SNRIs, TCAs)	Consider alternative agents (eg, SSRIs) depending on indication Avoid tyramine-containing foods with MAOIs
Atypical antipsychotics [†] (eg, risperidone, olanzapine) ^{33,34}	Discontinue or limit use when possible Consider behavior therapy where appropriate Recommend lifestyle modification (Section 5.1 "Lifestyle and Psychosocial Approaches") Consider alternative agents associated with lower risk of weight gain, diabetes, and dyslipidemia
Immunosuppressants [†] (eg, cyclosporine)	Consider converting to tacrolimus, which may be associated with fewer effects on BP
Oral contraceptives [†]	Use low-dose (eg, 20-30 mcg ethinyl estradiol) agents or a progestin-only form of contraception, or consider alternative forms of birth control where appropriate (eg, barrier, abstinence, nonhormonal IUD) Avoid use in women with uncontrolled hypertension ³⁵
Systemic corticosteroids [†] (eg, dexamethasone, fludrocortisone, methylprednisolone, prednisone, prednisolone)	Avoid or limit use when possible Consider alternative modes of administration (eg, inhaled, topical) when feasible
Angiogenesis inhibitor [†] (eg, bevacizumab) and tyrosine kinase inhibitors (eg, sunitinib, sorafenib)	Avoid or limit use when possible
Androgen deprivation therapy [†] such as CYP 17 inhibitors (eg, abiraterone, orteronel) or androgen receptor antagonist (eg, enzalutamide) ³⁶	Avoid or limit use when possible Consider alternative chemotherapy

*List is not all inclusive.

†In specific cases when a specific therapy is needed or the best option for the patient, it is reasonable to continue the medication and initiate or intensify antihypertensive therapy. Modified with permission from Whelton et al.¹⁴ Copyright 2018 American College of Cardiology Foundation and American Heart Association, Inc.

ADHD indicates attention-deficit/hyperactivity disorder; BP, blood pressure; CVD, cardiovascular disease; IUD, intrauterine device; MAOI, monoamine-oxidase inhibitors; MDPV, methylenedioxy pyrovalerone; NSAIDs, nonsteroidal anti-inflammatory drugs; SNRI, serotonin norepinephrine-reuptake inhibitor; SSRI, selective serotonin-reuptake inhibitor; and TCA, tricyclic antidepressant.

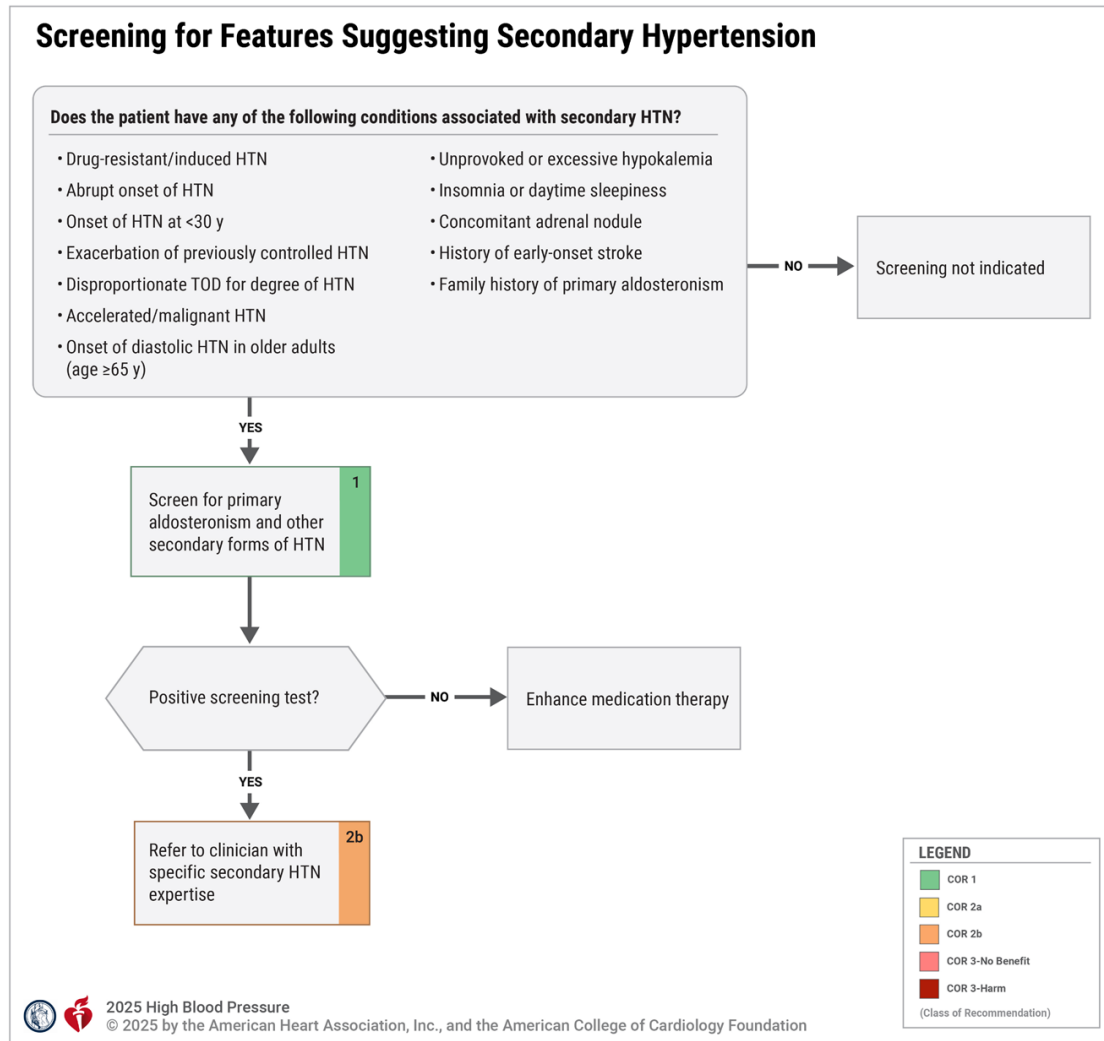


Figure 1. AHA/ACC 2025 GL on hypertension. Screening for Features Suggesting Secondary Hypertension.

HTN indicates hypertension; and TOD, target organ damage (eg, cerebrovascular disease, hypertensive retinopathy, left ventricular hypertrophy, left ventricular dysfunction, heart failure, coronary artery disease, chronic kidney disease, albuminuria, peripheral artery disease).

Table 5. ESC 2024 GL on hypertension. Optional tests that should be used to screen for secondary hypertension 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
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Thyroid disease (hyper- or hypothyroidism)	TSH
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Coarctation of the aorta	Echocardiogram Aortic CT angiogram

CT, computed tomography; eGFR, estimated glomerular filtration rate; MRI, magnetic resonance imaging; TSH, thyroid-stimulating hormone.

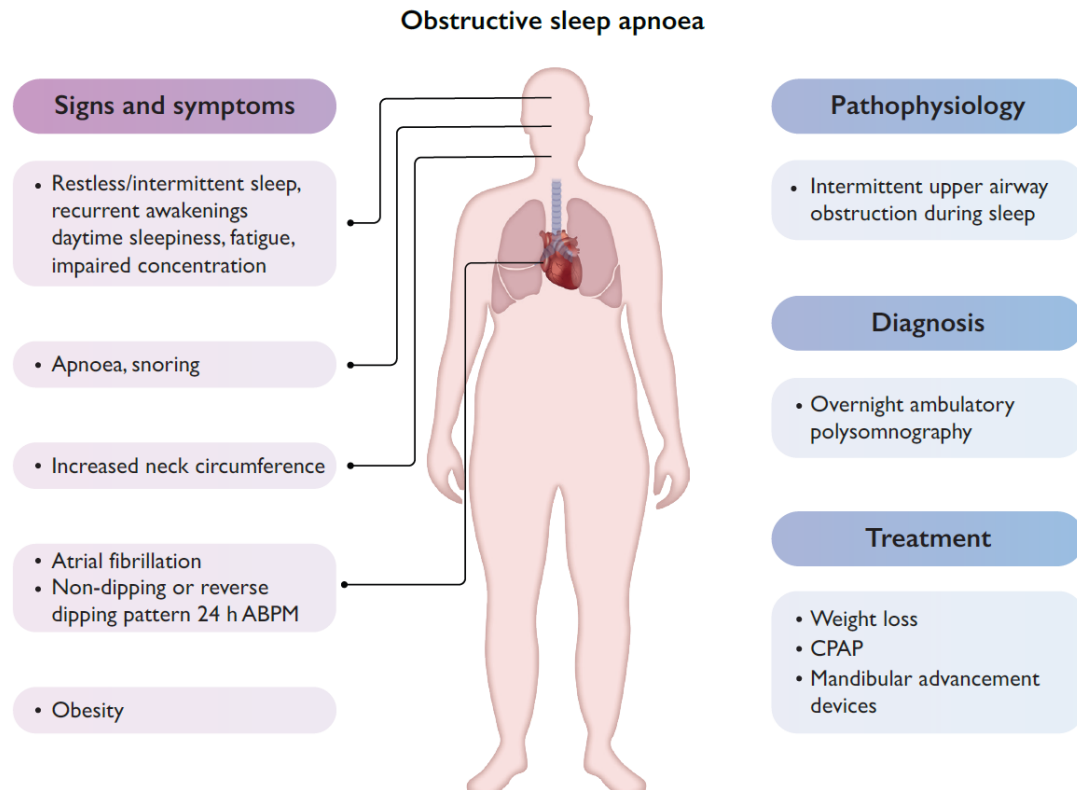


Figure 2. ESC 2024 GL on hypertension. Summary of obstructive sleep apnoea as a common form of secondary hypertension.

AF, atrial fibrillation; ABPM, ambulatory blood pressure monitor; CPAP, continuous positive airway pressure.

Table 6. Renal artery disease**AHA/ACC 2017 GL on hypertension. Renal artery stenosis.**

2a	B-R	1. In adults with hypertension and OSA who are overweight or obese, weight loss interventions when combined with continuous positive airway pressure (CPAP) treatment can be effective in reducing SBP. ¹
2a	B-R	2. In adults with resistant hypertension and moderate-to-severe OSA, CPAP treatment can be useful in reducing BP. ^{2,3}

ESC 2024 GL on Peripheral and Aortic Diseases.**Clinical signs suggestive of renal artery disease**

Hypertension onset before 30 years of age
Severe hypertension after the age of 55 years, when associated with CKD or heart failure
Hypertension and abdominal bruit
Rapid and persistent worsening of previously controlled hypertension
Resistant hypertension • Three antihypertensive drugs including a diuretic agent or • ≥ 4 antihypertensive drugs and • Other secondary form unlikely
Hypertensive crisis (i.e. acute renal failure, acute heart failure, hypertensive encephalopathy, or grade 3–4 retinopathy)
New azotaemia or worsening of renal function after treatment with RAAS blockers
Unexplained atrophic kidney or discrepancy in kidney size, or unexplained renal failure
Flash pulmonary oedema

CKD, chronic kidney disease; RAAS, renin–angiotensin–aldosterone system.

Recommendations for diagnostic strategies for renal artery disease

DUS is recommended as the first-line imaging modality in patients with suspicion of RAS. ^{787,789–791}	I	B
In cases of DUS-based suspicion of RAS or inconclusive DUS, MRA, or CTA are recommended. ^{789,791}	I	B
In patients with atherosclerotic RAS, it is recommended to assess clinical high-risk features and kidney viability when evaluating renal artery revascularization. ^{809,810}	I	B

CTA, computed tomography angiography; DUS, duplex ultrasound; MRA, magnetic resonance angiography; RAS, renal artery stenosis.

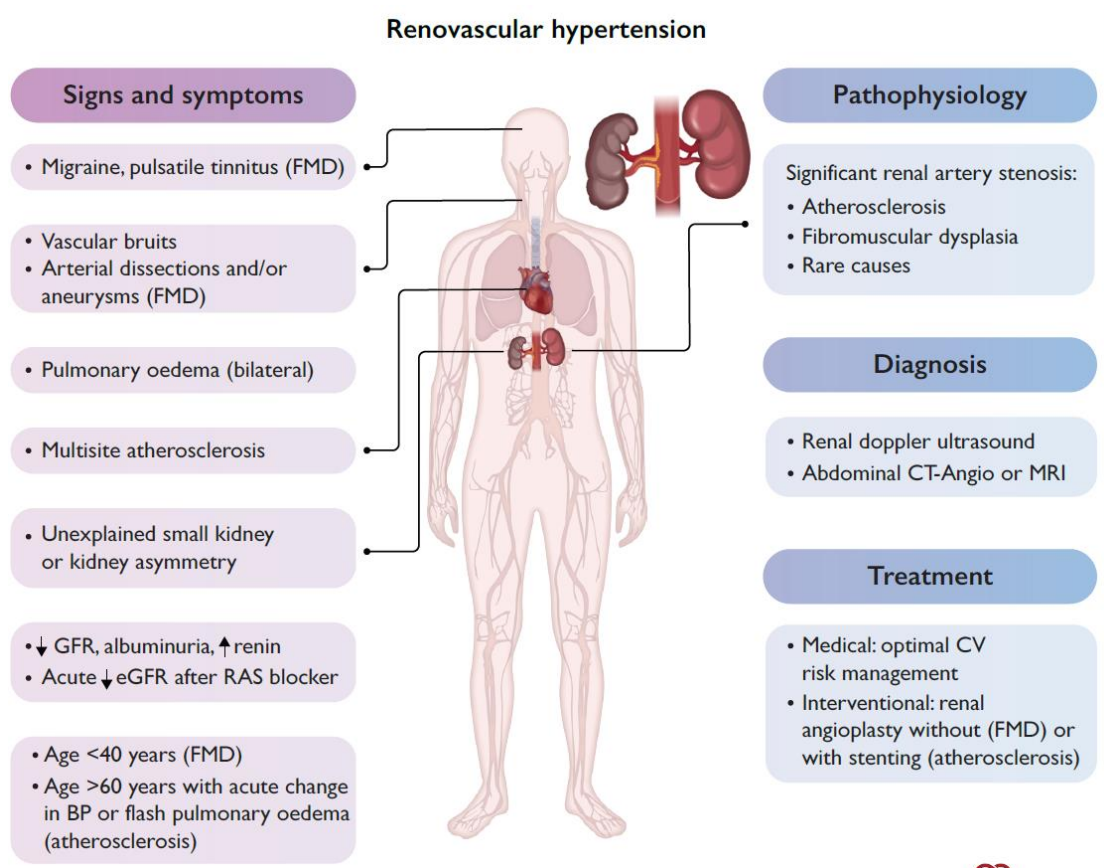


Figure 2. ESC 2024 GL on hypertension. Summary of renovascular disease as a common form of secondary hypertension.

CT-Angio, computed tomography angiography; CV, cardiovascular; FMD, fibromuscular dysplasia; GFR, glomerular filtration

Table 7. Therapy of renal artery disease**AHA/ACC 2017 GL on hypertension. Renal artery stenosis.**

1	A	1. In adults with hypertension and atherosclerotic renal artery stenosis, medical therapy is recommended to reduce kidney and CVD morbidity and mortality. ^{1–3}
2a	C-EO	2. In adults with hypertension and atherosclerotic renal artery stenosis for whom medical management has failed (eg, resistant hypertension, worsening kidney function, and/or acute HF), it is reasonable to refer patients for revascularization by percutaneous renal artery angioplasty and/or stent placement.
2b	C-LD	3. In adults with hypertension and nonatherosclerotic renal artery stenosis, including fibromuscular dysplasia, it may be reasonable to refer patients for revascularization by percutaneous renal artery angioplasty. ⁴

ESC 2024 GL on hypertension. Recommendations for managing hypertension in patients with renovascular hypertension

Renal artery angioplasty without stenting should be considered for patients with hypertension and haemodynamically significant renal artery stenosis due to fibromuscular dysplasia. ⁹⁴¹	IIa	C
Renal artery angioplasty and stenting may be considered in patients with haemodynamically significant, atherosclerotic, renal artery stenosis (stenosis of 70%–99%, or 50%–69% with post-stenotic dilatation and/or significant trans-stenotic pressure gradient) with: • Recurrent heart failure, unstable angina, or sudden onset flash pulmonary oedema despite maximally tolerated medical therapy; • Resistant hypertension; • Hypertension with unexplained unilaterally small kidney or CKD; • Bilateral renal artery stenosis or unilateral renal artery stenosis in a solitary viable kidney.^{942,943}	IIb	C
In patients with an indication to renal artery revascularization and technically unfeasible, or failed, renal artery angioplasty and stenting, open surgical revascularization may be considered.	IIb	C
Renal artery angioplasty is not recommended in patients without confirmed haemodynamically significant renal artery stenosis. ^{c 938,939}	III	A

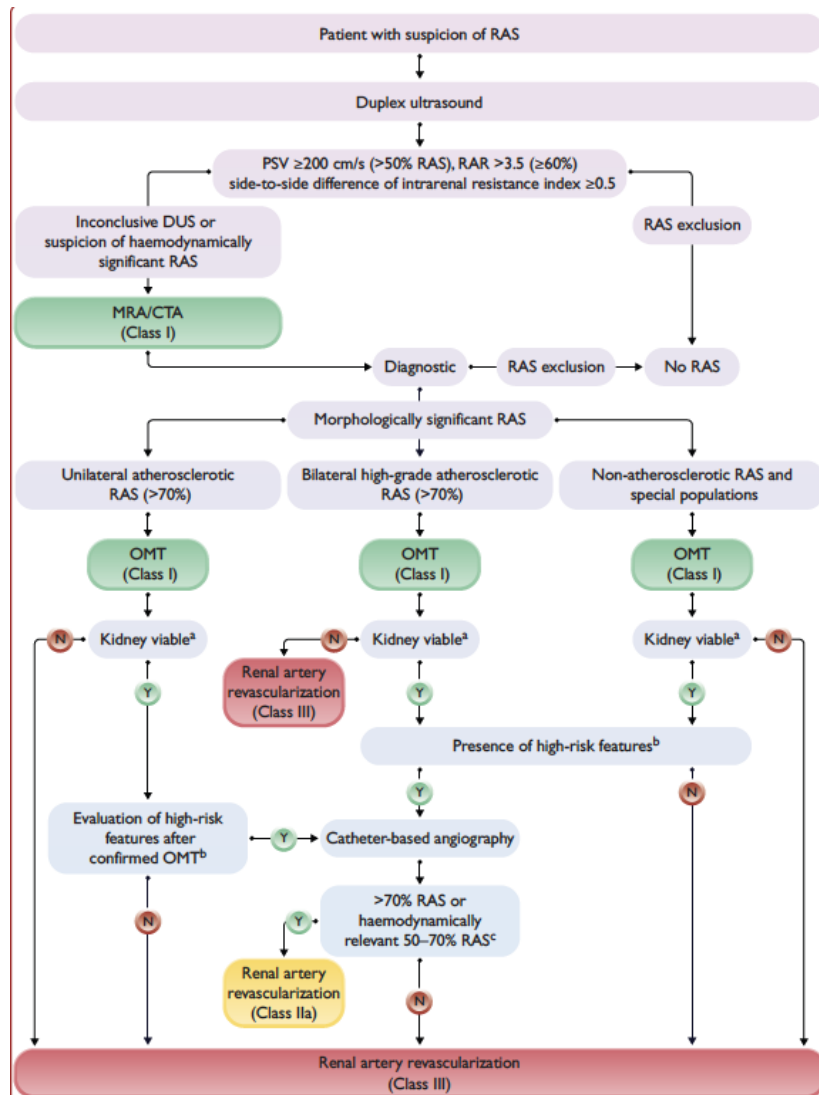
CKD, chronic kidney disease

cA haemodynamically relevant stenosis is usually defined by a luminal narrowing of >70% or 50%–70% with post-stenotic dilatation.

ESC 2024 GL on Peripheral and Aortic Diseases. Recommendations for treatment strategies for renal artery disease

Medical therapy		
In patients with atherosclerotic RAS the use of low-dose aspirin may be considered. ⁸¹¹	IIb	C
Revascularization		
In patients with atherosclerotic unilateral >70% RAS, concomitant high-risk features, and signs of kidney viability, renal artery revascularization should be considered after OMT has been established. ^{798,809,810}	IIa	B
In patients with atherosclerotic bilateral (>70%) RAS or RAS in a solitary kidney, concomitant high risk features, and signs of kidney viability, renal artery revascularization should be considered. ^{800–802}	IIa	B
In patients with hypertension and/or signs of renal dysfunction due to RAS caused by fibromuscular dysplasia, concomitant high-risk features, and signs of kidney viability, revascularization with primary balloon angioplasty and bailout stenting should be considered. ^{812,813}	IIa	B
In patients with an indication for renal artery revascularization and complex anatomy, or after failed endovascular revascularization, open surgical revascularization should be considered. ^{805,806}	IIa	B
In patients with atherosclerotic unilateral RAS, routine revascularization is not recommended. ^{324,800–804,814}	III	A

RAS, renal artery stenosis.



^aKidney viability in RAS

	Signs of viability	Signs of non-viability
Renal size	> 8 cm	< 7 cm
Renal cortex	Distinct cortex (> 0.5 cm)	Loss of corticomedullar differentiation
Proteinuria	Albumin-creatinine ratio < 20 mg/mmol	Albumin-creatinine ratio > 30 mg/mmol
Renal resistance index	< 0.8	> 0.8

^bRapidly progressive, treatment-resistant arterial hypertension; rapidly declining renal function; flash pulmonary oedema; solitary kidney.

^cResting mean pressure gradient > 10 mmHg; systolic hyperaemic pressure gradient > 20 mmHg; renal PdPa ≤ 0.9 (or 0.8).

Figure 3. ESC 2024 Guideline on Peripheral and Aortic Diseases. Diagnostic and treatment algorithm for renal artery stenosis.

CTA, computed tomography angiography; MRA, magnetic resonance angiography; OMT, optimal medical treatment; Pd/Pa, distal coronary pressure to aortic pressure ratio; PSV, peak systolic velocity; RAR, renal-aortic peak flow velocity ratio; RAS, renal artery stenosis.

a see table below

Table 8. AHA/ACC 2025 GL on hypertension. Primary aldosteronism

1	C-EO	1. In adults with hypertension, screening for primary aldosteronism is recommended in the presence of any of the following conditions to increase rates of detection, diagnosis, and specific targeted therapy: resistant hypertension (regardless of whether hypokalemia is present), hypokalemia (spontaneous or diuretic induced), OSA, incidentally discovered adrenal mass, family history of early-onset hypertension, or stroke at a young age (<40 years).
2b	C-EO	2. In adults with stage 2 hypertension, screening for primary aldosteronism may be considered to increase rates of detection, diagnosis, and specific targeted therapy.
1	C-LD	3. In adults with an indication for screening for primary aldosteronism, use of plasma aldosterone, renin activity, and the plasma aldosterone to renin activity ratio is recommended for initial screening to assess if there is biochemical evidence of primary aldosteronism. ¹⁻³
1	C-EO	4. In adults with an indication for screening for primary aldosteronism, it is recommended to continue most antihypertensive medications (other than mineralocorticoid receptor antagonists [MRAs]) prior to initial screening to minimize barriers to or delays in screening.
1	C-EO	5. In adults with hypertension and a positive screening test for primary aldosteronism or continued suspicion for primary aldosteronism based on suppressed plasma renin or disproportionate target organ damage, referral to a hypertension specialist or endocrinologist is recommended for further evaluation and treatment.

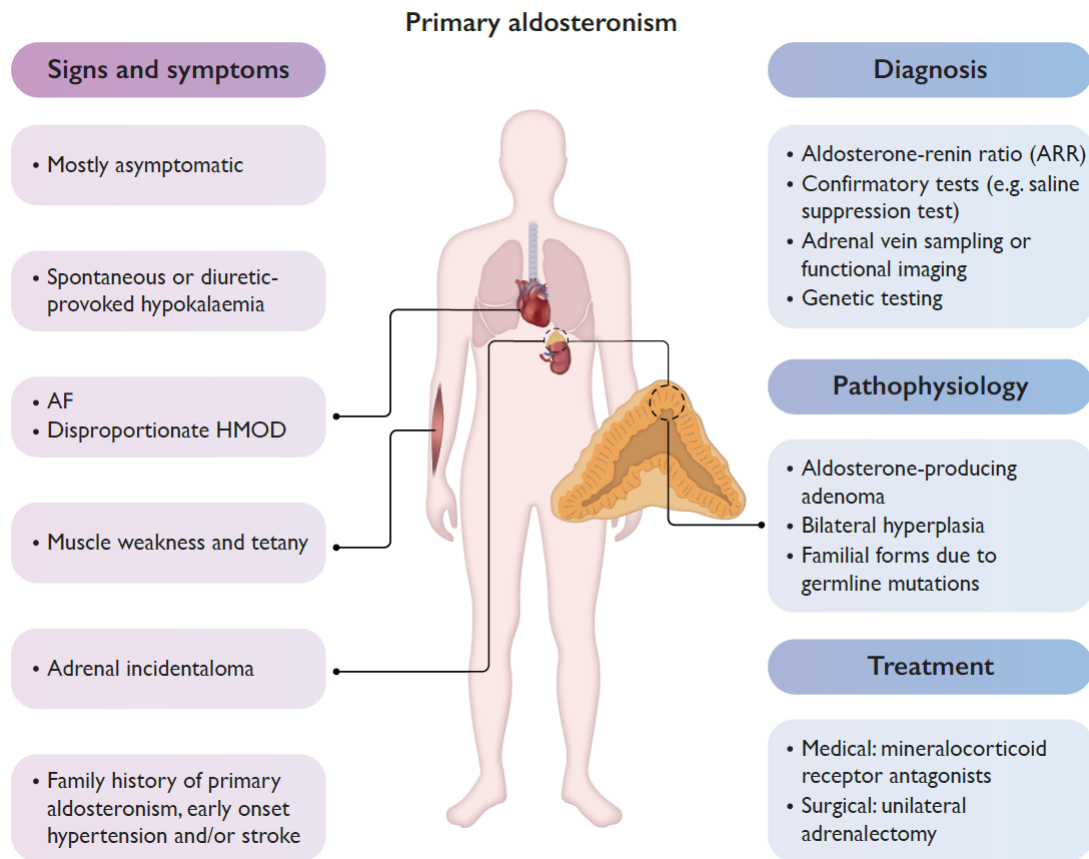


Figure 4. ESC 2024 GL on hypertension. Summary of primary aldosteronism as a common form of secondary hypertension.

AF, atrial fibrillation; HMOD, hypertension-mediated organ damage.