**Q**/ Whom should you test for secondary causes of hypertension?

**EVIDENCE-BASED ANSWER**

It’s recommended that all children and adolescents with a new diagnosis of hypertension undergo renal ultrasound and laboratory evaluation for renal pathology (strength of recommendation [SOR]: C, consensus-based guidelines).

Specific diagnostic tests are recommended for newly diagnosed patients who have suspicious clinical findings suggestive of a secondary cause of hypertension.

Evidence summary

The evidence for selecting which patients should undergo additional testing for potentially correctable secondary causes of hypertension is based on the prevalence of these causes in different age groups, case series of reversal of hypertension with effective treatment of the underlying cause, and clinical suspicion of a secondary cause that may be reversible. We found no prospective cohort studies or randomized trials evaluating diagnostic approaches or outcomes associated with particular selection criteria for conducting additional diagnostic evaluations in search of secondary causes. Therefore, our recommendations are based primarily on expert guidelines, which we summarize here.

When caring for children and adolescents with newly diagnosed hypertension...

Secondary hypertension is more prevalent in younger children and in children and adolescents with stage 2 hypertension (blood pressure [BP] >99th percentile for age and height plus 5 mm Hg). Renoparenchymal and renovascular disease account for most cases of secondary hypertension in these children.

The National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents recommends that all children and adolescents with hypertension have an additional diagnostic work-up. This is based on the observation that 70% to 85% of children <12 years and 10% to 15% of adolescents 12 to 18 years with hypertension have an underlying cause, most commonly renoparenchymal and renovascular disease.

According to the National Institutes of Health (NIH), “the possibility that some underlying disorder may be the cause of the hypertension should be considered in every child or adolescent” with elevated BP, but the evaluation itself should be individualized.

The NIH recommends more extensive evaluation for very young children, children with stage 2 hypertension, and children or adolescents who show clinical signs suggesting hypertension-linked systemic conditions. Such evaluation should include a renal ultrasound and laboratory testing (creatinine, urinalysis, and urine culture) to look for structural or functional anomalies.
### Secondary causes of hypertension: Identifying and evaluating suggestive findings\(^{12-14}\)

<table>
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<tr>
<th>History</th>
<th>Physical examination</th>
<th>Laboratory findings</th>
<th>Potential etiology</th>
<th>Diagnostic approach</th>
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<tbody>
<tr>
<td><strong>Adults</strong>: Excessive daytime sleepiness, snoring, morning headache, witnessed apnea; <strong>Children</strong>: Poor school performance, inattentiveness</td>
<td>Overweight/obese, large neck size, crowded oropharynx, adenotonsillar hypertrophy</td>
<td>None</td>
<td>Sleep apnea syndrome</td>
<td>Polysomnogram</td>
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<tr>
<td><strong>Headache, muscle weakness, paresthesias, paralysis</strong></td>
<td>Resistant hypertension, stage 2 hypertension</td>
<td>Hypokalemia, metabolic alkalosis, “incidentaloma” on CT scan</td>
<td>Primary aldosteronism</td>
<td></td>
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<tr>
<td><strong>Adults</strong>: African American, comorbid DM or atherosclerotic disease; <strong>Children</strong>: Enuresis, family history of renal disease, fatigue, recurrent UTI</td>
<td>Abdominal mass, gross hematuria, growth restriction</td>
<td>Proteinuria, elevated creatinine</td>
<td>Renoparenchymal disease</td>
<td>24-hour urine for protein and creatinine; renal ultrasound</td>
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<td>&lt;Age 30 yr and female or &gt;Age 50 yr and male</td>
<td>Abdominal bruit, flash pulmonary edema</td>
<td>Elevated creatinine (particularly after ACE-I or ARB use for hypertension)</td>
<td>Renovascular disease; fibromuscular dysplasia; atherosclerosis</td>
<td>MR or CT angiogram (normal renal function); MR angiogram or ultrasound of the kidneys (diminished renal function)</td>
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<tr>
<td><strong>Muscle weakness, bruising, acne, edema, hirsutism, oligomenorrhea</strong></td>
<td>Truncal obesity, abdominal striae, moon facies, ecchymosis</td>
<td>Hypokalemia, hyperglycemia</td>
<td>Cushing disease</td>
<td>Urinary free cortisol; dexamethasone suppression test; ACTH; CT/MRI of the pituitary and/or abdomen</td>
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<tr>
<td><strong>Paroxysmal hypertension, headache, palpitations, tremor, flushing</strong></td>
<td>Resistant hypertension, tachycardia, pallor</td>
<td>None</td>
<td>Pheochromocytoma</td>
<td>Plasma-free metanephrines; CT/MRI of the abdomen</td>
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<td>None</td>
<td>Difference in right and left arm BP, diminished femoral pulses, heart murmur, lower BP in legs than arms</td>
<td>None</td>
<td>Coarctation of the aorta</td>
<td>Echocardiogram</td>
</tr>
<tr>
<td><strong>Family history of thyroid disorder, heat intolerance, rash, sweating, pallor</strong></td>
<td>Ophthalmopathy, tachycardia, thyromegaly, weight loss</td>
<td>Suppressed thyroid-stimulating hormone</td>
<td>Hyperthyroidism</td>
<td>Thyroid scan</td>
</tr>
<tr>
<td><strong>Family history of autoimmune disease, fatigue, joint pain, rash</strong></td>
<td>Friction rub, joint swelling, malar rash</td>
<td>Elevated white blood cell count</td>
<td>Rheumatologic disorder</td>
<td>Abnormal findings on autoimmune laboratory studies; elevated markers of inflammation</td>
</tr>
</tbody>
</table>

ACE-I, angiotensin-converting enzyme inhibitor; ACTH, adrenocorticotropic hormone; ARB, angiotensin II receptor blocker; BP, blood pressure; CT, computed tomography; DM, diabetes mellitus; MR, magnetic resonance; MRI, magnetic resonance imaging; UTI, urinary tract infection.
What about newly diagnosed adults with suspected secondary causes?

Secondary hypertension reportedly occurs in 5% to 10% of hypertensive patients.4,5 The only prospective study completed in a primary care setting evaluated 1020 patients at a general outpatient clinic in Yokohama, Japan. The investigators reported that 9.1% of the patients had an endocrinologic or renovascular cause contributing to their hypertension.6

The 5 most common causes were primary aldosteronism (6%), Cushing syndrome (1%), preclinical Cushing syndrome (1%), pheochromocytoma (0.6%), and renovascular disease (0.5%).6

According to the Institute for Clinical Systems Improvement (ICSI), patients at highest risk for secondary hypertension have no family history of hypertension; abrupt onset, symptomatic, or crisis hypertension; stage 2 hypertension; sudden loss of hypertensive control; and drug-resistant hypertension.7

The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure recommends that patients with the following characteristics undergo further directed evaluation for a secondary cause:8

- younger than 30 years with no family history of hypertension
- older than 55 years with new hypertension
- abdominal bruit with diastolic component
- sudden worsening of BP control
- recurrent flash pulmonary edema
- renal failure with abnormal urinary sediment or proteinuria
- acute renal failure after administration of an ACE inhibitor or ARB.

These patients should receive particular scrutiny

Patients with resistant hypertension (BP>140/90 mm Hg despite taking optimal doses of 3 antihypertensive medications, one of which is a diuretic) should receive particular scrutiny for an identifiable secondary cause, according to the ICSI.7

In a retrospective analysis of 141 patients with resistant hypertension referred to a university hypertension center in Chicago in 2005, 5% of patients had an identifiable secondary cause.9 A chart review of 436 patients presenting to a tertiary hypertension clinic in Japan identified 91 with resistant hypertension. A secondary cause was identified in 9.1%.10

Careful history and examination should identify patients suffering from uncontrolled hypertension because of noncompliance, suboptimal antihypertensive regimen, inaccurate BP readings, antagonizing substances, and white coat hypertension.11 The TABLE summarizes common presentations of, and workup for, secondary causes of hypertension.12-14

### References

11. O’Rorke JE, Richardson WS. What to do when hypertension is difficult to control. BMJ. 2001;322:1229-1232.