The 2009 Canadian Hypertension Education Program recommendations for the management of hypertension: Part 1 – blood pressure measurement, diagnosis and assessment of risk

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OBJECTIVE: To provide updated, evidence-based recommendations for the diagnosis and assessment of adults with hypertension.

OPTIONS AND OUTCOMES: The diagnosis of hypertension is dependent on appropriate blood pressure measurement, the timely assessment of serially elevated readings, the degree of blood pressure elevation, the method of measurement (office, ambulatory, home) and associated comorbidities. The presence of cardiovascular risk factors and target organ damage should be ascertained to assess global cardiovascular risk and determine the urgency, intensity and type of treatment required.

EVIDENCE: MEDLINE searches were conducted from November 2007 to October 2008 with the aid of a medical librarian. Reference lists were scanned, experts were contacted, and the personal files of authors and subgroup members were used to identify additional studies. Content and methodological experts assessed studies using prespecified, standardized evidence-based algorithms. Recommendations were based on evidence from peer-reviewed full-text articles only.

RECOMMENDATIONS: Recommendations for blood pressure measurement, criteria for hypertension diagnosis and follow-up, assessment of global

cardiovascular risk, diagnostic testing, diagnosis of renovascular and endocrine causes of hypertension, home and ambulatory monitoring, and the use of echocardiography in hypertensive individuals are outlined. Key messages include continued emphasis on the expedited, accurate diagnosis of hypertension, the importance of global risk assessment and the need for ongoing monitoring of hypertensive patients to identify incident type 2 diabetes.

VALIDATION: All recommendations were graded according to strength of the evidence and voted on by the 57 members of the Canadian Hypertension Education Program Evidence-Based Recommendations Task Force. All recommendations were required to be supported by at least 70% of task force members. These guidelines will continue to be updated annually.

Key Words: Blood pressure; Diagnosis; Guidelines; High blood pressure; Hypertension; Risk factors

Les recommandations de 2009 du Programme éducatif canadien sur l'hypertension : 1^{re} partie – la mesure, le diagnostic et l'évaluation du risque de tension artérielle

OBJECTIF : Fournir des recommandations probantes et à jour pour le diagnostic et l'évaluation des adultes hypertendus.

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*A version of the hypertension recommendations designed for patient and public education has been developed to assist health care practitioners managing hypertension. The summary is available electronically (www.hypertension.ca and www.heartandstroke.ca)

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POSSIBILITÉS ET ISSUES : Le diagnostic d'hypertension dépend d'une mesure pertinente de la tension artérielle, de l'évaluation opportune de lectures sérielles élevées, du taux d'élévation de la tension artérielle, du mode de mesure (en cabinet, en milieu ambulatoire, à domicile) et des comorbidités connexes. Il faut évaluer la présence de facteurs de risque cardiovasculaires et l'atteinte des organes cibles afin de déterminer le risque cardiovasculaire global ainsi que l'urgence, l'intensité et le type de traitement.

DONNÉES PROBANTES : Des recherches dans MEDLINE ont été exécutées entre novembre 2007 et octobre 2008 avec l'aide d'un bibliothécaire médical. On a dépouillé les listes de référence, communiqué avec des experts et utilisé les dossiers personnels des auteurs et des membres des sous-groupes pour repérer d'autres études publiées. Des spécialistes du contenu et de la méthodologie ont évalué les études au moyen d'algorithmes normalisés, probants et préétablis. Les recommandations sont fondées sur des données probantes tirées d'articles intégraux révisés par des pairs.

RECOMMANDATIONS : Le présent document contient des recommandations sur la mesure de la tension artérielle, les critères de diagnostic et de suivi de l'hypertension, l'évaluation du risque cardiovasculaire global, les tests diagnostiques, le diagnostic des causes rénovasculaires et endocriniennes de l'hypertension, la surveillance ambulatoire et à domicile et le recours à l'échocardiographie chez les hypertendus. Les principaux messages exposent l'importance d'un diagnostic rapide et exact de l'hypertension, de l'évaluation du risque global et du besoin d'assurer une surveillance continue des patients hypertendus afin de repérer les cas incidents de diabète de type 2.

VALIDATION : Toutes les recommandations sont classées selon la solidité des données probantes, et les 57 membres du groupe de travail des recommandations probantes du Programme éducatif canadien sur l'hypertension ont exercé leur vote à leur égard. Toutes les recommandations devaient obtenir un consensus d'au moins 70 % de la part des membres du groupe de travail. Les présentes lignes directrices continueront d'être mises à jour chaque année.

Hypertension affects 27% of the Canadian adult population 35 to 64 years of age (1), and remains one of the most common modifiable risk factors for cardiovascular disease in Canada and globally (2,3). The present document summarizes the 2009 Canadian Hypertension Education Program (CHEP) recommendations for the diagnosis and assessment of hypertension in adults, focusing on those recommendations that are new or updated. For issues related to the diagnosis and evaluation of high blood pressure in children and adolescents, the reader is referred to separate guidelines (4). A more detailed discussion of previous changes to the Canadian recommendations is available in previous publications (5-8). Summary documents of all recommendations, including downloadable slide kits, are available free of charge on the Canadian Hypertension Society Web site (www.hypertension.ca).

METHODS

The previously published methodology remains unchanged (9) and was previously described (10). In brief, grade A recommendations are based on studies with high levels of internal validity, statistical precision, generalizability and clinical relevance. Grade B and C recommendations are derived from studies characterized by lower internal validity, precision or generalizability, or from studies reporting intermediate or surrogate outcomes instead of more clinically relevant ones. Grade D recommendations are based on expert opinion or studies with lower levels of internal validity or precision than grade C recommendations.

THE 2009 CHEP RECOMMENDATIONS

I. Accurate measurement of blood pressure

Recommendations

- 1) Health care professionals who have been specifically trained to measure blood pressure (BP) accurately should assess BP in all adult patients at all appropriate visits to determine cardiovascular risk and monitor antihypertensive treatment (grade D).
- 2) Use of standardized measurement techniques (Table 1) is recommended when assessing blood pressure (grade D).

Background

There have been no changes to these recommendations in 2009.

II. Criteria for diagnosis of hypertension and recommendations for follow-up (Figure 1)

Recommendations

- 1) At initial presentation, patients demonstrating features of a hypertensive urgency or emergency (Table 2) should be diagnosed as hypertensive and require immediate management (grade D).
- 2) If systolic BP (SBP) is 140 mmHg or higher and/or diastolic BP (DBP) is 90 mmHg or higher, a specific visit should be scheduled for the assessment of hypertension (grade D). If BP is high normal (SBP 130 mmHg to 139 mmHg and/or DBP 85 mmHg to 89 mmHg), annual follow-up is recommended (grade C).

- 3) At the initial visit for the assessment of hypertension, if SBP is 140 mmHg or higher and/or DBP is 90 mmHg or higher, at least two more readings should be taken during the same visit using a validated device and according to the recommended procedure for accurate BP determination (Table 1). The first reading should be discarded and the latter two averaged. A history and physical examination should be performed and, if clinically indicated, diagnostic tests to search for target organ damage (Table 3) and associated cardiovascular risk factors (Table 4) should be arranged within two visits. Exogenous factors that can induce or aggravate hypertension should be assessed and removed if possible (Table 5). Schedule visit 2 within one month (grade D).

- 4) At visit 2 of the assessment of hypertension, patients with macrovascular target organ damage, diabetes mellitus or chronic kidney disease (CKD) (glomerular filtration rate [GFR] less than 60 mL/min) can be diagnosed as hypertensive if SBP is 140 mmHg or higher and/or DBP is 90 mmHg or higher (grade D).

- 5) At visit 2 of the assessment of hypertension, patients without macrovascular target organ damage, diabetes mellitus and/or chronic kidney disease can be diagnosed as hypertensive if the SBP is 180 mmHg or higher and/or the DBP is 110 mmHg or higher (grade D). Patients without macrovascular target organ damage, diabetes mellitus or CKD but with lower BP levels should undergo further evaluation using any of the three approaches outlined below:

- i) **Office BPs:** Using office BP measurements, patients can be diagnosed as hypertensive if the SBP is 160 mmHg or higher or the DBP is 100 mmHg or higher averaged across the first three visits, or if the SBP averages 140 mmHg or higher or the DBP averages 90 mmHg or higher across five visits (grade D).

- ii) **Ambulatory BP monitoring (ABPM):** Using ABPM (see section VIII), patients can be diagnosed as hypertensive if the mean awake SBP is 135 mmHg or higher or the DBP is 85 mmHg or higher, or if the mean 24 h SBP is 130 mmHg or higher or the DBP is 80 mmHg or higher (grade C).

- iii) **Home BP measurement:** Using home BP measurements (see section VII), patients can be diagnosed as hypertensive if the average SBP is 135 mmHg or higher or the DBP is 85 mmHg or higher (grade C). If the average home BP is less than 135/85 mmHg, it is advisable to perform 24 h ABPM to confirm that the mean 24 h ABPM is less than 130/80 mmHg and the mean awake ABPM is less than 135/85 mmHg before diagnosing white coat hypertension (grade D).

- 6) Investigations for secondary causes of hypertension should be initiated in patients with suggestive clinical and/or laboratory features (outlined below) (grade D).

- 7) If at the last diagnostic visit the patient is not diagnosed as hypertensive, and has no evidence of macrovascular target organ damage, the patient's BP should be assessed at yearly intervals (grade D).

TABLE 1
Recommended technique for measuring blood pressure

- i) Measurements should be taken with a sphygmomanometer known to be accurate. A recently calibrated aneroid or a validated and recently calibrated electronic device can be used. Aneroid devices or mercury columns need to be clearly visible at eye level.
- ii) Choose a cuff with an appropriate bladder size matched to the size of the arm. For measurements taken by auscultation, bladder width should be close to 40% of arm circumference and bladder length should cover 80% to 100% of arm circumference. When using an automated device, select the cuff size as recommended by its manufacturer.
- iii) Place the cuff so that the lower edge is 3 cm above the elbow crease and the bladder is centred over the brachial artery. The patient should be resting comfortably for 5 min in the seated position with back support. The arm should be bare and supported with the blood pressure cuff at heart level, because a lower position will result in an erroneously higher systolic blood pressure and diastolic blood pressure. There should be no talking, and patients' legs should not be crossed. At least three measurements should be taken in the same arm with the patient in the same position. The first reading should be discarded and the latter two averaged. Blood pressure also should be assessed after 2 min standing (with arm supported) and at times when patients report symptoms suggestive of postural hypotension. Supine blood pressure measurements may also be helpful in the assessment of elderly and diabetic patients.
- iv) Increase the pressure rapidly to 30 mmHg above the level at which the radial pulse is extinguished (to exclude the possibility of a systolic auscultatory gap).
- v) Place the bell or diaphragm of the stethoscope gently and steadily over the brachial artery.
- vi) Open the control valve so that the rate of deflation of the cuff is approximately 2 mmHg per heart beat. A cuff deflation rate of 2 mmHg per beat is necessary for accurate systolic and diastolic estimation.
- vii) Read the systolic level – the first appearance of a clear tapping sound (phase I Korotkoff) – and the diastolic level (the point at which the sounds disappear) (phase V Korotkoff). Continue to auscultate at least 10 mmHg below phase V to exclude a diastolic auscultatory gap. Record the blood pressure to the closest 2 mmHg on the manometer (or 1 mmHg on electronic devices), the arm used and whether the patient was supine, sitting or standing. Avoid digit preference by not rounding up or down. Record the heart rate. The seated blood pressure is used to determine and monitor treatment decisions. The standing blood pressure is used to examine for postural hypotension, if present, which may modify the treatment.
- viii) If Korotkoff sounds persist as the level approaches 0 mmHg, then the point of muffling of the sound is used (phase IV) to indicate the diastolic pressure.
- ix) In the case of arrhythmia, additional readings may be required to estimate the average systolic and diastolic pressure. Isolated extra beats should be ignored. Note the rhythm and pulse rate.
- x) Leaving the cuff partially inflated for too long will fill the venous system and make the sounds difficult to hear. To avoid venous congestion, it is recommended that at least 1 min should elapse between readings.
- xi) Blood pressure should be taken in both arms on at least one visit and if one arm has a consistently higher pressure, that arm should be subsequently used for blood pressure measurement and interpretation.

These are instructions for blood pressure measurement when using a sphygmomanometer and stethoscope; many steps may not apply when using automated devices. Reprinted with permission from the Canadian Hypertension Education Program

- 8) Hypertensive patients receiving lifestyle modification advice alone (nonpharmacological treatment) should be followed up at three- to six-month intervals. Shorter intervals (every one or two months) are needed for patients with higher BPs (grade D).
- 9) Patients on antihypertensive drug treatment should be seen monthly or every two months, depending on the level of BP, until readings on two consecutive visits are below their target (grade D). Shorter intervals between visits will be needed for symptomatic patients and those with severe hypertension, intolerance to antihypertensive drugs or target organ damage (grade D). Once the target BP has been reached, patients should be seen at three- to six-month intervals (grade D).

Background

The criteria for the diagnosis of hypertension were previously discussed in detail (11). It should be emphasized that when using office BPs to diagnose hypertension, the thresholds given above refer to readings averaged over the specified number of visits and not just on the last visit.

III. Assessment of overall cardiovascular risk in hypertensive patients

Recommendations

- 1) Global cardiovascular risk should be assessed. Multifactorial risk assessment models can be used to predict more accurately an individual's global cardiovascular risk (grade A) and to use antihypertensive therapy more efficiently (grade D). In the absence of Canadian data to determine the accuracy of risk calculations, avoid using absolute levels of risk to support treatment decisions (grade C).
- 2) Consider informing patients of their global risk to improve the effectiveness of risk factor modification (grade C).

Background

Recognizing the importance of global risk assessment as a component of hypertension therapy (12), the 2006 recommendations (13) included a

detailed review of risk assessment tools (14) including the Framingham Heart Study model (www.nhlbi.nih.gov/about/framingham/riskabs.htm) (15-18), the cardiovascular life expectancy model (www.chiprehab.com) (19), the United Kingdom Prospective Diabetes Study (UKPDS) model (www.dtu.ox.ac.uk/index) (20,21) and the Symptoms-Causes-Output-Resources-Effects (SCORE) model (www.scorecanada.ca) (22). Measurement of the ankle-brachial index may improve the accuracy of cardiovascular risk prediction beyond risk scoring alone (23).

Detailed guidelines for hypertension treatment based on absolute risk thresholds are not available at this time, given the lack of published studies examining the validity of these models in the Canadian population. However, global risk assessment in general, and the use of these models specifically, can be used as a tool to assist physicians in identifying subjects with hypertension who are most likely to benefit from therapy. When considering an individual's future risk of developing cardiovascular disease and the potential impact of antihypertensive therapy, one should consider assessing both the risk of future cardiac as well as cerebrovascular events (24).

A recently published randomized clinical trial among Canadians with dyslipidemia has demonstrated that explicitly calculating a patient's cardiovascular risk and discussing the results can significantly increase the likelihood of achieving lipid targets, even after adjustment for the intensity of statin therapy (25). This suggests that informed patients are more adherent to lifestyle recommendations and/or pharmacotherapy. Although a similar trial focusing on hypertensive management has not been completed, these results are potentially generalizable to individuals with hypertension.

IV. Routine and optional laboratory tests for the investigation of patients with hypertension

Recommendations

- 1) Routine laboratory tests that should be performed for the investigation of all patients with hypertension include:
 - i) urinalysis (grade D);

Figure 1 The expedited assessment and diagnosis of patients with hypertension (HTN): focus on validated technologies for blood pressure (BP) assessment. *Thresholds refer to BP values averaged across the corresponding number of visits, and not just the most recent office visit. ABPM Ambulatory BP monitoring; BPM BP monitoring; DBP Diastolic BP; SBP Systolic BP. Reprinted with permission from the Canadian Hypertension Education Program

- ii) blood chemistry (potassium, sodium and creatinine) (grade D);
- iii) fasting blood glucose (grade D);
- iv) fasting serum total cholesterol and high-density lipoprotein cholesterol, low-density lipoprotein cholesterol and triglycerides (grade D); and
- v) standard 12-lead electrocardiography (grade C).
- 2) Assess urinary albumin excretion in patients with diabetes (grade D).
- 3) i) All treated hypertensive patients should be monitored according to the current Canadian Diabetes Association guidelines for the new appearance of diabetes (grade B).
- ii) During the maintenance phase of hypertension management, tests (including those for electrolytes, creatinine and fasting

lipids) should be repeated with a frequency reflecting the clinical situation (grade D).

Background

As previously discussed, the routine ascertainment of microalbuminuria in all nondiabetic hypertensive patients is currently not recommended (5). However, assessment for microalbuminuria may be indicated in selected patients when a global risk assessment is being performed to identify high-risk hypertensive patients eligible for statin therapy (6,26). Assessment of microalbuminuria is also required to guide therapy in patients with diabetes and those with chronic kidney disease.

Monitoring all hypertensive patients for incident diabetes according to the recommendations outlined in the guidelines of the

TABLE 2
Examples of hypertensive urgencies and emergencies

Asymptomatic diastolic blood pressure ≥ 130 mmHg
Hypertensive encephalopathy
Acute aortic dissection
Acute left ventricular failure
Acute myocardial ischemia

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TABLE 3
Examples of target organ damage

Cerebrovascular disease
Stroke
Ischemic stroke and transient ischemic attack
Intracerebral hemorrhage
Aneurysmal subarachnoid hemorrhage
Dementia
Vascular dementia
Mixed vascular dementia and dementia of the Alzheimer's type
Hypertensive retinopathy
Left ventricular dysfunction
Left ventricular hypertrophy
Coronary artery disease
Myocardial infarction
Angina pectoris
Congestive heart failure
Renal disease
Chronic kidney disease (glomerular filtration rate < 60 mL/min/1.73 m²)
Albuminuria
Peripheral artery disease
Intermittent claudication

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Canadian Diabetes Association (www.diabetes.ca) is recommended. In part, hypertensive patients are at higher risk for developing type 2 diabetes because of the tendency of cardiometabolic risk factors to cluster, particularly in the presence of central adiposity (27-29). At minimum, new-onset diabetes occurs in 1% to 2% of hypertensive patients each year (30,31). Among 18,411 nondiabetic hypertensive patients older than 55 years of age who had follow-up measurements of fasting plasma glucose (43% of the original cohort), the cumulative incidence of diabetes was 8% to 11% at four years (32). Furthermore, the prognosis of patients who develop diabetes is worse than those who do not (30-34). After 14.3 years of follow-up in the placebo arm of the Systolic Hypertension in Elderly Patients (SHEP) trial (33) (older than 60 years of age), cardiovascular mortality (hazard ratio [HR] 1.56, 95% CI 1.12 to 2.18) and total mortality (HR 1.35, 95% CI 1.05 to 1.73) were significantly increased among those who developed diabetes.

Although based on weaker evidence, the type of antihypertensive drug treatment also appears to influence future risk of type 2 diabetes (27,28). Studies suggest that both beta-blockers and thiazides are associated with an increased risk of diabetes, and angiotensin-converting enzyme inhibitors, angiotensin receptor blockers and calcium channel blockers are neutral or associated with decreased risk (27). However, in the Diabetes REduction Assessment with ramipril and rosiglitazone Medication (DREAM) trial (35) (three-year randomized controlled trial involving 5269 prediabetic patients), ramipril did not significantly reduce the incidence of type 2 diabetes (HR 0.91, 95% CI 0.81 to 1.03) or mortality. Thus, no specific antihypertensive drugs are currently recommended to prevent the development of diabetes mellitus.

It is important to note that there are currently no conclusive data that directly implicate drug-induced type 2 diabetes with increased

TABLE 4
Examples of key cardiovascular risk factors for atherosclerosis

Nonmodifiable
Age ≥ 55 years
Male sex
Family history of premature cardiovascular disease (age < 55 years in men and < 65 years in women)
Modifiable
Sedentary lifestyle
Poor dietary habits
Abdominal obesity
Dysglycemia
Smoking
Dyslipidemia
Stress
Target organ damage
Left ventricular hypertrophy
Microalbuminuria or proteinuria
Chronic kidney disease (glomerular filtration rate < 60 mL/min/1.73 m²)

A history of clinically overt atherosclerotic disease indicates a very high risk for a recurrent atherosclerotic event (eg, peripheral arterial disease, previous stroke or transient ischemic attack). Reprinted with permission from the Canadian Hypertension Education Program

TABLE 5
Examples of exogenous factors that can induce or aggravate hypertension

Prescription drugs
Nonsteroidal anti-inflammatory drugs, including coxibs
Corticosteroids and anabolic steroids
Oral contraceptive and sex hormones
Vasoconstricting or sympathomimetic decongestants
Calcineurin inhibitors (cyclosporin, tacrolimus)
Erythropoietin and analogues
Monoamine oxidase inhibitors
Midodrine
Other substances
Licorice root
Stimulants, including cocaine
Salt
Excessive alcohol use

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cardiovascular risk (33). Furthermore, in patients with or without diabetes, thiazide-based treatment regimens reduce cardiovascular and overall mortality to a similar extent as 'nondiabetogenic' agents (6). The task force will continue to monitor this area closely and issue updated recommendations as required.

V. Assessment for renovascular hypertension

Recommendations

- 1) Patients presenting with two or more of the clinical clues listed below, suggesting renovascular hypertension, should be investigated (grade D):
 - i) sudden onset or worsening of hypertension and age older than 55 years or younger than 30 years;
 - ii) the presence of an abdominal bruit;
 - iii) hypertension resistant to three or more drugs;
 - iv) a rise in serum creatinine level of 30% or more associated with use of an angiotensin-converting enzyme inhibitor or angiotensin II receptor antagonist;

TABLE 6
Hyperaldosteronism – screening and diagnosis

- i) Plasma aldosterone and plasma renin activity (see ii below for conversion factors) should be measured under standardized conditions, including the collection of morning samples taken from patients in a sitting position after resting for at least 15 min. Antihypertensive drugs may be continued, with the exception of aldosterone antagonists, angiotensin receptor blockers, beta-adrenergic antagonists and clonidine.
- ii) Renin, aldosterone and ratio conversion factors:
<i>A. To estimate:</i>	<i>B. From:</i>	<i>Multiply (B) by:</i>
Plasma renin concentration (ng/mL)	Plasma renin activity (ng/mL/h)	0.206
Plasma renin activity (g/L/s)	Plasma renin activity (ng/mL/h)	0.278
Plasma aldosterone concentration (pmol/L)	Plasma aldosterone concentration (ng/dL)	28
- iii) Definition of a positive screening test: plasma aldosterone to renin activity ratio greater than 550 pmol/L/ng/mL/h (or 140 pmol/L/ng/L when renin is measured as renin mass or concentration).
- iv) Manoeuvres to demonstrate autonomous hypersecretion of aldosterone:
- saline loading tests (2 L of normal saline over 4 h with primary aldosteronism defined as failure to suppress plasma aldosterone level to lower than 280 pmol/L, or oral sodium 300 mmol/day for three days with primary aldosteronism defined as failure to suppress plasma aldosterone level to lower than 240 pmol/L);
 - fludrocortisone suppression test (oral sodium loading plus oral fludrocortisone 0.25 mg per day for two days) positive for primary aldosteronism: plasma aldosterone of 140 pmol/L or more in upright and/or supine positions;
 - a plasma aldosterone to plasma renin activity ratio greater than 1400 pmol/L/ng/mL/h with a plasma aldosterone level higher than 440 pmol/L; and
 - captopril suppression test (primary aldosteronism defined as failure to suppress plasma aldosterone level to lower than 240 pmol/L 2 h after 25 mg of oral captopril).
- v) Differentiating potential causes of primary aldosteronism:
- For patients with established primary aldosteronism, attempts to differentiate potential causes should be made and may include localization with adrenal computed tomography scan (standard: 3 mm contiguous cuts) or magnetic resonance imaging (where available), or assessment of plasma aldosterone before (supine) and after 2 h to 4 h of upright posture.
 - For patients with established primary aldosteronism and negative imaging studies, selective adrenal venous sampling should be considered because it may be the only way to reliably differentiate between unilateral and bilateral overproduction of aldosterone. Adrenal venous sampling should be conducted in centres with experience in performing this diagnostic technique.

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- other atherosclerotic vascular disease, particularly in patients who smoke or have dyslipidemia; and
 - recurrent pulmonary edema associated with hypertensive surges.
- 2) When available, the following tests are recommended to aid in the usual screening for renal vascular disease: captopril-enhanced radioisotope renal scan, Doppler sonography, magnetic resonance angiography and computed tomographic angiography (for those with normal renal function) (grade B). Captopril-enhanced radioisotope renal scan is not recommended for those with CKD (GFR less than 60 mL/min) (grade D).

Background

There are no changes from the 2008 recommendations (7). Most diagnostic testing for renovascular hypertension has been validated in patients with normal renal function. In patients with CKD, there are notable limitations to current screening methods and the optimal method is uncertain. The diagnostic accuracy of captopril renal scanning is poor in the setting of GFR levels below 60 mL/min (36). Nephrogenic systemic fibrosis may very rarely occur (estimated incidence one per million) in patients receiving gadolinium-based contrast media for magnetic resonance angiography. The risk may vary by contrast agent and is higher in patients with CKD (particularly those with end-stage renal failure); similarly, computed tomographic angiography carries a risk of contrast nephropathy (37). Duplex Doppler ultrasonography of the renal vessels is safe, but is highly specialized, operator-dependent and not widely available (38).

VI. Endocrine hypertension

Recommendations

A. Hyperaldosteronism – screening and diagnosis

- Screening for hyperaldosteronism should be considered for the following patients (grade D):
 - hypertensive patients with spontaneous hypokalemia (K^+ level lower than 3.5 mmol/L);

- hypertensive patients with marked diuretic-induced hypokalemia (K^+ level lower than 3.0 mmol/L);
 - patients with hypertension refractory to treatment with three or more drugs; and
 - hypertensive patients found to have an incidental adrenal adenoma.
- Screening for hyperaldosteronism should include assessment of plasma aldosterone and plasma renin activity (Table 6).
 - For patients with suspected hyperaldosteronism (on the basis of the screening test, Table 6 [iii]), a diagnosis of primary aldosteronism should be established by demonstrating inappropriate autonomous hypersecretion of aldosterone using at least one of the manoeuvres listed in Table 6 (iv). When the diagnosis is established, the abnormality should be localized using any of the tests described in Table 6 (v).

B. Pheochromocytoma – screening and diagnosis

- If pheochromocytoma is strongly suspected, the patient should be referred to a specialized hypertension centre, particularly if biochemical screening tests (Table 7) have already been found to be positive (grade D).
- The following patients should be considered for screening for pheochromocytoma (grade D):
 - patients with paroxysmal and/or severe (BP 180/110 mmHg or higher) sustained hypertension refractory to usual antihypertensive therapy;
 - patients with hypertension and multiple symptoms suggestive of catecholamine excess (eg, headaches, palpitations, sweating, panic attacks and pallor);
 - patients with hypertension triggered by beta-blockers, monoamine oxidase inhibitors, micturition or changes in abdominal pressure; and
 - patients with incidentally discovered adrenal masses, patients with hypertension and multiple endocrine neoplasia 2A or 2B,

von Recklinghausen's neurofibromatosis or von Hippel-Lindau disease.

3. For patients with positive biochemical screening tests, localization of pheochromocytomas should employ magnetic resonance imaging (preferable), computed tomography (if magnetic resonance imaging is unavailable), and/or iodine-131 metaiodobenzylguanidine scintigraphy (grade C for each modality).

Background

There are no changes to these recommendations in 2009.

VII. Home measurement of BP

Recommendations

- 1) Home BP readings can be used in the diagnosis of hypertension (grade C).
- 2) The use of home BP monitoring on a regular basis should be considered for patients with hypertension, particularly those with:
 - i) diabetes mellitus (grade D);
 - ii) chronic kidney disease (grade C);
 - iii) suspected nonadherence (grade D);
 - iv) demonstrated white coat effect (grade C); and
 - v) BP controlled in the office but not at home (masked hypertension) (grade C).
- 3) When white coat hypertension is suggested by home monitoring, its presence should be confirmed with ABPM before making treatment decisions (grade D).
- 4) Patients should be advised to purchase and use only home BP monitoring devices that are appropriate for the individual and have met standards of the Association for the Advancement of Medical Instrumentation, the most recent requirements of the British Hypertension Society protocol or the international protocol for validation of automated BP measuring devices. Patients should be encouraged to use devices with data recording capabilities or automatic data transmission to increase the reliability of reported home BP values (grade D).
- 5) Home SBP values of 135 mmHg or higher or DBP values of 85 mmHg or higher should be considered elevated and associated with an increased overall mortality risk analogous to office SBP readings of 140 mmHg or higher or DBP of 90 mmHg or higher (grade C).
- 6) Health care professionals should ensure that patients who measure their BP at home have adequate training and, if necessary, repeat training in measuring their BP. Patients should be observed to determine whether they measure BP correctly and should be given adequate information about interpreting these readings (grade D).
- 7) The accuracy of all individual patients' validated devices (including electronic devices) must be regularly checked against a device of known calibration (grade D).
- 8) Home BP values for assessing white coat hypertension or sustained hypertension should be based on duplicate measures, morning and evening, for an initial seven-day period. First-day home BP values should not be considered (grade D).

Background

Information on validated blood pressure monitors can be found at <www.hypertension.ca/chep/approved-home-bp-devices>. There are no changes to these recommendations for 2009.

VIII. Ambulatory BP measurement

Recommendations

- 1) Ambulatory BP readings can be used in the diagnosis of hypertension (grade C).
- 2) ABPM should be considered when an office-induced increase in BP is suspected in treated patients with:
 - i) BP that is not below target despite receiving appropriate chronic antihypertensive therapy (grade C);

TABLE 7

Pheochromocytoma: Screening and diagnosis

Biochemical screening tests for pheochromocytomas:

- a) To screen for pheochromocytomas, 24 h urinary total metanephrines (sensitivity 95%) and urinary metanephrine to creatinine ratio (sensitivity 100%) should be assessed. Plasma catecholamines and, where available, plasma metanephrines may also be considered if clinical suspicion is high, particularly during a hypertensive episode or for those with familial forms. Urinary or plasma vanillylmandelic acid measurements should not be used as screening tests. In a low-risk setting, plasma fractionated free metanephrine measurements can be used to rule out pheochromocytoma.
- b) In the presence of borderline biochemical test results (eg, plasma noradrenaline and adrenaline levels of approximately 500 ng/L to 2000 ng/L) or potentially false-positive results, repeated testing and/or the clonidine suppression test may be used.

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- ii) symptoms suggestive of hypotension (grade C); or
- iii) fluctuating office BP readings (grade D).

- 3) Physicians should use only ABPM devices that have been validated independently using established protocols (grade D).
- 4) Therapy adjustment should be considered in patients with a 24 h ambulatory SBP of 130 mmHg or higher or DBP of 80 mmHg or higher, or an awake SBP of 135 mmHg or higher or DBP of 85 mmHg or higher (grade D).
- 5) The magnitude of changes in nocturnal BP should be taken into account in any decision to prescribe or withhold drug therapy based on ambulatory BP (grade C) because a decrease in nocturnal blood pressure of less than 10% is associated with increased risk of cardiovascular events.

Background

There are no new recommendations in this section.

IX. Role of echocardiography

Recommendations

- 1) Routine echocardiographic evaluation of all hypertensive patients is not recommended (grade D).
- 2) An echocardiogram for assessment of left ventricular hypertrophy is useful in selected cases to help define the future risk of cardiovascular events (grade C).
- 3) Echocardiographic assessment of left ventricular mass, as well as systolic and diastolic left ventricular function, is recommended for hypertensive patients suspected to have left ventricular dysfunction or coronary artery disease (grade D).
- 4) Patients with hypertension and evidence of heart failure should have an objective assessment of left ventricular ejection fraction, either by echocardiogram or nuclear imaging (grade D).

Background

This section was updated in 2006 (13) and there are no new changes in 2009.

FUTURE DIRECTIONS

The CHEP Recommendations Task Force will continue to monitor the published literature and update these guidelines annually based on new developments in the literature and feedback from stakeholders and other users of these recommendations.

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