Hypertension (HTN)
Lecture Note

October, 2009

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Outline

- Definition
- Epidemiology
- Measurement of BP

- Secondary cause
- Target organ damage
- Co-morbidity

- History taking
- PE
- Lab

- Treatment goal
- Life style modification
- Compelling indication / special consideration

- Drugs
- Resistant HTN
- HTN emergency

Definition of HTN

JNC VII (2003)

Normal	< 120 / 80
Pre-HTN	120-139 / 80-89
Stage 1 HTN	140-159 / 90-99
Stage 2 HTN	> or = 160 / 100

- No acute illness, no anti-HTN drug
- Systolic or diastolic HTN?
- Labile HTN, White coat HTN

Epidemiology / Etiology

- Prevalence : around 30% in adults
- 60% are treated, half of them are adequately controlled (USA 2000)

- Each 20 mmHg SBP or 10 mmHg DBP elevation : 2 X CV complications

- > 90% Essential HTN, no identifiable cause ; BP = CO X PR
- Secondary HTN (<20 or > 50 y) : sudden, severe, refractory, recurrent

Measurement of BP (1)

- Sit quietly for > 5 min
- No smoking or caffeine for 30 min
- Cuff : > 80% of arm (small cuff - falsely high readings)
- Korotkoff sounds : first and last sounds
- Electronic machine
- Which arm : higher reading side

Measurement of BP (2)

- 2 measurements each visit, separated by > 2 min
- 2 separate clinical visits before diagnosis of HTN
- Standing BP to R/O orthostatic hypotension (>20 fall of SBP, >10 DBP)
- Ambulatory BP monitoring (ABPM) : BP decrease by 10-20% during the night (HTN>120/75)
- Self measurement at home (HTN>135/85)

Secondary HTN (1): Kidney

- Renal parenchymal disease

- Renovascular disease
- Fibromuscular dysplasia (young) or Atherosclerosis (elderly)
- Abdominal bruit
- MRA (MRI) , RA angiography
- Stent or surgery or drug
- ARB / ACEI : Contraindicated

Secondary HTN (2): Endocrine

- Hyperthyroidism : systolic HTN
- Aldosteronism : hypokalemia, aldo/renin>20; CT/MRI; Spironolactone (Aldacotone)
- Cushing's disease : cortisol/ACTH
- Pheochromocytoma : paroxysmal; metanephrine; alpha and then beta-blocker
- Hypercalcemia
- Myxedema

Secondary HTN (3)

- Coarctation of aorta : children, low BP in lower extremity
- Drugs : NSAID, Decongestant, Steroid, OCP, Licorice, Epo, Cyclosporine, MAO inhibitor, Amphetamine, Cocaine
- Sleep apnea : morning HTN
- Polycythemia

Target Organ Damage (1)

- Heart :
- LVH (PMI, ECG, echo)
- LV dysfunction (CHF, echo, systolic, diastolic)
- CAD (angina, MI)

- Brain :
- CVA / TIA, ruptured aneurysm
- Carotid bruit
- Hypertensive encephalopathy (Brain edema)

Target Organ Damage (2)

- Kidney :
- Renal failure (Creatinine)
- Proteinuria

- Vascular :
- Intermittant claudication (PAOD)
- Aortic aneurysm
- Aortic dissection

- Retinopathy
- Eclampsia

CV Risk Factors (Co-Morbidity)

- Hypertension
- DM
- Hyperlipidemia
- Smoking
- Obesity
- Age (Man > 45, Woman > 55)
- Family history of premature CV disease (Man < 55, Woman < 65)

Initial Evaluation : PE

(1) Co-morbidity (2) Secondary cause (3) Target organ damage

- BP, both arm
- Eye fundi (3)
- Body mass index / Waist circumference (1)
- Carotid bruit (3)
- Thyroid gland (2), Heart (3), Lung (3)
- Abdomen for kidney (2), aortic pulsation (3) and bruit (2)
- Leg edema (3), pulse (2,3)
- Neurological assessment (3)

Initial Evaluation : Lab

(1) Co-morbidity (2) Secondary cause (3) Target organ damage

- Serum creatinine (2,3), K (2), glucose (1)
- Lipid profile (cholesterol: total, HDL and LDL; triglyceride) (1)
- ECG (3)
- Urinalysis
- Optional : serum calcium, thyroid stimulating hormone, uric acid

Management of BP

(* Compelling indication : CHF, MI, High CAD Risk, DM, CKD, Stroke)

- **Pre-HTN (120-139/80-89) :**
- **No * : Life style modification**
- *** : Drug for compelling indication**

- **Stage 1 HTN (140-159/90-99) :**
- **No * : thiazide diuretic for most (may consider ACEI, ARB, BB, CCB)**

- **Stage 2 HTN (> or = 160/100) :**
- **No * : Two-drug combination for most (usually including thiazide)**

Treatment Goal and Life Style modification

- Goal : < 140 / 90
- For Kidney disease and DM : <130/80

- Life Style Modification :
- Weight loss (BMI < 25)
- Exercise (walking > 30 min/day)
- Diet rich in fruit and vegetable, low total and saturated fat
- NaCl < 6 g/day (Na 100 mmol or 2.4 g/day)
- Alcohol <30 ml/day for man, 15 ml for woman

Compelling indications

- Angina : BB
- MI : BB, ACEI
- CHF : ACEI/ARB, loop diuretics, (aldosterone antagonist, BB)
- CKD : ACEI/ARB, loop diuretics
- DM : ACEI/ARB (DM nephropathy)
- CVA : ACEI/Thiazide (acute stage : goal 160/100 ?)

Special Consideration

- Pregnant women : Methyldopa, BB, Vasodilator (ACEI and ARB contraindicated)
- Aldosteronism : Aldosterone antagonist
- Pheochromocytoma : Alpha blocker first, then BB
- Aortic aneurysm : BB , ACEI
- Aortic dissection : BB first, then vasodilator

Anti-HTN Drugs

- **Diuretics**
- **Beta-Blockers (BB)**
- **Calcium Channel Blockers (CCB)**
- **Angiotensin Converting Enzyme Inhibitor (ACEI)**
- **Angiotensin Receptor Blocker (ARB)**

- **Alpha-Blockers**
- **Centrally Acting Agents**
- **(Direct-acting) Vasodilators**

Diuretics

- Thiazide diuretic
  Hydrochlorothiazide (Dichlotride, D50)
  50 mg/#, 1#, qd, po

- Loop diuretic
  Furosemide (Lasix)
  40 mg/#, 1#, qd. po
  20 mg/vial, 1 vial, IV/IM

- Potassium sparing diuretic
  Spironolactone (*Aldactone*), *25 mg/#*
  Amiloride 5 mg + D50 (*Moduretic*), 1#, qd, po

Thiazide Diuretic in Hypertension

- Cheap and effective
- EBM: reduce stroke, MI and save life
- Add thiazide, if response to other antihypertensive drug is inadequate
- Elderly or Black patients respond well
- For CHF or renal insufficiency, use Loop diuretic such as Lasix (IV, if needed)

ADR of Diuretics

- **Metabolic:**
  Increase glucose, uric acid (!)
  Increase triglyceride and cholesterol (Thiazide)
  Decrease Na, K, Mg (K-sparing ones increase K)

- **Others:**
  Pancreatitis (Thiazide)
  Gynecomastia (Aldactone)
  Ototoxicity (Lasix)
  Muscle cramp (Decreased K)
  Impotence (?)

- **Nephrotoxicity of diuretics (mercurial & herbal diuretics)**
  Azotemia

Beta-Blocker

- Beta-adrenergic blocking agent (antagonist)
- One of the greatest medical achievements in 20th century
- Sir James Black, Nobel Laureate
- ICI (now Astra-Zeneca)
- Also developed H2 antagonist for peptic ulcer at SKB (now GSK)

Types of Beta-blocker

	Propranolol (Inderal), tid	Atenolol (Tenormin), qd
Lipid solubility	High	Low
Membrane (CNS) effect	(+)	(-)
Beta-1 (cardiac) Selectivity	(-)	(+)
Elimination	Liver metabolism	Kidney excretion

Both drugs have no Intrinsic Sympathomimetic (partial agonist) activity

Application of Beta-blocker

- Hypertension
- Coronary artery disease (angina, MI)
- Arrhythmia
- Migraine
- Essential tremor
- Hyperthyroidism

ADR of Beta-blockers

- Reduce heart rate, induce bronchospasm, impair myocardial contractility
- May also induce Raynaud's phenomenon, impotence and metabolic side effect (increase triglyceride and decrease HDL)
- Cardiac selectivity and ISA are relative, not absolute. Beware of sensitive patients.
- Abrupt withdrawal is dangerous !

  Receptor up-regulation

Calcium Channel Blockers

- Calcium channel blocker (antagonist)
- Three types:

  Share calcium channel blocking activity

  Differ in effect and side effect
- Nifedipine (Adalat): similar to direct vasodilator

  Verapamil (Isoptin): similar to beta-blocker

  Diltiazem (Herbesser): milder effect
- All have short acting and long acting preparations

Effects of Ca-blockers

	Nifedipine	Verapamil	Diltiazem
BP	↓↓↓	↓	↓
Heart Rate	↑ (Reflex)	↓↓↓	↓↓
Myocardial Contractility	↔	↓↓	↓↓
Angina	↓↓	↓	↓↓

Nifedipine-like Ca-blockers

- Dihydropyridines
- Nifedipine (Adalat)

  5 mg/capsule, 1 capsule tid po

  Sublingual for rapid onset (avoid)

  30 mg/extended release tablet, 1 tablet qd
- Felodipine (Plendil)

  5 mg/#, 1# qd – bid
- Amlodipine (Norvasc)

  5 mg/#, 1# qd

ACEI and ARB

- **Angiotensin converting enzyme inhibitor (Inhibit the production of Angiotensin II)**
- **Angiotensin Receptor Blocker**

- **Cough in ACEI, not in ARB**
- **Hyperkalemia**
- **Also used for CHF & Diabetic nephropathy**
- **Contra-indication:**
  Renal artery stenosis
  Pregnancy (Fetal mortality)

ACEI and ARB

- ACEI

  Captopril (Capoten), 25 mg/#, 1# tid

  Enalapril (Renitec), 5 mg/#, 1# qd

  Lisinopril (Zestril), 10 mg/#, 1# qd

- ARB

  Losartan (Cozaar), 50 mg/#, 1# qd

  Losartan + Thiazide = Hyzaar, 1# qd

  Telmisartan (Micardis), Valsartan (Diovan), Candesartan (Blopress)

Alpha-blockers

- Selective alpha 1 adrenergic receptor blocker
- Arterial Vasodilation, reflex tachycardia
- Doxazosin (Doxaben), 2 mg/#, 1# qn
  Terazosin (Hytrin), Prazosin (Minipress)
- First dose effect: orthostatic hypotension
- Also used in BPH
- Non-selective alpha-blocker:
  phenoxybenzamin (Phentolamin): PIPE

Alpha/Beta-Blocker

- Vasodilation with little reflex tachycardia

- Carvedilol (Dilatrend):
  Also for CHF !

Centrally Acting Drugs

- Drowsiness, slow heart rate, impotence
- Clonidine (Catapres), 0.075 mg/#, 1# qn - bid

  Stimulate pre-synaptic alpha 2 receptor

  Relieve of menopausal syndrome

  Acute withdrawal syndrome
- Methyldopa (Aldomet)
- Reserpin

Direct Vasodilators

- Arterial smooth muscle relaxation
- Reflex tachycardia and water retention
- Combine with beta-blocker and/or diuretic
- Minoxidil, Hair growing
- Apresoline
- No Viagra please !!

Resistant HTN

- Three drug therapy including a diuretic
- Compliance ?
- Excessive sodium intake / water retention
- Drug induced ?
- Associated conditions : obesity, insomnia/anxiety, excessive alcohol
- Secondary hypertension ? Surgery ?

Hypertensive Crisis

- HTN Urgency (>180/120, no acute TOD) : Control BP in hours using oral drug

- HTN Emergency (with TOD) :
- Intravenous drug in ICU
- Lower mean arterial pressure by 25% within 2 hours, (then to 160/100 over next 2 to 24 hours ?)

Parenteral Agents for Hypertensive Emergency

- Sodium nitroprusside (Nipride)
  Arterial and venous vasodilation
- Pre-load and after-load reduction
- Also for CHF
- Rapid onset, titratable, short lived
- ICU, intra-arterial BP monitoring
- Thiocyanate toxicity
- Nitroglycerin : also for angina, CHF

- Labetalol (Trandate) : alpha/beta blocker