My Approach to Hypertension

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Leeds Teaching Hospitals NHS Trust
Objectives

- Define Hypertension
- Outline how to diagnose hypertension
- Recall clues for aetiology of hypertension
- Understand indications for specialised investigation
- Consider management strategies
Case (1)

- Caroline – age 52, housewife
- No children
- Referred by cardiologists for ‘resistant hypertension’
- PHx – Type 2 diabetes, syncopal episodes, polyuria and polydipsia
- FHx – hypertension – Mum died aged 65 ‘stroke’, had a ‘stent in her kidney’
- DHx – 5 BP tablets
- Allergies – nifedipine, methyl dopa, indapamide
Case (2)

- Investigated by cardiologists – 24 hour tape, REVEAL device – NAD
- Echocardiogram – mild LVH
- ECG – normal
- BP at home and in clinic ‘high’
- Renal function – ‘normal’
Aliskiren 50mg od
Aspirin 75mg od
Atenolol 50mg od
Bendrofluamethazide 5mg od
Citalopram 10mg od
Doxazosin MR 8mg od
Metformin 1g bd
Moxonidine 200mcg bd
Simvastatin 40mg od
Valsartan 160mg bd
Case (3) – Medications

- Aliskiren 50mg od
- Aspirin 75mg od
- Atenolol 50mg od
- Bendrofluamethazide 5mg od
- Citalopram 10mg od
- Doxazosin MR 8mg od
- Metformin 1g bd
- Moxonidine 200mcg bd
- Simvastatin 40mg od
- Valsartan 160mg bd
Some definitions.....
Definition of Hypertension

- American Heart Association (2017)
  - 130/80
  - At least 3 readings

- British Hypertension Society
  - 140/90 (Age <80) ABPM 135/85
  - 150/90 (Age >80) ABPM 145/85
  - IF ACR >70 – 130/80
Resistant Hypertension

- **Apparent Resistant Hypertension**
  - Uncontrolled BP despite the prescription of at least 3 medications

- **True Resistant Hypertension**
  - Uncontrolled despite being compliant with at least 3 BP medications plus a diuretic – confirmed on ABPM assessment

- **Pseudo Resistant Hypertension**
  - Inaccurate measurement
  - Poor adherence
  - Suboptimal dose
  - Poor adherence to lifestyle/diet etc
Why worry about Hypertension?

Coronary heart disease mortality related to blood pressure and age

Stroke mortality related to blood pressure and age

Lancet 2002
Why worry about Hypertension?

Calculator: Cardiovascular risk assessment in adults (10-year; ACC/AHA 2013)

Input:
- Race: White
- Sex: Female
- Age: 52 yr
- Total cholesterol: 7.2 mmol/L
- HDL cholesterol: 2.4 mmol/L
- Systolic blood pressure: 230 mmHg
- On hypertension medication: No
- Diabetes: Yes
- Smoker: Yes

Results:
- 10-year risk: 10.11 %
- Decimal precision: 2
How should we diagnose hypertension?

- Clinic BP readings?
- Home BP readings?
How should we diagnose hypertension?

- Clinic BP readings?
- Home BP readings?
Ambulatory Blood Pressure Monitoring
Who should have ABPM?

- ‘episodic’ hypertension
- to ascertain therapeutic response (CKD, glomerulonephritis)
- ‘Resistant’ Hypertension
- Hypotensive Symptoms
- Autonomic Dysfunction
Back to Caroline (1) – clinic review

- History – as described
  - ‘BP trouble for years’
  - Did not have list of tablets
  - ‘Always remembers to take them’
  - Non-smoker
  - Headaches and collapses – multiple Ix NAD

O/E obese, BP 210/100 (clinic)
Brought BP diary with her
No other abnormalities noted
Caroline (2)

- Clinic BP? – 200/100

- Home BP readings?

BP 200/98
BP 230/110
BP 220/90
BP 128/61
BP 149/90
Caroline (2)

- Clinic BP? - 200/100
- Home BP readings?

Ambulatory BP monitoring?

BP 200/98
BP 230/110
BP 220/90
BP 128/61
BP 149/90
24 hour ABPM
What Next

What is the differential Diagnosis?
Next Steps?

- ECG
- Urine Dip
Clinic Investigations?

CXR

Fundoscopy
Clinic Investigations?

CXR – normal

Fundoscopy – diabetic retinopathy
Blood Tests

- Urea and Electrolytes
- Bicarbonate
- HbA1c
- Calcium
- Thyroid function
- Total cholesterol
- Liver function tests
- Urine PCR
Blood Tests

- Urea and Electrolytes – Normal
- Bicarbonate – 22
- eGFR 70
- HbA1c – 12.1
- Calcium – Normal
- TSH – Normal
- Total cholesterol – 7.1mmol/l
- Liver function tests – Normal
- Urine PCR – < 0.5g/day
What is your diagnosis?

A Primary/Essential Hypertension

B Secondary Hypertension
Essential Hypertension

- Age
- Obesity
- Family History
- Race
- Reduced Nephron Number
- Alcohol
- Diet
- Physical Inactivity
Clues for Secondary Hypertension
### Clinical features of the different causes of secondary hypertension

<table>
<thead>
<tr>
<th>Disorder</th>
<th>Suggestive clinical features</th>
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<tbody>
<tr>
<td><strong>General</strong></td>
<td>Severe or resistant hypertension&lt;br&gt;An acute rise in blood pressure over a previously stable value&lt;br&gt;Prepon age of onset before puberty&lt;br&gt;Age less than 30 years with no family history of hypertension and no obesity</td>
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<td><strong>Renovascular disease</strong></td>
<td>An acute elevation in serum creatinine of at least 30% after administration of ACE inhibitor or ARB&lt;br&gt;Moderate to severe hypertension in a patient with diffuse atherosclerosis, a unilateral small kidney, or asymmetry in renal size of more than 1.5 cm that cannot be explained by another reason&lt;br&gt;Moderate to severe hypertension in patients with recurrent episodes of flash pulmonary edema&lt;br&gt;Onset of stage II hypertension after age 55 years&lt;br&gt;Systolic or diastolic abdominal bruit (not very sensitive)</td>
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<td><strong>Primary renal disease</strong></td>
<td>Elevated serum creatinine concentration&lt;br&gt;Abnormal urinalysis</td>
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<td><strong>Oral contraceptives</strong></td>
<td>New elevation in blood pressure temporally related to use</td>
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<td><strong>NSAIDs</strong></td>
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<td><strong>Stimulants (e.g., cocaine, methylphenidate)</strong></td>
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<td><strong>Calcineurin inhibitors</strong></td>
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<td><strong>Antidepressants</strong></td>
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<td><strong>Pheochromocytoma</strong></td>
<td>Paroxysmal elevations in blood pressure&lt;br&gt;Triad of headache (usually pounding), palpitations, and sweating</td>
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<td><strong>Primary aldosteronism</strong></td>
<td>Unexplained hypokalemia with urinary potassium wasting; however, more than one-half of patients are normokalemic</td>
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<td><strong>Cushing's syndrome</strong></td>
<td>Cushingoid facies, central obesity, proximal muscle weakness, and ecchymoses&lt;br&gt;May have a history of glucocorticoid use</td>
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<td><strong>Sleep apnea syndrome</strong></td>
<td>Common in patients with resistant hypertension, particularly if overweight or obese&lt;br&gt;Loud snoring or witnessed apnic episodes&lt;br&gt;Daytime somnolence, fatigue, and morning confusion</td>
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<td><strong>Coarctation of the aorta</strong></td>
<td>Hypertension in the arms with diminished or delayed femoral pulses and low or unobtainable blood pressures in the legs&lt;br&gt;Left brachial pulse is diminished and equal to the femoral pulse if origin of the left subclavian artery is distal to the coarc</td>
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<td><strong>Hypothyroidism</strong></td>
<td>Symptoms of hypothyroidism&lt;br&gt;Elevated serum thyroid stimulating hormone</td>
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<td><strong>Primary hyperparathyroidism</strong></td>
<td>Elevated serum calcium</td>
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ACE: angiotensin-converting enzyme; ARB: angiotensin II receptor blocker; NSAID: nonsteroidal antiinflammatory drug.
A COUPLE OF QUESTIONS
Which of these drugs does NOT cause hypertension?

A. Decongestants
B. Antacids
C. NSAIDs
D. Paracetamol
E. Erythropoetin
Which of these drugs does NOT cause hypertension?

A. Decongestants
B. Antacids
C. NSAIDs
D. **Paracetamol**
E. Erythropoetin
The following statements are correct for hypertension

A. Life expectancy is improved by reducing BP in all groups of pts where the diastolic BP > 90

B. The presence of hypertension and hyperkalaemia suggests Conn’s

C. The presence of hypertension, centripetal obesity and hyper-reninaemia suggests Cushings’s Syndrome

D. After repair of coarcation of the aorta the BP often remains high unless medically treated
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B. The presence of hypertension and hyperkalaemia suggests Conn’s

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D. After repair of coarctation of the aorta the BP often remains high unless medically treated
What Next for Caroline?

- Renal USS
- 24 hour urine cortisol
- Plasma aldosterone/Plasma renin ratio
- 24 hour urine collection for catecholamines
Revision of Renin/Aldosterone
Question
Q – Plasma Renin Levels are LOW in which of the following conditions?

A  Malignant Hypertension  
B  Renovascular Disease  
C  Primary Hyperaldosteronism  
D  Nephrotic Syndrome  
E  Liquorice Ingestion
Plasma Renin Levels are LOW in which of the following conditions

A  Malignant Hypertension (H)
B  Renovascular Disease (H or N)
C  **Primary Hyperaldosteronism** (LOW)
D  Nephrotic Syndrome (H)
E  Liquorice Ingestion (LOW)
Hypokalaemic, Alkalotic with Hypertension

- Primary Hyperaldosteronism

- Secondary Hyperaldosteronism
  - Renovascular disease, CCF, nephrotic, liver disease

- Non–Aldosterone Mineralocorticoid excess
  - Cushings
  - CAH
  - Liquorice Ingestion
  - Genetic Disorders – Liddle’s
Indications for measuring PRA/PAC

- Hypertension, hypokalaemia, alkalosis
- Severe HTN/Drug resistance
- Hypertension with adrenal lesion
- Hypertension with Sleep Apnoea
- Hypertension with FHx of HTN or CVA at young age
- First degree relative of patient with hyperaldosteronism

- Not for – elderly with normal K, or pts where diagnosis would not alter the management
<table>
<thead>
<tr>
<th>Condition</th>
<th>PRA</th>
<th>PAC</th>
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<tr>
<td>Primary Hyperaldosteronism</td>
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<td>Secondary Hyperaldosteronism</td>
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<td>Low/normal</td>
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<td>Non-aldosterone mineralocorticoid excess</td>
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<td>Low/normal</td>
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<td>Aldosterone Receptor Antagonisism</td>
<td>high</td>
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<td>variable</td>
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<td>ACE-I</td>
<td>high</td>
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</table>
Additional Tests

- 24 hour urine – potassium, aldosterone
- Salt loading/Saline infusion
- Adrenal Vein Sampling
Back to Caroline

- Renal USS – Normal
- 24 hour urine cortisol – Normal
- Plasma aldosterone/Plasma renin ratio – Normal (Se Ald 280pmol/L, PRC – 1nmol/L)
- 24 hour urine collection for catecholamines – Normal
MRA – renal arteries
MRA
Q – What would you do?

› Treat the lesion?

› Continue medical management?
What is the evidence for RAS?

- ASTRAL Trial
- Published 2009
- 806 patients with Atherosclerotic Renovascular Disease
- Randomised to Revascularisation or Maximal Medical Therapy
Revascularization versus Medical Therapy for Renal-Artery Stenosis

The ASTRAL Investigators

Renal and Cardiovascular Events – no difference
Revascularization versus Medical Therapy for Renal-Artery Stenosis

The ASTRAL Investigators

Renal Function
- no difference
Revascularization versus Medical Therapy for Renal-Artery Stenosis

The ASTRAL Investigators*

A Systolic Blood Pressure

B Diastolic Blood Pressure

Systolic and Diastolic BP – no difference
Revascularization versus Medical Therapy for Renal-Artery Stenosis

The ASTRAL Investigators

All cause mortality – no difference

In summary, we compared endovascular revascularization plus medical therapy with medical therapy alone in patients with atherosclerotic renovascular disease. Revascularization carried substantial risk but was not associated with any benefit with respect to renal function, blood pressure, renal or cardiovascular events, or mortality.
No evidence for benefit of revascularisation unless

- Failure of medical therapy including ACE-I
- Intolerance of medications
- Recurrent flash pulmonary oedema
- If renal lesion thought to the cause of progressive decline in renal function
Back to Caroline

- 5 antihypertensive agents (including ARB)
- End organ damage
- ‘Resistant Hypertension’
5 antihypertensive agents
End organ damage
‘Resistant Hypertension’

ADMIT FOR ANGIOPLASTY
### Peri-Procedure Nursing Notes

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### Oxygen Saturation

| %  | 93 | 95 | 95 | 96 | 96 | 96 |

### Drug Administration

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<tr>
<th>Drug</th>
<th>Buscopan</th>
<th>Hepin</th>
<th>GTN</th>
<th>Midazolam</th>
<th>Morphine</th>
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### Complications and Post Procedure Care

- BP on arrival 70/1-
- Patient "fell awful".
- Must see urologist today.
- Recheck urine 8am today.
- Bp 12.
So……

- Observed on the ward
- Medications stopped for 24 hours
- BP 130/70 – discharged on valsartan 160mg od and amlodipine

- 2 weeks later in clinic
- BP 220/140
Next steps

- Discussed concordance
- Referred to clinical psychology
- Over the next 4 months BP remains out of control – back on 6 agents

- Further admission – BP remains high
- Renal angioplasty undertaken – ‘borderline gradient’
- BP 140 SBP on discharge – 2 agents
Over the next 24 months

- Back on 6 antihypertensive agents
- BP 180–210 SBP on repeat 24 hour testing

- ‘100% compliant’

- Admitted for BP control with headache and nausea
- Propranolol and Diazepam – BP back to normal
- Discharged
2 weeks later in clinic

- BP 190/100
- Patient has stopped propranolol (cold hands), and diazepam (spaced out)
When preparing this talk
Diagnosis: Elective admission - refractory hypertension

This 46 year old lady with a long history of essential hypertension, type II diabetes with poor control (HbA1c 11%), hypercholesterolaemia with target organ damage (LVH and retinopathy) was admitted electively for assessment of medication and review of blood pressure control. On admission her blood pressure was 237/135mmHg with no evidence on examination of a secondary cause. Echocardiography showed well preserved LV systolic function with concentric LVH. Her recent bloods showed normal renal function with a cholesterol of 6.4mmol/l, HbA1c of 11% (random glucose 18) and an eGFR of 90mls/min>.

She was initially kept on all her usual medications with a pleasing response to the blood pressure, when we up titrated the medication slightly she did develop a degree of hypotension (109/72mmHg in the left arm and 111/72mmHg in the right arm), all in keeping with limited compliance whilst at home being behind her refractory nature of the blood pressure. Her albumin, creatinine ratio taken as an inpatient was satisfactory at 1.1mmol/l. She has therefore been reassured, due to some dizziness precipitated on taking certain medication we reduced back to a baseline level, such at discharge she was on the following; Aspirin 75 mgs od, Atenolol 50 mgs od, Citalopram 30 mgs od, Gliclazide 160 mgs bd, Metformin 500 mgs bd, Rosiglitazone 4 mgs od, Spironolactone 25 mgs od, Atorvastatin 40 mgs od, Co-Diavan 160/25mgs od.

If further blood pressure control is required I would suggest the use of Doxazosin in a small dose gradually up titrated. If compliance is undertaken then she is running excellent blood pressure control. This has been reiterated to her as an inpatient. She understands the importance of lifestyle modification principally weight reduction. I haven't arranged any routine appointment at this stage but I would be happy to see and advise should you have any future problems.

Yours sincerely
How do I evaluate Hypertension

- Detailed History and Examination
- Look for clinical clues
- Scrutinise the Clinical Notes (and GP records)
- Initial Investigations
- Complex Relevant Investigations
- Think about the physiology

- Don’t forget simple things – compliance!
Sleep: A Surprising Way To Lower Blood Pressure