Obesity and Hypertension

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Scope of Talk

• Prevalence of childhood obesity in the UK
• Prevalence of hypertension in obese children
• Pathophysiology of hypertension in obesity
• Relevance – does it matter?
• Cases from our hypertension clinic
Definition of obesity - BMI

- There are several definitions around for overweight and obesity
  - Clinical cut-offs - 85th and 95th percentile
  - Health policy - 91st and 98th percentile (NICE/ DoH)
  - International Obesity Task force (IOTF) - 88th /90th and 99th
    - corresponds with adult BMI cut offs at 25 kg/m² and 30 kg/m²
Although whichever way you look at it, the figures are sobering...
Trend in the prevalence of obesity and excess weight

Children aged 2-15 years; Health Survey for England 1995-2012

Child excess weight BMI ≥ 85th centile, child obesity BMI ≥ 95th centile of the UK90 growth reference. 95% confidence intervals are displayed on the chart.
Obesity prevalence by region
National Child Measurement Programme 2012/13

Patterns and trends in child obesity
and how common is hypertension in obese children?
Hypertension in obese children

- Obesity and hypertension in children have been consistently associated across different childhood populations
  - Higher blood pressure found in obese versus lean kids
- Although categorisation clinically useful the relationship of BP with BMI is continuous
  - Abdominal obesity more strongly associated with hypertension
Hypertension in obese children-2

Hypertension though is only one of the outcomes

- Type 2 diabetes mellitus
- Dyslipidaemia
- Left ventricular hypertrophy
- Non-alcoholic fatty liver (steatohepatitis)
- Obstructive sleep apnea
- Orthopaedic problems
and this is a major issue as unfortunately the same patient often has more than one of these problems!
Pathophysiology - 1

• Direct effect of obesity on cardiovascular hemodynamics
  – Increase blood volume, stroke volume and cardiac output

• What mechanism links obesity with peripheral vascular resistance
  – Autonomic nervous system activation
  – Renal mechanisms: impaired pressure natriuresis; ↑ RAS
  – Hormones: insulin resistance, Leptin
  – Endothelial dysfunction: a state of inflammation
Pathophysiology - 1

The heart, arteries, and arterioles in hypertension

• Blood pressure - balance between CO and peripheral resistance
• In adults - CO maintained but peripheral resistance goes up as arterioles have smooth muscle cells
  – transient to more permanent change in the arteriolar bed
• It has been postulated that in very early hypertension – increased CO before increased peripheral resistance and that this driven by sympathetic overactivity

Beevers et al BMJ 2001
Pathophysiology - 2

Kotsis et al Hypertension Research 2010
Summary-1

- Obesity and excess weight is prevalent and an increasingly concerning health issue
- Hypertension in obesity is common but only one of several CV risk factors present in this cohort
- Despite this during childhood its patho-physiology remains poorly understood
Do obese hypertensive children exhibit TOD?

Obesity – increased clustering of CV risk factors

Elevated BMI, SBP and serum triglyceride and LDL-C

Do obese hypertensive children exhibit TOD?

- Increased carotid intima medial thickness (cIMT) and LVH described in children with essential hypertension
- cIMT and LV mass correlate with blood pressure and BMI
What about their impact in later life?

• We know that both BMI and blood pressure tracks during childhood – ‘tracking’

• Similarly, abnormal BMI and BP have been shown to increase to higher percentiles over time

What about their impact in later life?

• Several population based studies (n= 750-2200) performed in the 1970’s-1980’s
  – Bogalusa and Muscatine study in the US
  – ARYA (Belgium) and Young Finn (Finland) in Europe

• Included children 3-18 year who had one or more cross-sectional assessments through childhood

• Now, in young adults aged 24-44 year they

• Report predictability TOD following ‘exposure’ to CV risk factors during childhood
What about their impact in later life?
Atherosclerosis has its roots in childhood

• **Preclinical carotid atherosclerosis**
  - Bogolusa study: **BMI**, LDL-C → cIMT
  - Muscatine study: **SBP**, LDL-C, smoking → cIMT
  - Young Finn study: **BMI, SBP**, LDL-C, smoking → cIMT

• **Arterial elasticity and arterial PWV - stiffness**
  - Bogalusa: **SBP** → PWVba
  - ARYA study: not with SBP → PWVcf
  - Young Finn: **obesity and SBP** → PWV & reduced elasticity

• **More severe pathology corresponding to multiple and/or more long standing risk exposure**
Summary-2

• Obesity and excess weight is prevalent and an increasingly concerning health issue
• Hypertension in obesity is common but only one of several CV risk factors present in this cohort
• Despite this during childhood its pathophysiology remains poorly understood
• Both BMI and BP track – in health and in disease
• There is strong association of obesity and hypertension with surrogate markers of CV disease both during childhood and as young adults with ‘childhood-onset’
• Worst ‘disease’ in those with most long-standing persistent abnormality
‘One stop’ clinic for evaluation of hypertension in children - single visit

- Family history & investigation work-up completed
- Out of office evaluation including interpretation of results
- Dietary assessment for salt and calories
- 24-hour urine specimen for measurement of sodium
- Cardiac (and vascular) assessment
- Monitoring following commencement of therapy
- Shared care management
Case 1

- 12 year old boy, african origin - headaches & chest pain
- No cardiac cause identified hence referred to the clinic
  - 135.7 cm (2nd-9th percentile) and 42.7 kg (75th percentile)
  - BMI 23.2 kg/m² (95th percentile) – **clinical excess weight**
  - 126/78 mmHg clinic (95th percentile 119/78) - confirmed on ambulatory BP 126/67 mmHg - **ISH**
  - **concentric LVH** with increased **microalbuminuria**
  - **7g of sodium** in 24-hour urine specimen
Case 1

• Future management
  • Commenced on amlodipine whilst actively modifying lifestyle & diet

• 12 months later BP 112/70 mmHg
  – asymptomatic but now performing regular physical exercise
  – 138.5 cm and 46kg - BMI 24.0 kg/m2 (97th percentile)
  – Very few snacks - 5g equivalent of sodium in 24-hour urine
  – LVMI – improved 44 g/m2.7
Improve clinical practice - 1

‘Cardio Z’ iphone app from ELCH
http://www.ubqo.com/cardioz

• Must measure BP in children >3 years
• Copies of the normal BP tables in boys and girls from the ‘Fourth report’, should be available to all clinicians in clinic rooms

calculation of a user-defined 'target centile' blood pressure
Case 2

• 16 years 2 month old boy, african origin – feels unwell, headache
  – 177 cm (25\textsuperscript{th}-50\textsuperscript{th} percentile) and 75 kg;
  – BMI: 23.9 kg/m\textsuperscript{2} (92\textsuperscript{nd} percentile) - clinical excess weight
  – 170/62 mmHg clinic; (95\textsuperscript{th} percentile 136/86) confirmed on ambulatory BP 142/64 mmHg - ISH
  – 7.9g of sodium in 24-hour
  – eccentric LVH with increased microalbuminuria
Case 2

• Future management - 9 months later
  • Initially on two but now on single agent - ACEi - BP 122/64 mmHg - asymptomatic
  • Modified diet - no snacks, family modified diet
Out of office BP monitoring

Out-of-office measurement is important to identify both white coat hypertension and masked hypertension
Out of office BP monitoring

During the process of diagnosis both to confirm hypertension before starting treatment
Case 3

• 15 year old boy, caucasian - asymptomatic
  – High BP detected at the time of check entry to health club
  – 168.7 cm (50th percentile) and 85.9 kg;
  – BMI: 30.2 kg/m2 (99th percentile) - clinical excess weight
  – 142/92 mmHg clinic; (95th percentile 131/80) confirmed on ambulatory BP 139/70 mmHg - ISH
  – 8.5g of sodium in 24-hour
  – No evidence of LVH
Case 3

- Strong family history of hypertension, strokes and heart disease involving maternal grandparents
- Family don’t want to start any anti-hypertensive therapy
  - actively modifying lifestyle & diet
  - exercise
Improve clinical practice - http://www.nhs.uk/Tools/Pages/Healthyweightcalculator.aspx

Family convinced – their son is not fat... and that they all had a very healthy diet with little salt
Case 4

• 16 years 9 months boy, caucasian – intermittent headaches
  – High BP detected at the time of check entry to health club
  – DGH - height 176.8 (50th -75th centile) and weight 119 kg
  – BMI 38.1 kg/m² (>99th percentile) – morbidly obese
  – 160/86 mmHg - confirmed on ABPM 151/74 mmHg - ISH
  – HTN clinic - 112.3 kg! and BP improved as well!!
    • Clinic - 124/62 mmHg clinic; ambulatory BP 110/66 mmHg on no medication
  – No evidence of LVH
Case 4

• Future management
  – Took up boxing – 18 months later – 83.5kg & very well - discharged
  – Dynamap 143/71 but Aneroid measurements 112/68 mmHg
Management

• Non-pharmacological: **weight reduction and exercise**
  – **together most effective** at least early (>6-month)
  – compliance an issue
  – target BMI <85th percentile, 40-min exercise 3-5 days a week

• Diet – need to cut down on salt intake
  – This needs to be demonstrated to families often as convinced salt intake not high!

• Pharmacotherapy generally reserved for
  – symptomatic hypertension +/- evidence of end-organ damage
  – elevated BP unresponsive to conservative treatment
Summary-3
some findings from the hypertension clinic

• Isolated systolic hypertension 80%-85%
  – males, adolescents, increased BMI
  – No identifiable cause – renal, cardiac, other
  – mostly asymptomatic; ADHD
  – exercise - not certain but generally not as much
  – High salt intake and excessive sodium in 24-hour urine even in those with normal BMI

• In confirmed cases of hypertension
  – less than a 1/3rd have LVH (+/-micro Alb)

• Most effective treatment measures that have improved BP
  – Reduction of salt intake
  – CCB and diuretics in some
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Selected references

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