Leave no stone unturned!!
An update on Renal stone disease

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Ref: EAU Guidelines
Introduction

• Demographics
• Etiology and pathogenesis
• Stone classification
• Metabolic evaluation
• Prevention
• Personal experience and views
Demographics

Prevalence up to 5% of population
Commoner in Caucasiands and Asians
Rare in Africans and Afro-Caribbeans
Peak occurrence 45 to 55 years of age
Male: Female = 3:1 (but changing)
Increasing affluence and improved diet
BMI/ Diabetes and central obesity
Data from 6000+ stone analyses from 60 hospitals (IR spectroscopy)
# Ethnicity data (2004)

<table>
<thead>
<tr>
<th>SWBH stone patients</th>
<th>Census 2001 (450,000)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ethnicity</strong></td>
<td><strong>percentage</strong></td>
</tr>
<tr>
<td>Caucasian</td>
<td>62.5</td>
</tr>
<tr>
<td>South Asian</td>
<td>28.9</td>
</tr>
<tr>
<td>Afro-Caribbean</td>
<td>2.6</td>
</tr>
<tr>
<td>Caucasian</td>
<td>67</td>
</tr>
<tr>
<td>South Asian</td>
<td>13</td>
</tr>
<tr>
<td>Afro-Caribbean</td>
<td>8</td>
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</tbody>
</table>
### SWBH Ethnicity data (2012)

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>2012 Percentage</th>
<th>Census 2011 (450,000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caucasian</td>
<td>63</td>
<td>79.7</td>
</tr>
<tr>
<td>South Asian</td>
<td>28</td>
<td>13.3</td>
</tr>
<tr>
<td>Afro-Caribbean</td>
<td>3</td>
<td>5.2</td>
</tr>
<tr>
<td>Middle East</td>
<td>4.5</td>
<td>0.7</td>
</tr>
</tbody>
</table>
Diabetes in asian and caucasian patients with nephrolithiasis
Fernando H, Gupta A, Devarajan R
City Hospital, Birmingham

RESULTS:
The mean age of patients 49.7 years, of which 97 (80.2%) were males. Forty (33%) patients were of Asian origin. Thirteen of the 40 asians were diabetic while 10 out of 81 caucasians were diabetic (p=0.009). There was no significant difference between the two races in the diabetic cohort for the urinary calcium(p=0.09), uric acid(p=0.4), oxalate(p=0.25), phosphate(p=0.08) and citrate(p=0.18).

CONCLUSION:
The incidence of diabetes is higher in asian stone formers when compared to the caucasian cohort. The fact that there is no significant difference in the urinary excretion levels suggests that there may be other metabolic factors involved in the increased incidence in diabetic Asians. This is the first report in the literature describing an association of increased stone formation in diabetic asians.

Graph depicting the relationship between incidence of diabetes and race in stone formers.
Chemical Composition
(majority are mixed composition)

- Calcium oxalate (80-85%)
- Calcium phosphate (<5%)
- Urate (5-10%)
- Cystine (<1)
- Magnesium ammonium phosphate - Struvite (5%)
- Others: Xanthine, Indinavir
## Stone classification
### X Ray characteristics

<table>
<thead>
<tr>
<th>Radiopaque</th>
<th>Poor radiopacity</th>
<th>Radiolucent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium oxalate dihydrate</td>
<td>Mag.ammonium phosphate (Struvite)</td>
<td>Uric acid</td>
</tr>
<tr>
<td>Ca oxalate monohydrate</td>
<td>Apatite</td>
<td>Ammonium urate</td>
</tr>
<tr>
<td>Calcium phosphate</td>
<td>Cystine</td>
<td>Indinavir (also not seen on CT)</td>
</tr>
</tbody>
</table>
Stone classification

• By size in 1 or 2 dimensions in mm

• By location:
  – Upper, mid or lower ureter
  – Upper mid or lower pole calyx
  – Renal pelvis, calyceal diverticular
  – Staghorn (partial or complete)
Etiology

- Environmental factors
- Dietary factors
  - High protein intake
  - High oxalate
  - Milk products
- Fluid intake
- Metabolic causes
- Obstruction of urinary tract
- Urinary infection
Stone classification (by Etiology)

- Non-infection
  - Calcium oxalate
  - Calcium phosphate
- Infection
  - Magnesium ammonium phosphate
  - Carbonate apatite
- Genetic
  - Cystine
  - Xanthine
- Drug stones
  - Retroviral drugs
Risk stratification

• Low risk
  – Approx. 20% risk in 10 years

• High risk
  – Early onset
  – Familial
  – Multiple stones at presentation
  – Recurrent stones
  – Inflammatory bowel diseases.
  – Bilateral at presentation
  – Metabolic causes
High risk stone formers

• General factors:
  – Early onset
  – Familial
  – Brushite (CaHPO$_4$·$2$H$_2$O)
  – Uric acid
  – Infection stones
  – Solitary kidney
High risk stone formers

- Diseases associated with stone formation:
  - Hyperparathyroidism
  - GI diseases: Inflammatory bowel disease, malabsorptive conditions, intestinal resection, Bariatric surgery
  - Sarcoidisis
High risk stone formers

• Genetic conditions:
  – Cystinuria
  – Primary hyperoxaluria
  – Renal tubular acidosis
  – Xanthinuria
High risk stone formers

- Anatomical abnormalities:
  - Medullary sponge kidney (tubular ectasia)
  - PUJ obstruction
  - Calyceal diverticulum
  - Horseshoe kidney
  - Ureterocoele
Pathophysiology

• Urine is “super-saturated”
• Imbalance of solutes in urine and inhibitors
• Inorganic and organic inhibitors
• Stasis of urine
• Infection: Proteus, pseudomonas and Klebsiella
  Produce enzyme: Urease splits urea into ammonia and CO2.
  Alkaline urine: leads to ammonium and magnesium phosphate (Struvite calculus)
Metabolic Causes
Calcium Related

- Hyperparathyroidism
- Dietary excess
- Absorptive hypercalciuria
- Renal (leak) hypercalciuria
- Excess vitamin D or calcium supplements
- Renal tubular acidosis
- Prolonged immobilisation
- Sarcoidosis
Metabolic Causes (Oxalate Related)

- Hereditary hyperoxaluria - renal failure
- Dietary excess - rhubarb, strawberries, nuts, chocolate, tea
- Intestinal diseases - Crohn’s, ulcerative colitis
  - Unbroken fatty acids bind with dietary calcium
  - Not available to bind with dietary oxalates
  - Increased oxalate absorption and excretion
Metabolic Causes (Uric Acid)

- Dietary excess of animal proteins - purine rich
- Gout related - enzyme deficiency - poor breakdown of uric acid
- High cell turnover: e.g. Acute leukaemia
- Leads to acidic urine (pH < 6)
- Radiolucent calculi
Cystine

• Autosomal recessive condition
• Consanguinity in certain communities
• Tubular failure to reabsorb amino acids- **Cystine. Ornithine, Lysine and Arginine**
• Acidic urine- precipitation of cystine
• Partially opaque on X-Ray (ground glass)
Prevention and follow up
EAU Recommendations

• Always perform stone analysis in first-time formers using a valid procedure (X-Ray Diffraction or Infra-red spectroscopy).

• Repeat stone analysis in patients:
  • presenting with recurrent stones despite drug therapy;
  • with early recurrence after complete stone clearance;
  • with late recurrence after a long stone-free period because stone composition may change
Stone clinic

• Dedicated clinic with X-ray review
• Review all investigation
• Identify high risk and arrange metabolic assessment
• Refer to nephrology or clinical biochemist with interest in stone disease
• ? Reduces recurrences- stone clinic effect!
• New to review ratio!!!
Metabolic Screening (all patients)

• Serum calcium and uric acid
• Urinary pH
• Parathyroid hormone (in hypercalcemia)
Metabolic Screening (high risk patients)

- At least 20 days or more after expulsion or clearance
- Explain exactly what has to be done
- Under normal dietary conditions
- Biochemistry department should have clear guidance
- Care with containers with acid
- 2 X 24 hour urinary excretion of Calcium, Uric acid, Oxalate, Cystine
- Repeat after 8-12 weeks of starting medical treatment
Medical Management

Increased fluid intake: output of 2.5 to 3 litres
Circadian drinking
Urine should be clear
Fruit juices rich in citrate or bicarbonate
Medical Management

Diet leaflets (BAUS)

– Reduce meat protein intake (0.8 to 1gm/KG)
  (Excess causes: hypocitraturia, lowering of pH, hyperoxaluria and hyperuricosuria)
– Increase fruit/vegetables (beneficial effect of raising pH)
– Avoid oxalate rich foods (strawberries, rhubarb, nuts, chocolates and tea)
– Avoid excessive milk and milk products (CAVEAT)
– Avoid added salt (3-5gm/day)
Personal experience!
Medical Management

• Drugs:
  – Allopurinol in uric acid and uricosuric oxalate stone formers
  – Potassium citrate: uric acid and cystine stone formers by making urine alkaline
  – Penicillamine: binds and dissolves cystine
  – Thiazide diuretics in renal hypercalciuria
  – Calcium carbonate (malabsorption)
  – Acetohydroxamic acid (urease inhibitors) for struvite stones

• Antibiotics: for *Proteus, pseudomonas and klebsiella*
Medical management of Urate stones

- Awareness
- Urine pH
- Diabetic/High BMI/ High protein intake
- Hounsfield density <500 or red on dual energy CT scan
Case no. 1

- 76 year old with BMI>31
- Diabetic
- AF
- Warfarin
- >IHD
Case no. 2

- 34 year old
- Fitness aware!
- Admitted with bilateral loin pain
- eGFR< 23
- 250gm of protein per day
• Bilateral stenting
• Commenced on allopurinol
• Pot. Citrate
• Listed for bilateral flexible ureteroscopy
Post op CT KUB
Aids for patients

- BAUS Information leaflets
- BAUS consent forms
- Diet and fluid advice
- Show the images!
- Pictorial information
- Draw in notes to explain
- Videos
The dreaded JJ Stent!!

With or without string
Stent with string

- Self removal or
- Outpatient nurse led clinic
- No waiting time for flexible cystoscopy
- Patient counselling
- Information leaflet
- Patient empowerment!!
How to avoid the forgotten stent

• Paper/Theatre records
• BAUS register
• Who accesses and inputs data?
• Personal database
• ? Radiology inserted stents
• Patient information with stent cards
How I do it

Password Required

Enter database password:

[Password field]

[OK]  [Cancel]
Personal database
Stented patients
Summary of Urinary Calculus Disease

- Common urological problem
- Socio-economic consequences
- Treatment options are different
- Technology driven
- Etiology is multifactorial
- Prevention of recurrence is possible
- Subspecialist interest and clinic to manage such patients
Thank you

Any questions?