Urolithiasis is a common and burdensome urinary disease affecting approximately 1 in 11 people in the United States with as many as 13% of men and 7% of women having a kidney stone in their lifetime. This has resulted in dramatic increases in direct and indirect costs of over $5 billion to the United States’ national healthcare system. The indirect costs of over $5 billion to the United States with as many as 13% of men and 7% of women having a kidney stone in their lifetime. This has resulted in dramatic increases in direct and indirect costs of over $5 billion to the United States’ national healthcare system. The reasons for these trends are not entirely clear, but studies show correlations between age, diet, climate, and race and the presence of certain minerals in mixed stones.

Here, we performed a retrospective study of stones from patients treated at a tertiary center from 2005-2015. SPSS version 23 was used for all statistical analyses. Statistical significance was set at \( p < 0.05 \).

Methods

Data acquisition

This is a retrospective study of stones from patients at NMH who underwent PCNL or ureteroscopy for the management of urolithiasis and had their calculi analyzed between the years 2005-2015. Birthdate, sex, race, ethnicity, and stone result analyses were retrieved via the NMEDW.

Stone Composition Analysis

Stones were classified based on the mineral that comprised the largest percentage of the stone: calcium oxalate monohydrate/dihydrate (COM/COD), carbonate apatite (CA), uric acid (UA), struvite, calcium phosphate (CP), and/or cystine. Stones classified as “dual-majority” (DM) had an equal presence of two stones. The small amount of pure stones in this study is therefore not representative of the whole USA, and the inclusion being limited to surgically removed stones.

Statistical Analysis

Binary logistic regression was used to assess trends for each stone type with year, sex, and age groups treated as covariates and each stone type treated as a separate dependent variable. Chi-squared tests were used to calculate notable differences in the prevalence across sex and age group in 2005 versus 2015. SPSS version 23 was used for all statistical analyses. Statistical significance was set at \( p < 0.05 \).

Results

Table 1: Demographic data and counts relating to the whole stone population

<table>
<thead>
<tr>
<th>Stone Composition</th>
<th>Count</th>
<th>Pure Stones</th>
<th>%</th>
<th>Mixed Stones</th>
<th>%</th>
<th>Overall</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>COM</td>
<td>5298</td>
<td>9.8</td>
<td>5.3</td>
<td>4.5</td>
<td>2.5</td>
<td>7.8</td>
<td></td>
</tr>
<tr>
<td>COD</td>
<td>3036</td>
<td>53.6</td>
<td>28.8</td>
<td>24.8</td>
<td>14.0</td>
<td>23.4</td>
<td></td>
</tr>
<tr>
<td>CA</td>
<td>697</td>
<td>12.0</td>
<td>6.6</td>
<td>5.4</td>
<td>3.2</td>
<td>6.2</td>
<td></td>
</tr>
<tr>
<td>UA</td>
<td>3625</td>
<td>65.2</td>
<td>36.8</td>
<td>29.4</td>
<td>17.5</td>
<td>25.2</td>
<td></td>
</tr>
<tr>
<td>Struvite</td>
<td>2232</td>
<td>42.4</td>
<td>23.6</td>
<td>18.8</td>
<td>11.2</td>
<td>14.0</td>
<td></td>
</tr>
<tr>
<td>Mixed (DM)</td>
<td>9336</td>
<td>42.4</td>
<td>19.7</td>
<td>13.7</td>
<td>8.0</td>
<td>11.6</td>
<td></td>
</tr>
</tbody>
</table>

In Figure 3, the prevalence of COM increased substantially from 11.8% in 2005 to 74.6% in 2015 (\( p < 0.001 \); OR: 1.515) with a complementary decrease in stones containing exclusively UAA or UAD (\( p < 0.001 \); OR: 0.657). This was less prevalent within both sexes reflected gender effects on stone composition and trends in overall stone prevalence

The proportions of mixed stones and sex did not change remarkably in 2015 versus 2005. Changes in stone type prevalence within both sexes reflected gender effects on stone composition and trends in overall stone prevalence (Figure 1). In males, COM and COD increased by 12.5% (\( p < 0.01 \)) and 8.3% (\( p < 0.01 \)), respectively, whereas COD and struvite decreased by 7.2% (\( p < 0.05 \)) and 11.9% (\( p < 0.001 \)), respectively. In females, CA was the predominant calcium in 2005, but decreased by 26.2% (\( p < 0.001 \)) such that COM was predominant in 2015. COD and struvite increased significantly by 10.6% (\( p < 0.01 \)) and 10.1% (\( p < 0.01 \)), respectively, as well. Relative to 2005, stone formers were older on average in 2015, with significant increases in the prevalence of 60-74 and 75+ year olds by 9.9% and 10.0%, respectively, and decreases in the younger age groups.

Composition of Mixed Stones

A majority of stones in Figure 2 contained COD and/or CA. Mixed stones with COM contained CA less often as time progressed, peaking at 69.5% in 2008 and decreasing to 17.8% by 2015 (\( p < 0.001 \); OR: 0.786). There was also a steady increase in UA from 1% in 2005 to 15.9% in 2015 (\( p < 0.001 \); OR: 1.282). COD also fell, albeit less deeply, and the presence of other minerals did not change significantly.

Conclusion

The small amount of pure stones in this study is surprising. This could be from epidemic obesity/metabolic syndrome in our population, which induces urine acidification and increases excretion of UA, sodium, and phosphate. Our sub-analysis also confirms a decrease in CO stones after age 60, which we found to be mostly due to COD.

Men form more stones due to excreting more oxalate and less citrate and possibly due to a higher animal protein intake that promotes calcium oxalate stone formation. In our study, however, the M/F ratio evolved from 1.8 in 2007 to 1.04 in 2015, with 51.7% of stones being from males. The rise in female stones was mainly due to the increase in COD (from 8 to 18.6%) and struvite (from 1.8 to 11.9%). Therefore, we postulate that increased female obesity in Cook County (while male obesity has been stable) leveled the M/F ratio.

The geriatric population is known to have an increased incidence of isolated hypocitraturia and uric acid calculi. The UA increase amongst mixed stones with COM and UA prevalence rise coincide with a higher proportion of population being 75+ in 2015. Limitations of this study include its retrospective design, the fact that it is a single center analysis and therefore is not representative of the whole USA, and the inclusion being limited to surgically removed stones.

References