Nephrocalcinosis and Medullary Sponge Kidney in Aviation Pilots: Clinical and Aeromedical Practice

Cui Liang, Li Jing-min, W Zhou, Wang Qing, Xiong Ying, Zhu Hai-feng

CIVIL AVIATION MEDICAL CENTER OF CAAC, CHINA

Email: cui_leon@sina.com
Retrograde Flexible Ureteroscopy for Calyceal Calculi in Aviation Pilots
(Report of 6 cases)

Cui Liang, Li Jing-min
CIVIL AVIATION MEDICAL CENTER OF CAAC
EMAIL: cui_leon@sina.com
Clinical Practice and Aeromedical Certification of Civil Aviation Pilots with Renal Caliceal Calculi

Cui Liang, Li Jing-min, Wang Qing, Zhu Hai-feng
CIVIL AVIATION MEDICAL CENTER OF CAAC, CHINA

Email: cui_leon@sina.com

Comparison of results obtained by NHCT and FUS

<table>
<thead>
<tr>
<th>Item</th>
<th>Renal Calculi</th>
<th>Calcification</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>NHCT scan</td>
<td>69</td>
<td>14</td>
<td>83</td>
</tr>
<tr>
<td>FUS operation</td>
<td>52</td>
<td>31</td>
<td>83</td>
</tr>
</tbody>
</table>

There is significant difference of two kinds of diagnostic examination methods of renal calculi (p=0.0030).
Establishment of Aeromedical Certification System about Civil Aviation Pilots with Renal Caliceal Calculi

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CIVIL AVIATION MEDICAL CENTER OF CAAC, CHINA

Email: cui_leon@sina.com

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Clinical Data

• 2013 May to 2017 May

• 126 Airline Transport Pilots, Male

• Flexible ureteroscopy check

• Two pilots: Medullary sponge kidney (MSK)
Example
Case 1

- Male, 27y
- Boeing 737 Co-pilot
- **Bilateral kidney Stone (US)**
- No Change after medical expulsive therapy, 4 months
- Potassium citrate: no effective
No symptoms
What is it?
Renal Calculi?
Calcification?
Urinary CT & CTU/KUB
# Metabolic Evaluation

<table>
<thead>
<tr>
<th>Test Items</th>
<th>Test Result</th>
<th>Unit System</th>
<th>Reference Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium (Ca)</td>
<td>2.36</td>
<td>mmol/L</td>
<td>2.11~2.52</td>
</tr>
<tr>
<td>Uric acid (Ua)</td>
<td>381.31</td>
<td>umol/L</td>
<td>208~422</td>
</tr>
<tr>
<td>Creatinine (Cr)</td>
<td>81.36</td>
<td>umol/L</td>
<td>57~97</td>
</tr>
</tbody>
</table>
· Flexible retrograde ureteroscopy
- No free stone
- Volcano-like papilla
• Submucosal stones
• Stone basket
• Mechanical expansion
Analysis of Stone Composition

- Carbonated apatite
- Calcium oxalate monohydrate
Diagnosis

- Bilateral multiple renal calculi
- Nephrocalcinosis (Calcification)
- Medullary Sponge Kidney (MSK)
Case 2

- Male, 40y
- Airbus A320 Captain
- Bilateral kidney Stone (US)
- No Change after medical expulsive therapy, 10 months
- Potassium citrate: no effective
- No symptoms
- What is it?

Renal Calculi?
Calcification?
## Metabolic Evaluation

<table>
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</tr>
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<tbody>
<tr>
<td>Calcium (Ca)</td>
<td>2.36</td>
<td>mmol/L</td>
<td>2.11～2.52</td>
</tr>
<tr>
<td>Uric acid (Ua)</td>
<td>491.59</td>
<td>umol/L</td>
<td>208～422</td>
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<tr>
<td>Creatinine (Cr)</td>
<td>103.85</td>
<td>umol/L</td>
<td>57～97</td>
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<tr>
<td>Triglycerides (TG)</td>
<td>1.33</td>
<td>mmol/L</td>
<td>0.56～1.7</td>
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</tbody>
</table>
• Flexible ureteroscopy
• Mechanical expansion
• Remove the stone
• Pathognomonic appearance of MSK in endoscopy
Diagnosis

- Bilateral multiple renal calculi
- Medullary Sponge Kidney (MSK)

Postoperative
Analysis of Stone Composition

- Calcium oxalate monohydrate
What Is MSK?
Medullary Sponge Kidney (MSK)

- Lenarduzzi-Cacchi-Ricci disease (1930’)
- idiopathic
- 1:5000～20000
- Normal renal function
- Dilated distal portions of collecting ducts
  superficially resemble cysts:
  - Urinary stones within the "cysts"
  - Superimposed infection(pyelonephritis)
- Chronic back pain
The Anatomy of MSK
In the nephron (left), tiny blood vessels intertwine with urine-collecting tubes. Each kidney contains about 1 million nephrons.

In MSK, cysts form in the collecting tubes and keep urine from flowing freely through the kidneys.
What are the signs and symptoms of MSK?

- Hematuria or blood in urine
- Kidney stones
- Urinary tract infections (UTIs)
Making the Diagnosis of MSK

➢ Ultrasonography is *screening method* of urinary calculi

Ultrasounds are just as effective as CT scans at finding kidney stones and should be used as a first step to avoid unnecessary radiation exposure

--- 《New England Journal of Medicine》
Making the Diagnosis of MSK

- Ultrasound
- Intravenous Urography
- CT Scans and Other Imaging
Making the Diagnosis of MSK

- Intravenous Urography
- CT Scans and Other Imaging
- High Definition Endoscopy
• MSK papilla
• Submucosal stones
• Normal papilla
• Stones
Treatment of MSK

• The optimal approach is **flexible ureteroscopy** as this can be both diagnostic and therapeutic
Nephrocalcinosis and MSK
‘Strictly, the term ‘nephrocalcinosis’ refers to the generalized deposition of calcium oxalate (CaOx) or calcium phosphate (CaPi) in the kidney’
Nephrocalcinosis and MSK

- Radiologists often speak “nephrocalcinosis”
- Nephrocalcinosis refers to the presence of calcium deposits in the kidney tissue
- Radiologists cannot differentiate reliably between tissue calcifications and stones
- Only urologists speak of nephrocalcinosis seen during flexible ureteroscopy, because they can see tissue calcifications, stones, or both
Tips for diagnosing MSK

• Confirmation with flexible renal endoscopy can make a definitive diagnosis in patients suspected to have MSK and can be diagnostic as well as potentially therapeutic in terms of stone removal.

• Consider urographic phase imaging either with IVU or CTU to confirm MSK suspicion in cases where renal endoscopy is not clinically indicated.

• Nephrocalcinosis is more common than previously appreciated and does not necessarily indicate systemic disease or the specific developmental disorder of MSK.
MSK and Aeromedical Management

- MSK is a kidney malformation that generally manifests with nephrocalcinosis and recurrent renal stones
- **Flexible Ureteroscopy** is the gold standard for the diagnosis of nephrocalcinosis and MSK
- These are the aviation pilots where *metabolic evaluations* and attempts at stone prevention are most critical
- Treatment strategies and aeromedical health management of MSK should be *individualized*
Welcome to China!

Email: cui_leon@sina.com