Nutcracker Syndrome: Who To Treat and What Works Best

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DISCLOSURES

- Investor, Adient Medical
- Consultant, Trisalus Medical
THE NUTCRACKER SYNDROME

- Flank pain
- Hematuria (microscopic or macroscopic)
- Orthostatic proteinuria
- Pelvic pain or varicocele

Quality of Life Problem

ANATOMIC CONSIDERATIONS: PCS

Anterior Nutcracker

Posterior Nutcracker
WHO DEVELOPS NCS?

- **Prevalence** unknown
  - Young/middle-aged, F > M?

- **Overlap exists between symptomatic and asymptomatic patients with similar imaging findings**
  - 1957 May and Thurner described findings in 430 cadavers
    - 22% cadavers had intraluminal thickening directly related to external compression of L iliac vein between R iliac artery against 5th lumbar vertebral body
    - Nutcracker Phenomenon seen on 11-27% of CT scans
HOW DO WE DIAGNOSE NCS?

Clinical symptoms: Left flank pain, varicoceles, haematuria

Routine lab investigations:
1. Bloods
2. Urine Microscopy, Culture & Sensitivity

US Scan + Intravenous urography

Cystoscopy
Uretero-renoscopy

Colour Duplex Scan

CT Angiography/
MR Angiography

Intravascular ultrasound / Phlebothrombography

Diagnosis of exclusion - NRS

Clinical symptoms: Left flank pain, varicoceles, NO haematuria

Routine lab investigations: 1 Blood

US Scan

Ananthan K et al. Eur J Vasc Endovasc Surg 2017
 HOW DO WE IDENTIFY NCP?

Ratio of LRV hilum:narrowing > 4.9
Sensitivity 66.7%, Specificity 100%*

Fong JKK AJR 2014

HOW DO WE IDENTIFY NCP?

BEAK Sign

HOW DO WE IDENTIFY NCP?

Aortomesenteric Angle
Normal ~90°
< 41° 100% sensitive, 55.6% specific*

Fong JKK AJR 2014
MEASUREMENTS, MEASUREMENTS, MEASUREMENTS

Can we distinguish NCP and NCS?

Enlarged perirenal and/or gonadal vessels
Table 3. Multivariate logistic regression analysis of discriminating nutcracker syndrome (NCS) from asymptomatic nutcracker phenomenon (NCF)

<table>
<thead>
<tr>
<th></th>
<th>B</th>
<th>Odd ratio*</th>
<th>P value</th>
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</thead>
<tbody>
<tr>
<td>Age</td>
<td>&lt;0.001</td>
<td>0.101</td>
<td></td>
</tr>
<tr>
<td>SMA-aortic angle</td>
<td>0.396</td>
<td>1.487 (1.230, 1.796)</td>
<td>&lt;0.001</td>
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<tr>
<td>D_AFS</td>
<td>0.134</td>
<td>0.456</td>
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<tr>
<td>D_WRW</td>
<td>0.385</td>
<td>0.001</td>
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<tr>
<td>Visualization of dilated collateral vein with reflux</td>
<td>2.846</td>
<td>17.227 (3.328, 89.172)</td>
<td>0.001</td>
</tr>
</tbody>
</table>

Yun SJ et al. Abdom Radiol 2016

How do we diagnose NCS?

Clinical symptoms: Left flank pain, varicocele, haematuria

Routine lab investigations:
1. Bloods
2. Urine Microscopy, Culture & Sensitivity

US Scan + intravenous urography

CT angiography/MR angiography

Intravascular ultrasound

Cystoscopy

Ureteroscopy

Colour Doppler scan

Clinical symptoms: Left flank pain, varicocele, NO haematuria

Diagnosis of exclusion - NCS

Routine lab investigations:
1. Bloods

US Scan

Ananthan K et al. Eur J Vasc Endovasc Surg 2017
**NCP -> NCS**

Clinical symptoms: Left flank pain, varicoceles, haematuria

Clinical symptoms: Left flank pain, varicoceles, NO haematuria

Routine lab investigations
1. Bloods
2. Urine Microscopy, Culture & Sensitivity

US Scan + Intravenous urography

Cystoscopy

Uretero-renoscopy

Doppler Scan

CT Angiography/
MR Angiography

Intravascular ultrasonography /
Phlebography

**Treatment of Nutcracker Syndrome**

**Treatment Modalities**

- Non-operative Approach
- Open Surgical Approach
- Laparoscopic Approach
- Endovascular Approach

Young patients with mild symptoms

Left renal vein transposition
Renal artery transposition
Other (left renal vein ligation and IVC, vein bypass, superior mesenteric, splenic vein bypass, nephrectomy, gonadocoele bypasses)

Extravascular stent placement


Ananthan K et al. Eur J Vasc Endovasc Surg 2017
**Treatment of Nutcracker Syndrome**

**Conservative approach**

- Growing individuals may experience resolution because of an increase in intra-abdominal and retroperitoneal fat -> emphasize weight gain

- Some propose conservative management for 24 months in adolescents and 6 months in adults

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![Conservative approach diagram](image1)

Ananthan K et al. *Eur J Vasc Endovasc Surg* 2017

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![Treatment Modalities diagram](image2)

Treatment of Nutcracker Syndrome

Endovascular Treatment of NCS

Lamba R et al. Radiographics 2014
Endovascular Treatment of NCS

Migration Isn’t Immediate!!!

Table II. Data and treatment outcomes of five patients with stent migration after endovascular stenting (EVS) for nutcracker syndrome (NCS)

<table>
<thead>
<tr>
<th>Sex/age, years</th>
<th>Clinical manifestation</th>
<th>Stent brand/size, mm</th>
<th>Interval*, months</th>
<th>Outcomes</th>
<th>Clinical manifestation after stent migration</th>
<th>Balloon treatment</th>
<th>Follow up, year</th>
<th>Long-term result</th>
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<tbody>
<tr>
<td>M/21</td>
<td>Urine latent blood</td>
<td>S.M.A.R.T. Control, 14 × 40</td>
<td>5</td>
<td>Migration into right ventricle</td>
<td>Chest pain and urine latent blood</td>
<td>Open cardiac</td>
<td>1</td>
<td>Urine latent blood</td>
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<td></td>
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<td></td>
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<td>surgery and tricuspid valve replacement</td>
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<td>M/25</td>
<td>Asymptomatic gross hematuria</td>
<td>S.M.A.R.T. Control, 10 × 40</td>
<td>10</td>
<td>Migration into right atrium</td>
<td>Recurrent asymptomatic gross hematuria</td>
<td>Open cardiac surgery and a 14 × 40-mm stent deployed in LRV</td>
<td>10</td>
<td>Good'</td>
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<td></td>
<td>Close follow-up</td>
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<tr>
<td>M/19</td>
<td>Urine latent blood and flank pain</td>
<td>S.M.A.R.T. Control, 14 × 40</td>
<td>2</td>
<td>Migration to left side of LRV</td>
<td>Urine latent blood and flank pain</td>
<td>Close follow-up</td>
<td>8</td>
<td>Urine latent blood</td>
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<td></td>
<td></td>
<td></td>
<td>Stable'</td>
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<tr>
<td>M/31</td>
<td>Asymptomatic gross hematuria</td>
<td>S.M.A.R.T. Control, 14 × 40</td>
<td>5</td>
<td>Partial protruding into IVC</td>
<td>No recurrent symptoms</td>
<td>Close follow-up</td>
<td>6</td>
<td>Stable'</td>
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</tr>
<tr>
<td>M/22</td>
<td>Asymptomatic gross hematuria</td>
<td>Wallsten, 14 × 40</td>
<td>7</td>
<td>Totally protruding into IVC</td>
<td>Asymptomatic gross hematuria</td>
<td>Stent extraction and IVC-LRV bypass</td>
<td>2</td>
<td>Urine latent blood</td>
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Treatment of Nutcracker Syndrome

B

Treatment Modalities

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Young patients with mild symptoms

- Left renal vein transposition
- Renal auto-transplantation
- Other left renal vein ligation and liac vein bypass, superior mesenteric artery transposition, nephrectomy, gonadocaliceal bypass

Extravascular stent placement

Open Surgical Repair: LRV Transposition

Erben Y J Vasc Surg Venous and Lym Dis 2015

Velasquez CA et al. J Vasc Surg Venous and Lym Dis 2018

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Open Surgical Repair: LRV-T Variants

Open Surgical Repair: Mayo Clinic Series
(37 patients over 20 years)
Treatment of Nutcracker Syndrome

Treatment Modalities

- Non-operative Approach
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- Other left renal vein ligation and iliac vein bypass, superior mesenteric artery transposition, nephrogyney, gonadotecent bypass

Extravascular Stent Placement

Chen F-M et al. Urology 2019
Extravascular Stent Placement

Extravascular Stent Placement

Endovascular Management of Nutcracker Syndrome After Migration of a Laparoscopically Placed Extravascular Stent

Shanwen Chen, MD,1 Hongkun Zhang, MD,2 Lu Tian, MD,2 and Ming Li, MD2

Conclusions

• Like all compression syndromes, there is an important distinction to be made between permissive anatomy and disease state

• Initial conservative management, prolonged in adolescents

• The optimal intervention is not entirely clear
  – "I am not in favor of primary endovascular stenting based on risk of migration, timing of migration, and uncertainty of long-term patency

THANK YOU!