Robotic Thymectomy for Myasthenia Gravis and Thymoma

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Sweetbreads: thymus gland of a calf or lamb
Myasthenia Gravis: What is it?

• Autoimmune neuromuscular disease leading to waxing and waning weakness and fatigue

• MG is classically associated with AChR antibodies

• Other forms of MG exist
  – MuSK antibody positive MG
  – Seronegative MG
  – Ocular MG
Myasthenia Gravis: Treatment

• Four basic therapies to treat MG
  – Medical symptom treatment
    • anticholinesterase inhibitors (i.e. Mestinon or Pyridostigmine)
  – Chronic medical immunomodulation
    • Steroids
    • CYA, TAC, AZA, MMF
    • Rituximab, IVIG, Cyclophosphamide
  – Acute immunomodulating therapies
    • Plasmapheresis
    • IVIG
  – Surgery
    • Thymectomy
Myasthenia Gravis: Principles of Surgical Treatment

• Thymus may play a role in the pathogenesis of MG

• Most patients with AChR antibodies have thymic abnormalities
  – Hyperplasia in 60-70%
  – Thymoma in 10-15%

• Thymectomy is indicated for all patients with thymoma, regardless of MG type
Myasthenia Gravis: Principles of Surgical Treatment

• Thymectomy for patients without thymoma remains a controversial topic

• No randomized controlled studies exist evaluating the efficacy of thymectomy for MG without thymoma

• American Academy of Neurology guidelines published in 2000, but reaffirmed more recently
  – For patients with nonthymomatous autoimmune MG, thymectomy is recommended as an option to increase the probability of remission or improvement (Class II).
Myasthenia Gravis: Principles of Surgical Treatment

- AChR Ab+ MG
  - Retrospective review of 756 patients, those Rx with thymectomy were 1.6 times more likely to have remission

<table>
<thead>
<tr>
<th>Variable</th>
<th>Odds ratio</th>
<th>Confidence interval</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Onset &lt; 40 years</td>
<td>2.32</td>
<td>1.47–3.65</td>
<td>0.0003</td>
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<tr>
<td>Sex (female)</td>
<td>1.16</td>
<td>0.80–1.68</td>
<td>0.42</td>
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<tr>
<td>Thymectomy (yes)</td>
<td>1.63</td>
<td>1.08–2.45</td>
<td>0.02</td>
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</tbody>
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Myasthenia Gravis: Principles of Surgical Treatment

- AChR Ab+ MG
  - Propensity matched groups of 49 patients each: thymectomy vs control

Myasthenia Gravis: Principles of Surgical Treatment

- For AChR Ab+ MG thymectomy is generally recommended
- For Seronegative MG thymectomy is also typically recommended
- For Ocular MG thymectomy role is less clear, but most centers will recommend if minimally invasive resection feasible
- For MuSK Ab+ MG the presence of thymic pathology is very rare and thymectomy is not usually recommended
Myasthenia Gravis: Principles of Surgical Treatment

• Treatment effect is not immediate.
  – Less than 20% remission at 1 year after thymectomy.
  – Increases with time out to 7-10 years.

• Decreasing efficacy with age
  – Over 60 years of age the benefit is thought to diminish due to involution of the thymus.
  – Some will operate on over 60 y/o, especially minimally invasively.


  – Prepubertal cases have more chance of spontaneous resolution or to be seronegative.
Myasthenia Gravis: Principles of Surgical Treatment

- Preoperative considerations include:
  - Evaluation by a neurologist with neurologic exam
  - Thoracic imaging (Chest CT or MRI)
  - PFT’s and ABG
  - Consider immediately preoperatively IVIG or plasmapheresis for severely affected, bulbar, or respiratory symptoms
Myasthenia Gravis: Robotic Thymectomy

• Which side?
  – Left sided approach advantages include:
    • Identification of right phrenic from left easier than left phrenic from right.
    • Easier to harvest ectopic cephalad thymic tissue from left
    • Left thymic portion usually larger and extends to cardiophrenic area more
    • AP window may be site of ectopic tissue
  – Right sided approach advantages include:
    • Better visualization of the venous confluence
    • Perhaps easier and safer for novices
Myasthenia Gravis: Robotic Thymectomy

- Which side? Data support both possibilities
  - Left sided
    - 273 left sided thymectomies for MG, 57% complete remission rate and 0% thymoma recurrence rate
    - Ages 4 years to 86 years old
    - 2 left phrenic nerve injuries
  - Right sided
    - 30 right sided thymectomies for MG. No conversions.
Myasthenia Gravis: Robotic Thymectomy

Patient Positioning

- Position patient on edge of table
- Insert roll sub-scapularly to allow patient shoulder to drop.
- Arm of patient positioned below table in a sling.
- Roll table to provide proper exposure of chest wall (Approximately 30°)
- Bring Robot in from opposite side
Myasthenia Gravis: Robotic Thymectomy

Port Placement
Myasthenia Gravis: Robotic Thymectomy

Port Placement

- Camera in 4\textsuperscript{th} or 5\textsuperscript{th} intercostal space, anterior to anterior axillary line
- Robot arm ports in 2\textsuperscript{nd}/3\textsuperscript{rd} IC space, 6\textsuperscript{th}/7\textsuperscript{th} IC space more anteriorly
  - Each handbreadth away from camera port
- Accessory port
  - 12 step in 5\textsuperscript{th}/6\textsuperscript{th}/7\textsuperscript{th} space more posteriorly
Myasthenia Gravis: Robotic Thymectomy

Port Placement

Xiphoid Process
Sternal Notch

6th/7th IC S
4th/5th IC S
2nd/3rd IC S

MCL
AAL

Instrument Ports
Myasthenia Gravis: Robotic Thymectomy

Visualization

- Use 0 degree scope for most of case
- 6-8 mm Hg Insufflation
- Clearly identify contralateral phrenic nerve
  - Switch to 30 degree when looking for contralateral phrenic
  - Can utilize a 5mm port and camera on contralateral side if phrenic remains difficult to visualize
  - Injection with ICG and fluorescence scope may be beneficial
Myasthenia Gravis: Robotic Thymectomy

Visualization

Myasthenia Gravis: Robotic Thymectomy

Visualization

Robotic Thymectomy via Right Chest Approach - Video 4
Myasthenia Gravis: Robotic Thymectomy

Visualization
Myasthenia Gravis: Robotic Thymectomy

Dissection

• Start at the pericardiophrenic angle
  – Dissection along the phrenic inferior to superiorly, laterally to medially
• Continue dissection into the neck
  – Tease out the upper poles of the cervical thymus
• Visualize inominate vein and thymic branches
  – Doubly clip and transect
• Take specimen out of the accessory port with a protective bag
Myasthenia Gravis: Robotic Thymectomy

Feet  Head

5 = Camera
3, 7 = Robot Arms
A = 12 Step Accessory

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