Clinical Pearls Session: Neuromuscular Blockers - What to Use in the Face of a Drug Shortage
Jeremy P. Hampton, PharmD, BCPS
Clinical Assistant Professor – UMKC School of Pharmacy
Clinical Specialist-Emergency Medicine – Truman Medical Center
The speaker has no conflict to disclose.

Objectives
• Identify the most commonly used neuromuscular blocking agents (NMBA) for rapid sequence intubation (RSI).
• Compare the pharmacokinetic profiles and therapeutic uses of succinylcholine and rocuronium
• Determine strategies for obtaining optimal paralyzing conditions using rocuronium

Drug Shortages
• Per Institute of Safe Medication Practices (ISMP)
  – Recent number of shortages “unprecedented”
  – Difficult to anticipate
  – Potential for medication errors
Drug Shortages

• Potential for dramatic impact
  – Propofol
  – Epinephrine
  – Dextrose (D50%)
  – Succinylcholine

Rapid Sequence Intubation (RSI)

• Process in which pharmacologic agents administered to facilitate endotracheal intubation
  – Induction
  – Paralysis
  – Post-intubation sedation and analgesia

Paralysis

• Frequently utilized agents
  – Non-Depolarizing
    • Succinylcholine: 82%
  – Depolarizing
    • Rocuronium: 12%
    • Vecuronium: 5%
Paralytic Pharmacokinetics

<table>
<thead>
<tr>
<th></th>
<th>Succinylcholine</th>
<th>Rocuronium</th>
<th>Vecuronium</th>
<th>Pancuronium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Onset (sec)</td>
<td>45</td>
<td>60</td>
<td>120 - 180</td>
<td>120 - 180</td>
</tr>
<tr>
<td>Duration (min)</td>
<td>6 - 10</td>
<td>40 - 60</td>
<td>45 - 65</td>
<td>60 - 100</td>
</tr>
</tbody>
</table>

Neuromuscular blocking agents, in: "Manual of Emergency Airway Management"

Contraindications/precautions

- Succinylcholine
  - Malignant Hyperthermia
  - Hyperkalemia*
  - Glaucoma
- Rocuronium
  - No absolute contraindications

Monday morning in the ED

- Pharmacy buyer pages you
  - Succinylcholine is on backorder
  - Only have 20 vials in house
  - Hospital uses an average of 10 vials per day
- Time to scramble
Succinylcholine shortage

- Affects multiple departments
  - Emergency Department
  - Critical care
  - Surgery
- Therapeutic alternatives
  - Rocuronium vs. Vecuronium

### Choices for RSI

<table>
<thead>
<tr>
<th></th>
<th>Succinylcholine</th>
<th>Rocuronium</th>
<th>Vecuronium</th>
<th>Pancuronium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Onset (sec)</td>
<td>45</td>
<td>60</td>
<td>120-180</td>
<td>180-160</td>
</tr>
<tr>
<td>Duration (min)</td>
<td>6-10</td>
<td>40-60</td>
<td>10-65</td>
<td>60-90</td>
</tr>
</tbody>
</table>

**MALLON WK, ET AL. ROCURONIUM VS. SUCCINYLCHOLINE IN THE EMERGENCY DEPARTMENT: A CRITICAL APPRAISAL**

*J EMERG MED. 2009; 37:183-88*
Mallon, et. Al.

- Evidence based review of succinylcholine vs. rocuronium
- 3 clinical studies, 1 Cochrane review
- Rate of acceptable conditions, no significant difference
- Succinylcholine judged superior due to short duration

Rocuronium

- Non-depolarizing neuromuscular blocker
  - Onset: 45 – 60 seconds
  - Duration: 40 – 60 minutes
- Dose: 0.6 – 1.2 mg/kg
  - 1 mg/kg is ideal

Rocuronium

- Considerations
  - Slower time to onset
  - Longer acting
- Potential problems
  - Inability to secure airway
  - Post-intubation management
Rocuronium

- Post-intubation management
  - Adequate sedation vitally important
  - Vital sign monitoring
  - Risk of post-traumatic stress disorder (PTSD)

Rocuronium – Reversal Options

- Neostigmine 0.5 – 2.5 mg IV (Max 5 mg total)
- Pretreat with atropine 25-30 mcg/kg
- Average 17.4 minutes for reversal

Sugammadex

- Modified cyclodextran
  - Reversal agent for rocuronium and vecuronium
- Originally submitted to FDA 1/3/2008
  - Denied 8/2008 citing need for safety study
- New Drug Application submitted 1/2/2011
  - Assigned priority review status by FDA
Sugammadex vs. Neostigmine vs. Edrophonium

- 60 patients undergoing elective surgery
- Sugammadex 4 mg/kg IV: N=20 (group S)
- Neostigmine 70 mcg/kg IV: N=20 (group N)
- Edrophonium 1 mg/kg IV: N=20 (group E)
- Primary outcome: TOF ratio of 0.7 and 0.9

Sugammadex vs. Neostigmine vs. Edrophonium

- Significantly faster reversal group S (vs. N and E, P < 0.05)
- All in group S reversed < 5 min
- None in group N reversed < 5 min
- 5% in group E reversed < 5 min

Recommendation

- Rocuronium 1 mg/kg IV
  - Allow 60 seconds before intubating
- Keep neostigmine and atropine on hand
- Closely monitor vital signs post-intubation
- Ensure adequate sedation and analgesia
Summary

• Drug shortages have large impact on practice
• Succinylcholine shortage has had direct effect
• Rocuronium indicated in absence
  — 1 mg/kg
• Sugammadex may render succinylcholine obsolete

References

Post Test Questions:

1. The most commonly utilized neuromuscular blocker for rapid sequence intubation is____.  
   a. Succinylcholine  
   b. Rocuronium  
   c. Vecuronium  
   d. Pancuronium

2. The most appropriate paralytic for rapid sequence intubation, in the absence of succinylcholine is _____.  
   a. Vecuronium  
   b. Pancuronium  
   c. Rocuronium  
   d. Cisatracurium

3. The optimal paralytic dose of rocuronium in rapid sequence intubation is___.  
   a. 1.2 mg/kg  
   b. 0.6 mg/kg  
   c. 1 mg/kg  
   d. 1.5 mg/kg

4. The non-depolarizing neuromuscular blocker with the shortest duration of action currently on the market is ______.  
   a. Vecuronium  
   b. Rocuronium  
   c. Pancuronium  
   d. Rapacuronium

5. Pending FDA approval, a potential future option for rocuronium-induced paralysis is ______.  
   a. Sugammadex  
   b. Saflutan  
   c. Epanova  
   d. Aflibercept