An Economic Analysis of Midline Venous Catheters to Reduce IV Contrast Extravasation

Antony Hayes, MD
D. Lee Bennett, MD, MBA

1 University of Iowa Hospitals and Clinics, Iowa City, IA
2 University of Iowa Roy J. and Lucille A. Carver College of Medicine

No financial disclosures
Background

- Mechanisms of contrast extravasation\(^1\)
  - Leakage from venotomy
    - Backflow from fibrin sheath\(^2,3\)
    - Fractured catheter
  - Migration of catheter out of vessel
  - Erosion through vessel

- Midline (MDL) use declined in 1990s
  - Hypersensitivity reactions to catheter material\(^3\)

- Interest in midlines returning to reduce central-line associated blood stream infections (CLABSI)\(^4-6\)

- Preferred for IV access for 6-14 days\(^7\)
Proposed Benefits

- MDLs are less likely to have infiltration/extravasation
  - Tip is distal to venotomy
    - Fibrin sheath takes time to develop and won’t be relevant for ~1 week
    - Long length less likely to migrate out of vessel
  - Erosion through vessel wall not likely immediately
- New catheter materials do not cause allergic reactions
- Longevity is 7-16 days\(^8\)
  - PIV lifespan 44 hr – 99 hrs\(^9-11\)
Methods

- Brief analysis of potential cost-savings for using MDL versus PIVs
  - Cost of placing MDLs in select patient populations divided by cost of PIVs and subsequent new PIVs during a single inpatient encounter

- Review of the literature
  - Lifespan PIV catheters
  - Cost of PIV placement\(^8,12\)
  - Cost of ultrasound-guided MDL

- Assumptions
  - Average length of stay for inpatient scanned with contrast: 8.9 days\(^13\)
  - 30% of contrast enhanced imaging done as inpatient\(^14\)
    - Extravasation rate is as low as 0.21%
  - 41% of patients scanned in ER will become inpatients\(^15\)
Our Model and Examples

\[
\text{Midline costs} = \frac{\text{Inpatient days}}{\text{Average PIV life}} \times \text{Inpatient population} + \text{ER population} + \text{Outpatient population}
\]

\[
= \frac{\$32 \times \left( \frac{8.9d}{1.83d} \times 0.3 + 0.38 + 0.32 \right)}{\$32(2.16)} = \frac{\$90}{\$69.1} = 1.3
\]

Modified formula with no outpatients and assumption of scanned ER patients that become inpatients:

\[
\frac{\text{Midline costs} \times \text{Inpatient population + ER admissions} + \text{ER not admitted}}{\text{Average PIV life}}
\]

\[
= \frac{\$90}{\$32(3.58)} = \frac{\$90}{\$114.56} = 0.78
\]
<table>
<thead>
<tr>
<th>Description</th>
<th>PIV lifespan</th>
<th>ER admissions included?</th>
<th>Outpatients included?</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original model</td>
<td>44 hours</td>
<td>No</td>
<td>Yes</td>
<td>1.3</td>
</tr>
<tr>
<td>ER patients admitted</td>
<td>44 hours</td>
<td>Yes</td>
<td>No</td>
<td>0.78</td>
</tr>
<tr>
<td>Longer PIV</td>
<td>65 hours</td>
<td>Yes</td>
<td>No</td>
<td>1.1</td>
</tr>
<tr>
<td>Breakeven PIV life</td>
<td>58 hours</td>
<td>Yes</td>
<td>No</td>
<td>1.0</td>
</tr>
</tbody>
</table>
Discussion

- Cost savings from prevented extravasation insignificant compared to total costs
  - Due to the extremely low rate
  - Most extravasations require only conservative treatment\(^\text{14}\)

- Midlines can save money relative to PIVs
  - Greater savings realized when PIV dwell time is shorter
  - Assumes midlines dwell time is greater than length of admission
Limitations

- Average PIV dwell time is likely institution dependent
- Costs estimates for line placement
- Extravasation rate for MDLs unknown
  - MDLs currently not recommended for vasopressors
- Rate of ER to inpatient estimated from abdominal CTs
Conclusion

- Midline catheters likely reduce contrast extravasation
- Potential cost savings due to single line placement on admission or at time of CT scan
- More research needed to confirm assumptions made
  - Midline catheters are more durable
  - Midline catheters do not cause extravasation


John R. Wilcox, MD for the initial idea.