Is Topical Application of Epsilon-Aminocaproic Acid Effective in Reducing Blood-Loss in Total Knee Arthroplasty?

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Epsilon-Aminocaproic Acid (ε-ACA)

- Lysine analog
- Reversibly saturates the lysine binding sites on plasminogen
- Inhibits the binding of fibrin and the conversion to fibrin degradation products
- Prevents clot dissolution

Epsilon-Aminocaproic Acid (ε-ACA) reduces blood loss after joint replacement

• Several studies have demonstrated that ε-ACA reduces blood loss in TKA when given intravenously
• Previous work by the study group has shown that locally applied ε-ACA reduces blood loss after THA by 18%

Sucher, Giordani, Nedopil, Int. Ortho. 2016
Camarasa, Serra-Prat, Br J Anaesth. 2006
Questions

• Is there a reduction in blood loss in patients treated with locally applied ε-ACA for TKA?
• Is local application of ε-ACA safe for use in TKA?
• Is there a reduction in treatment costs with local application of ε-ACA?
Methods and Materials

- Retrospective single surgeon, single center analysis of consecutive patients who underwent TKA from January 2012-August 2016
Methods and Materials

• Tourniquet was used for cementing and inflated after satisfactory alignment of components
• 5 g $\varepsilon$-ACA diluted in 100 ml normal saline soaked into the wound and secured with compression dressing, which was left in place for three minutes.
• No post operative drains were used
Methods and Materials

• 80 patients: no ε-ACA was applied to the wound
• 80 patients: 5 g ε-ACA was applied before the release of the tourniquet
• 80 patients: 5 g ε-ACA applied after the tourniquet was released
Outcome Measurements

- Blood Loss
- Length of Stay
- Rates of VTE
### Blood Loss

<table>
<thead>
<tr>
<th></th>
<th>Control Group (N= 80)</th>
<th>ε-ACA-after-tourniquet-release Group (N= 80)</th>
<th>ε-ACA-before-tourniquet-release Group (N= 80)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BLOOD LOSS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preoperative hemoglobin (g/dL) (mean ± SD)</td>
<td>13.8 ± 1.2</td>
<td>14.0 ± 1.3</td>
<td>13.5 ± 1.2</td>
</tr>
<tr>
<td>Lowest postoperative hemoglobin (g/dL) (mean ± SD)</td>
<td>9.9 ± 1.3</td>
<td>10.2 ± 1.2</td>
<td>10.4 ± 1.2</td>
</tr>
<tr>
<td>Estimated intraoperative blood loss (mL) (mean ± SD)</td>
<td>223.4 ± 128.1</td>
<td>203.4 ± 79.5</td>
<td>159.6 ± 81.2</td>
</tr>
<tr>
<td>Total blood loss (mL) (mean ± SD)</td>
<td>1478.8 ± 367.1</td>
<td>1424 ± 249.3</td>
<td>1052.3 ± 419.1</td>
</tr>
</tbody>
</table>
Reduction in blood loss

- Statistically significant reduction in blood loss of 426.5 ml
- $P < 0.05$
- No difference in transfusions
## Length of Stay

<table>
<thead>
<tr>
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<th>Control Group (N= 80)</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Length of stay (days)</td>
<td>3.3 ± 1.3</td>
<td>3.2 ± 0.9</td>
<td>2.6 ± 1.1</td>
</tr>
<tr>
<td>Disposition home</td>
<td>67</td>
<td>69</td>
<td>62</td>
</tr>
<tr>
<td>Disposition to skilled nursing facility</td>
<td>13</td>
<td>11</td>
<td>18</td>
</tr>
</tbody>
</table>

- Statistically significant reduction in length of stay of 0.7 days (P < 0.005)
Adverse events

- 1 patient (0.0625%) in the ε-ACA group developed VTE
- 1 patient (1.25%) in the control group developed VTE
- Treated with low molecular weight heparin followed by Coumadin for 6 months
Does Topically applied ε-ACA reduce blood loss in TKA?

• Statistically significant reduction in blood loss of 426.5 ml
• Systematic review by Kagoma et. showed 331 ml reduction in blood loss in THA and TKA with IV ε-ACA

Kagoma, Crouther, Doukhetis et al. Thromb Res 2009
Is ε-ACA safe for use in TKA?

- 1.25% rate of VTE in control
- 0.0625% rate of VTE in treatment group
- Churchill et al. J Knee Surg 2016 no increase in rates of VTE between TXA, ε-ACA and control in a comparative study with 2922 patients
- They found 0.82%, 0.73% and 0.8% VTE in TXA, ε-ACA and control respectively
Is ε-ACA Cost Efficient?

• Cost of ε-ACA at our institution: $1.03 for 5g
• Cost of TXA in various studies: $39.58-$80
• Cost savings per dose: $38-$79 dollars per TKA

• $38,000-$79,000 savings per year in institution that performs 1000 TKA
Is $\varepsilon$-ACA Cost Efficient?

- Average cost of inpatient day in the hospital reported by the Kaiser Family Foundation:
  - $2,271 for the United States
  - $3,341 for California

- Average reduction of length of hospital stay of 0.7 days for $\varepsilon$-ACA

- The cost savings per patient using $\varepsilon$-ACA locally before tourniquet release are: 
  \[(0.7 \times $2,212) = $1,548.40\]
Topically Applied Epsilon-Aminocaproic Acid is a safe, effective and cost-efficient way to reduce blood loss in TKA
Thank you

- California Orthopedic Association
- Alexander Nedopil MD
- Mauro Giordani MD
- Mark Sucher MD
References

Thank you