Risk of Kidney Injury after Percutaneous Thrombectomy Using Angiojet

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Introduction

- Thrombolysis using TPA is the primary agent used to restore flow in patients.
- Traditional catheter-directed therapy (CDT) allows passive delivery of TPA for lysis.
- Multiple endovascular devices have emerged to accelerate lysis and/or remove thrombus.
- Pharmacomechanical thrombectomy has been globally embraced for rapid treatment of acute thrombotic syndromes.
Introduction

- Angiojet (Possis Medical) uses a high-velocity/high pressure spray to fragment clots and deliver fibrinolytic solutions.
Introduction

• Angiojet (Possis medical) uses a high-velocity/high pressure spray to fragment clots and deliver fibrinolytic solutions

• However, a consequence of intravascular high-pressure jet spray is hemolysis of red blood cells
Common after Angiojet
Hypothesis

• Angiojet increases the risk of renal dysfunction when compared to non-Angiojet thrombolysis
Methods

• Retrospective review from 2007-2013 utilizing procedural codes related to thrombolysis and/or Angiojet

• Laboratory values before and after the procedure (up to 3 days) were collected

• AKI defined as an increase in Cr > 25% of baseline within 72 hours
Methods

- Patients on dialysis, not CDT or those missing data were excluded
- Evaluated most common risk factors for post-procedure renal failure: age, diabetes, CRF, compartment syndrome, anemia and surgery
- Compared incidence of AKI in AJ versus non-AJ CDT
## Results - Baseline

<table>
<thead>
<tr>
<th></th>
<th>AngioJet (N=53)</th>
<th>Non-AJ Lysis (N=50)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>50 (20-87)</td>
<td>51 (21-86)</td>
<td>NS</td>
</tr>
<tr>
<td>Male</td>
<td>31 (59%)</td>
<td>32 (64%)</td>
<td>NS</td>
</tr>
<tr>
<td>Diabetes</td>
<td>21 (40%)</td>
<td>8 (16%)</td>
<td>NS</td>
</tr>
<tr>
<td>Cr &gt;1.5 at baseline</td>
<td>5 (8%)</td>
<td>8 (16%)</td>
<td>NS</td>
</tr>
<tr>
<td>Arterial Indication</td>
<td>66%</td>
<td>88%</td>
<td>NS</td>
</tr>
<tr>
<td>Venous Indication</td>
<td>33%</td>
<td>12%</td>
<td></td>
</tr>
<tr>
<td>Baseline Cr</td>
<td>0.9</td>
<td>1.0</td>
<td>NS</td>
</tr>
<tr>
<td>Baseline Hct</td>
<td>38%</td>
<td>39%</td>
<td>NS</td>
</tr>
</tbody>
</table>
Change in Cr before and after Lysis procedures (P=0.004)

% change from baseline

25%
20%
15%
10%
5%
0%
-5%
-10%

Angiojet

Non-AJ
More AKI in Angiojet

- 16/53 patients (30%) treated with Angiojet developed AKI
  - The average increase in Cr in the AKI group was 0.5 mg/dL (67% rise from baseline)

- 4/50 (8%) of CDT (non-AJ) developed AKI
% change of baseline Cr with Surgery

P=0.001

P=NS

AJ no Surgery
AJ + Surgery
Non-AJ No Surgery
Non-AJ + Surgery
Surgery and AKI

• 64% (7/11) Angiojet patients that underwent surgery had AKI

• 8% (1/13) of CDT (non-AJ) that had surgery suffered AKI
Hct before and after Lysis

P = 0.001

Pre AJ | Post AJ | Pre Lysis | Post Lysis
Hematocrit and AKI

% change from Baseline

AJ with AKI

AJ no AKI

non-AJ with AKI

non-AJ no AKI

P=0.0001

NS
Conclusions

• Pts with Angiojet had a 30% incidence of AKI within 72 hours

• AKI was independent of serum Cr before the procedure, indication, age, and diabetes
Conclusions

• Surgery after AJ was associated with 64% incidence of AKI

• Angiojet patients with AKI had a greater drop in their HCT than those not treated with AJ
Discussion

• Does hemolysis from AJ cause a “2nd hit” to propagate AKI?

• Damage to the kidney may be cumulative which implies that every injury counts
Limitations

- Single-center, retrospective study with limited number of patients
- No control for contrast induced nephropathy, prehydration, rhabdomyolysis, Angiojet run time
- Plan for prospective study
Any questions?
## ANGIOJET™ Catheter Reference Guide

<table>
<thead>
<tr>
<th>Model</th>
<th>Indication</th>
<th>Delivery Platform</th>
<th>Minimum Vessel Diameter</th>
<th>Catheter Length</th>
<th>Catheter Diameter</th>
<th>Guidewire Wire Diameter</th>
<th>Introducer Sheath</th>
<th>Flow Rate</th>
<th>Total Run Time</th>
<th>Run Time with Blood Flow</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AngioJet Console</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ZelanteDVT™</td>
<td>Venous</td>
<td>OTW</td>
<td>6 mm</td>
<td>105 cm</td>
<td>8 F</td>
<td>2.67 mm</td>
<td>0.035”</td>
<td>0.089 mm</td>
<td>60 mL/min</td>
<td>480 sec 240 sec</td>
</tr>
<tr>
<td>Solent™ Dista</td>
<td>Peripheral Arterial</td>
<td>OTW</td>
<td>1.5 mm</td>
<td>145 cm</td>
<td>4/3 F</td>
<td>1.33/1 mm</td>
<td>0.014”</td>
<td>0.035 mm</td>
<td>23 mL/min</td>
<td>600 sec 300 sec</td>
</tr>
<tr>
<td>Solent™ Omni</td>
<td>Peripheral Arterial and Venous, AV Access</td>
<td>OTW</td>
<td>3 mm</td>
<td>120 cm</td>
<td>6 F</td>
<td>2 mm</td>
<td>0.035”</td>
<td>0.089 mm</td>
<td>60 mL/min</td>
<td>480 sec 240 sec</td>
</tr>
<tr>
<td>Solent™ Proxi</td>
<td>Peripheral Arterial and Venous, AV Access</td>
<td>OTW</td>
<td>3 mm</td>
<td>90 cm</td>
<td>6 F</td>
<td>2 mm</td>
<td>0.035”</td>
<td>0.089 mm</td>
<td>60 mL/min</td>
<td>480 sec 240 sec</td>
</tr>
<tr>
<td>AVX™</td>
<td>AV Access Grafts and Fistula</td>
<td>OTW</td>
<td>3 mm</td>
<td>50 cm</td>
<td>6 F</td>
<td>2 mm</td>
<td>0.035”</td>
<td>0.089 mm</td>
<td>60 mL/min</td>
<td>600 sec 300 sec</td>
</tr>
<tr>
<td>PE</td>
<td>Main Pulmonary and Lobar Arteries</td>
<td>OTW</td>
<td>6 mm</td>
<td>120 cm</td>
<td>6 F</td>
<td>2 mm</td>
<td>0.035”</td>
<td>0.089 mm</td>
<td>60 mL/min</td>
<td>600 sec 300 sec</td>
</tr>
</tbody>
</table>
Logistic Regression Analysis

<table>
<thead>
<tr>
<th></th>
<th>OR</th>
<th>Std Error</th>
<th>Z</th>
<th>P</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>AJ</td>
<td>8.22104</td>
<td>5.975751</td>
<td>2.9</td>
<td>0.004</td>
<td>1.978</td>
</tr>
<tr>
<td>Maj Surg</td>
<td>5.37772</td>
<td>3.626819</td>
<td>2.49</td>
<td>0.013</td>
<td>1.434</td>
</tr>
<tr>
<td>Age</td>
<td>1.03298</td>
<td>0.021247</td>
<td>1.58</td>
<td>0.115</td>
<td>0.992</td>
</tr>
<tr>
<td>Male</td>
<td>0.41517</td>
<td>0.259933</td>
<td>-1.4</td>
<td>0.16</td>
<td>0.122</td>
</tr>
<tr>
<td>Diabetes</td>
<td>0.71889</td>
<td>0.527242</td>
<td>-0.45</td>
<td>0.653</td>
<td>0.171</td>
</tr>
<tr>
<td>CRF</td>
<td>2.87943</td>
<td>2.583368</td>
<td>1.18</td>
<td>0.238</td>
<td>0.496</td>
</tr>
<tr>
<td>10% Drop HCT</td>
<td>4.04332</td>
<td>2.598535</td>
<td>2.17</td>
<td>0.03</td>
<td>1.147</td>
</tr>
</tbody>
</table>

Odds Ratio of Acute Kidney Injury
## Adjuvant Procedures

<table>
<thead>
<tr>
<th>Procedure</th>
<th>AngioJet</th>
<th>Non-AJ Lysis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Endovascular procedures</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AJ/Lysis Alone</td>
<td>12 (22%)</td>
<td>26 (52%)</td>
</tr>
<tr>
<td>Angioplasty</td>
<td>22 (42%)</td>
<td>15 (30%)</td>
</tr>
<tr>
<td>Stenting</td>
<td>19 (36%)</td>
<td>9 (18%)</td>
</tr>
<tr>
<td><strong>Open Procedures</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fasciotomy</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Thromboembolectomy</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>Bypass/Endarterectomy</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Major Amputation</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>
Hemolysis and AKI?

- Hemoglobin + Haptoglobin
  - Free Hemoglobin
    - Dimeric Hemoglobin
      - Uptake into glomerulus
        - Heme + Globin
          - Direct cytotoxicity
          - Heme + Tamm-Horsfall Proteins
535 Patients

103 Patients

432 Non CDT On Dialysis Pre-op Data Missing

53 Patients AngioJet

50 Patients Non-AngioJet