Minimally Invasive Thrombectomy Using the AngioVac System

Brian J. deGuzman, MD
AmSECT
Tampa, FL
April 14, 2015
Disclosure

- Biomet Microfixation
- Edwards LifeSciences
- Angiodynamics
- AtriCure
- Pavilion Medical Innovations
- Kaleidoscope Medical
- Sahpena Medical
- PAXmed
Frontiers in Endovascular Therapy

1990’s
- Coronary

2000’s
- Peripheral
- Renal
- Neuro
- Aortic

2010’s
- DVT
- PE
- Right Atrial

Arterial - Venous
## VTE Mortality

**Overall 300,000 VTE Deaths per Year in US - #3 cause**

<table>
<thead>
<tr>
<th>Cause</th>
<th>Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart Disease</td>
<td>595,000</td>
</tr>
<tr>
<td>Cancer</td>
<td>574,000</td>
</tr>
<tr>
<td>VTE</td>
<td>296,000</td>
</tr>
<tr>
<td>COPD</td>
<td>138,000</td>
</tr>
<tr>
<td>Stroke</td>
<td>129,000</td>
</tr>
</tbody>
</table>

Standard VTE Treatment

**PHARMACOLOGIC**
- Anticoagulation
- Thrombolytics

**MECHANICAL**
- Catheter
- Surgical
Limitations of Thrombolytic Therapy

- **Effectiveness**
  - Only works on fresh clot but *ALL* VTEs have some chronic component
  - Up to 50% of patients have contraindications
  - Residual obstruction increases long term mortality even if symptoms improve

- **Bleeding**
  - 10-15% Major
  - 1-3% Intracranial or Fatal

- **Resource Utilization**
  - Up to 72 hours in ICU
  - Repeat trips to cath lab
Catheter Treatment of PE

- Modest clinical success
  - Adjuvant thrombolytics in >60%
  - *High mortality rates* >20%

- Fundamental obstacles
  - Small catheters don’t permit removal of large clot burden
  - Large catheters lead to blood loss
Surgical Embolectomy - Operative Technique

Surgical Exposure

Right Pulm Artery

Pulm Embolus

Left Pulm Artery

The Day’s Catch

Fresh Clot

Chronic Clot
Surgical Embolectomy Provides Best Treatment Outcomes

Acute Pulmonary Embolectomy
A Contemporary Approach

ACQUIRED CARDIOVASCULAR DISEASE

Improved midterm survival of pulmonary emboli treated surgically

James P. Greelish, MD, MPH
John G. Byrne, MD

Objectives: We propose an algorithm to differentiate those best treated medically (type B) versus surgically (type A) pulmonary emboli treated medically.

Methods: Patients admitted between 2002 and 2008 with a diagnosis of pulmonary emboli made based on computed tomographic angiographic imaging (n = 779) were analyzed. Computed tomographic angiographic images were reviewed in a blind fashion, and anatomic classification of emboli was made. Patients with central...
Surgical Embolectomy
AngioVac® Cannula

• Large bore 22F
• Proprietary Funnel tip
  – Deployed remotely by inflating low pressure balloon
  – Balloon does not occlude vessel
  – Improves flow rates
  – Engages and conforms material larger than Cannula ID
AngioVac® Circuit

- Simple veno-veno extracorporeal circuit
- No reservoir
- Centrifugal pump
- Inline filter
  - Transparent provide immediate visual feedback

**Real-time reinfusion of shed blood**
  - Hemodynamic stability
  - Preserves blood volume
Animal Model - DVT
AngioVac® Procedure
Cannula Insertion

• Guidewire access to target site
• Angiogram and/or TEE
• Insert AngioVac® Cannula
  ▪ Percutaneous vs Open
  ▪ IJ/Fem/Axillary/RA/PA
• Insert Reinfusion Cannula
  ▪ 16-18F Percutaneous Cannula
  ▪ IJ vs Femoral vein
• Connect Cannulae to Circuit
AngioVac® First in Man
Eisenhauer, et al - Brigham

Todoran et al  ■  JVIR
Volume 22 ■ Number 9 ■ September ■ 2011
Complete IVC Thrombosis

Filter

Thrombus
AngioVac® IVC Thrombectomy
AngioVac® IVC Thrombectomy

Post-Angio Wide Open IVC
Saddle PE
Rosenfield, et al – Mass General
Saddle PE
Rosenfield, et al – Mass General
Prosthetic Pulmonic Valve Endocarditis

Divekar et al – U of Iowa
Extracardiac Conduit Thrombosis
Love/Fischman et al – Mount Sinai NYC
PE in Transit
Ali, et al – Fort Worth
PE in Transit
Ali, et al – Fort Worth
The impella device for high-risk procedures first in Fort Worth by Plaza Medical 10. Plaza Med-icore itself in cardiovascular and procedures. The hospital feet to performangi, and the 44 percent of a congenital closing a hole.

With the first art attack prove and the revelation by The-union, Plaza is to provide access care in.

Above: Fazihan Ali, M.D. with the Venous Augiva®.

Below: Ali with the family of Ms. Lee.

Bromos (from left to right): Dr. S. Karshnik, Dr. R. Foreman, Dr. F. Ali, Dr. B. daCosta, Dr. S. Pasting.
RA Tumor

Eisenhauer, et al - Brigham
Tricuspid Vegetation
Goldman, et al – Lankenau Hosp, PA
PICC Line Thrombus
Kassas et al - Covenant
PICC Line Thrombus

Kassas et al - Covenant
“Proximal Protection” for Obstructed IVC Filter Removal

Chen/Hirsch et al – Phoenix, AZ
“Proximal Protection” for Obstructed IVC Filter Removal
Chen/Hirsch et al – Phoenix, AZ
“Proximal Protection” Obstructed IVC Filter Removal

Chen/Hirsch et al – Phoenix, AZ
“Proximal Protection” for Obstructed IVC Filter Removal
Goswami et al – Springfield IL
Intracaval Tumor/Thrombus

Rosenfield, Vlahakes – Mass General
Intrahepatic IVC Thrombus in Liver Transplant

Klink, Pagni - Louisville
Unilateral DVT/May Thurner
Yang/Doemeny – Scripps, San Diego
FIM Arterial AngioVac Thrombectomy
Habib/Siragusa et al - Jacksonville, FL
FIM Arterial AngioVac Thrombectomy
Habib/Siragusa et al – Jacksonville, FL
Successive passes had flow rates ranging from 0.3 to 4.0 L/min. After each pass, the physician would unclamp the touhy...from bleeding back through the touhy arm. Physicians were very excited about the results.
AngioVac Anatomic Spectrum

- Right Atrial Mass
  Vegetations, Thrombus, Tumor
  Lead/Catheter Associated
  Tricuspid Valve Endocarditis

- Inferior Vena Cava
  IVC Thrombosis
  IVC Filter Associated
  Intracaval Tumor
  "Proximal Protection"
  Portal/TIPS/DIPS

- Pulmonary
  Pulmonary Embolism
  Pulmonic Valve Endocarditis

- Arterial
  Aortic

- DVT
  Iliofemoral
A NOVEL ENDOVENOUS APPROACH FOR TREATMENT OF MASSIVE CENTRAL VENOUS OR PULMONARY ARTERIAL THROMBUS, MASS, OR VEGETATION: THE ANGIOVAC SUCTION CANNULA AND CIRCUIT


*J. Am. Coll. Cardiol.* 2011;57;E1535
doi:10.1016/S0735-1097(11)61535-0

Hybrid Minimally Invasive Extraction of Atrial Clot

Catheter-Based Therapies for Massive Pulmonary Embolism

Thomas M. Todoran, Piotr Sobieszczyk

Cardiovascular Division, Vascular Medicine Section, Brigham and Women's Hospital, Boston, MA 02115
## AngioVac® Clinical Experience

<table>
<thead>
<tr>
<th>Patients</th>
<th>1559</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Age</td>
<td>54</td>
</tr>
<tr>
<td>Gender</td>
<td>52% Male  48% Female</td>
</tr>
</tbody>
</table>
| Primary Location of UIM™ | PA 15%  
|           | RA 40%  
|           | Ileofem/IVC 43%  
|           | Other 2% |
| Material Aspirated | 98% |
| Procedural Success | 92% |
| Conversion to Open | 0.5% |
| Complications | 0.57% |
| Procedural Mortality | 0.09% |
Discussion
Bench Testing

AngioVac 22Fr Funnel Designs

Measured Flow Rate (LPM) vs Input Pump Speed (RPM) graph for different funnel designs, with the highlighted (25Fr) design showing a specific trend.
# Bench Testing

<table>
<thead>
<tr>
<th>Pump Speed (RPM)</th>
<th>Flow Rate (LPM)</th>
<th>Cannula Pressure (mmHg)</th>
<th>Vessel Pressure (mmHg)</th>
<th>Distance to Clot (cm)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>1000</td>
<td>1.45</td>
<td>0</td>
<td>0</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>1500</td>
<td>2.4</td>
<td>-1</td>
<td>0</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>3.27</td>
<td>-33</td>
<td>0</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>2500</td>
<td>4.25</td>
<td>-62</td>
<td>-2</td>
<td>&lt;11</td>
<td>Moving slowly</td>
</tr>
<tr>
<td>3000</td>
<td>5.2</td>
<td>-100</td>
<td>-2</td>
<td>&lt;11</td>
<td></td>
</tr>
<tr>
<td>3500</td>
<td>6.16</td>
<td>-145</td>
<td>3</td>
<td>&lt;11</td>
<td>Advanced to 5 cm, clot captured</td>
</tr>
</tbody>
</table>
AngioVac® Suction AND Kinetic Procedure

• Flow is your friend...

Inflated Balloon
Standard Maneuvers

1. Position AngioVac® Cannula near UIM
2. Flush Filter
   Repeat Imaging
3. Deploy Funnel
4. Advance AngioVac® Cannula to UIM
5. Initiate and Optimize Flow