Ultrasound Guidance during Arterial Access for Peripheral Vascular Intervention: A VSGNE Quality Improvement Project

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On behalf of the Vascular Study Group of New England
Introduction

• Local vascular complication = most frequent adverse outcome from femoral puncture
  – Groin hematoma
  – Pseudoaneurysm
  – Retroperitoneal hematoma
  – Vessel thrombosis
  – Arteriovenous fistula

(Koreny M, JAMA 2004;291:350-7)
(Tavris DR, J Invasive Cardiol 2012;24:328-34)
Landmarks

• Inguinal skin crease = unreliable marker for puncture
  – Bifurcation of common femoral artery (CFA) is cephalad to this crease \(\sim 75\%\) of the time
    • Lechner, *Cardiovasc Intervent Radiol* 1988

• Fluoroscopy and bony landmarks ↓ access site complications vs. palpation
  – CFA overlies femoral head 92% of the time
    • Garrett, *Catheter Cardiovasc Interv* 2005
<table>
<thead>
<tr>
<th></th>
<th>Fluoroscopy</th>
<th>Ultrasound</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>CFA cannulation</td>
<td>83.3%</td>
<td>86.4%</td>
<td>0.17</td>
</tr>
<tr>
<td>Sheath in EIA</td>
<td>4.9%</td>
<td>6.6%</td>
<td>0.25</td>
</tr>
<tr>
<td>Sheath distal to CFA bifurcation</td>
<td>11.8%</td>
<td>7.0%</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>Number of attempts</td>
<td>3.0 ± 3.2</td>
<td>1.3 ± 0.9</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>First-pass success</td>
<td>46.4%</td>
<td>82.7%</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Mean time to insertion (sec)</td>
<td>213 ± 194</td>
<td>185 ± 175</td>
<td>&lt; 0.02</td>
</tr>
<tr>
<td>Hematoma &gt; 5cm</td>
<td>2.2%</td>
<td>0.6%</td>
<td>0.03</td>
</tr>
<tr>
<td>Any complication</td>
<td>3.4%</td>
<td>1.4%</td>
<td>0.04</td>
</tr>
</tbody>
</table>
Published VSGNE Study

1. Utilize the VSGNE database to identify variables associated with groin hematoma after peripheral vascular intervention (PVI)

2. Examine routine vs. selective use of ultrasound guidance in relation to hematoma rates

Definitions of Hematoma

- includes pseudoaneurysms

- **Minor** = required compression or observation

- **Moderate** = required transfusion or thrombin injection

- **Major** = required operation
Sample Selection

- 7359 PVI performed in 6108 patients
  - January 2010 to January 2014
  - 159 interventionalists from 26 academic and community medical centers
  - 1 to 239 PVI per interventionalist
  - 26 to 1043 PVI per medical center

- Percutaneous femoral access
  - Occlusive disease (excludes aneurysms)
  - Overall groin hematoma rate = 4.5%
    (moderate/major = 0.8%)
Routine vs. Selective Users

- Outcomes of interventionalists based on routine or selective use of ultrasound
  - 114 interventionalists with $\geq 10$ PVI procedures
  - Unadjusted and adjusted analyses

- 31 Routine Users ($\geq 80\%$)

- 83 Selective Users ($< 80\%$)
Ultrasound Use

The bar chart shows the distribution of interventionists' usage of ultrasound guidance. The x-axis represents the percent usage of ultrasound guidance, and the y-axis shows the number of interventionists. The chart indicates that the majority of interventionists use ultrasound guidance between 1-10% and 91-100% of the time, with the highest number being 23 interventionists in the 1-10% range.
## Multivariate Logistic Regression

<table>
<thead>
<tr>
<th>Variable</th>
<th>Odds Ratio</th>
<th>95% CI</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age &gt; 80</td>
<td>2.45</td>
<td>1.31-4.57</td>
<td>0.005</td>
</tr>
<tr>
<td>Sheath Size &gt; 6 French</td>
<td>1.62</td>
<td>1.24-2.11</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Female Gender</td>
<td>1.54</td>
<td>1.22-1.94</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Bilateral Femoral Access</td>
<td>1.44</td>
<td>1.08-1.93</td>
<td>0.013</td>
</tr>
<tr>
<td>Closure Device</td>
<td>0.47</td>
<td>0.37-0.61</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Timing (Jan-Jun)</td>
<td>0.73</td>
<td>0.58-0.92</td>
<td>0.007</td>
</tr>
<tr>
<td>Routine Ultrasound (≥ 80%)</td>
<td>0.74</td>
<td>0.57-0.95</td>
<td>0.02</td>
</tr>
</tbody>
</table>
Updated VSGNE Data

• PVI Dataset (Jan 2010 – Feb 2015)
  – Femoral access only

• 27 Centers
  – Hematoma range 0-13%

• 25 Centers with ≥ 10 procedures
  – Hematoma range 1-13%
VSGNE Data

• 182 Surgeons  
  – Mean hematoma rate = 4.7% (range 0-100%)

• 130 Surgeon with ≥ 10 procedures  
  – Mean hematoma rate = 4.65% (range 0-23%)

• Mean Ultrasound Guidance Use = 40% (range 0-100%)
VSGNE Data

• 23 Routine Users (≥ 80%)
  – Mean hematoma rate = 3.7%

• 107 Selective Users (< 80%)
  – Mean hematoma rate = 4.9%

• VSGNE members given personalized Quality Reports
  – Hematoma Rate and Ultrasound Guidance
How To Use Ultrasound Guidance
Transverse View

GSV

CFA

CFV
Longitudinal View

CFA

SFA

PFA
Step 1: Survey
Step 2: Spread
Step 3: Puncture
Step 3: Puncture
Step 4: Wire
Percutaneous EVAR
CPT Code 76937

• Ultrasound guidance for vascular access requiring ultrasound evaluation of potential access sites, documentation of selected vessel patency, concurrent real-time ultrasound visualization of vascular needle entry, with permanent recording and reporting
Documentation

“Ultrasound guidance was used to access the right common femoral artery using the micropuncture technique after infiltration of 1% lidocaine for local anesthesia. Ultrasound documented patency of the common femoral artery and vein, as well as the exact location for puncture. Images were stored in PACS for documentation purposes.”
CPT Code 76937

• Technical charge ~ $273.00
• Technical payment ~$21.00

• Professional Payments
  – Medicare $15.31
  – Medicaid $11.16
  – Harvard Pilgrim ~$29-$34
  – Blue Cross ~$15-$21

• Work RVU’s = 0.3
Barriers to Adoption

1. No U/S machine easily accessible

2. Cost to purchase and maintain U/S machine

3. Time for set-up and access

4. Lack of training

5. Learning curve
Summary

• Puncture over upper half of femoral head is safest access location

• Cephalad punctures $\uparrow$ complication rates and should be avoided even if access appears in CFA by ultrasound

• Caudal punctures acceptable if ultrasound identifies needle placement cephalad to femoral bifurcation
Summary

• Operator interpretation of images crucial to ↓ complications

• Learning curve necessary to perfect the technique

• Ultrasound ↓ complications from routine percutaneous femoral access, and possibly with “Preclose” for large sheaths in EVAR
Conclusions

• Many important risk factors that predict hematoma formation after femoral arterial access are not modifiable.

• Appropriate use of smaller sheaths, closure devices, and routine ultrasound guidance may potentially protect against hematoma formation.

• Routine use of ultrasound guidance may decrease the risk for hematoma formation for both modifiable and non-modifiable patient/procedural characteristics.
VSGNE Goals

1. Add “how to videos” and data to the VSGNE website

2. Track hematoma rates of surgeons/centers that switch to routine ultrasound usage

3. Track new data fields
   • **EVAR/TEVAR**: percutaneous femoral access, ultrasound guidance
   • **PVI**: individual access sites recorded separately, “closure device successful”

4. Increase the utilization of ultrasound guidance for arterial access from 40% to 80%?