بِسْمِ اللَّهِ الرَّحْمَٰنِ الرَّحِيمِ
Arterial Vascular Access for Coronary Procedures: Femoral approach

By
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Professor of cardiology
Faculty of Medicine
Mansoura University
13 October 2014
Introduction

• Vascular access skills are one of the most fundamental and critical competencies for endovascular procedures
• The outcome of a procedure can be affected by the location and technique for obtaining vascular access
• A serious vascular access complication can cloud the success of an intervention
Introduction

• It is important to master the basic principles of access and to

• understand the various approaches that may be considered to optimize care for each patient and to succeed as an invasive cardiologist
Arterial access via the common femoral artery (CFA) still comprises the most frequent strategy in the US and in EGYPT.
Whey CFA is commonest access for cardiac cath?

1. Large in caliber
2. Superficial
3. Predictable location
4. Overlying the femoral head provides solid support against which manual compression
Technique of CFA access and closure

• Identify and palpate anatomical landmarks

• Local anesthesia

• Femoral artery puncture
  a. Traditional puncture without flouroscopy
  b. Micropuncture
  c. Ultrasound-guided
Technique of CFA access and closure

• Subcutaneous tunnel
• Sheath insertion
• Study
• Sheath removal and hemostasis
• Complications
Transfemoral Access – Basics

Femoral Crease
Transfemoral Access – Basics

Where is the Crease?

Perhaps This

Is this the Crease?

1:00

Courtesy
Dr Z Turi
Anterior spine
Inguinal ligament
Skin crease
Common femoral artery
Profunda
Superficial femoral artery
Saphenous vein
Femoral vein

3 cm
Femoral Artery Anatomy

- deep iliac circumflex
- lateral iliac circumflex
- common femoral
- lateral femoral circumflex
- profunda
- femoral
- inferior epigastric
- inguinal ligament
- inferior gluteal
Transfemoral Access – Basics

"The Target" – Mid Femoral Head

Place a radio-opaque object at the inferior border of the femoral head.

Insert needle at 45 degree angle at the point of intersection with the femoral artery pulse.
Femoral Artery Anatomy: A Prospective Study

• 200 consecutive patients
• All undergoing coronary angiography
• Femoral angiography at end of procedure
• Quantitative angiography

Schnyder et al CCI 2001
Femoral Head and the CFA Bifurcation

Number of patients

<table>
<thead>
<tr>
<th>Level</th>
<th>Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>111</td>
</tr>
<tr>
<td>II</td>
<td>44</td>
</tr>
<tr>
<td>III</td>
<td>34</td>
</tr>
<tr>
<td>IV</td>
<td>8</td>
</tr>
<tr>
<td>V</td>
<td>3</td>
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</tbody>
</table>

n=200
Routine femoral head fluoroscopy to reduce complications in coronary catheterization

Joshua A. Jacobi, MD, Jeffrey M. Schussler, MD, and Kenneth B. Johnson, MD

<table>
<thead>
<tr>
<th>Variable</th>
<th>Overall (n = 256)</th>
<th>Treatment (n = 130)</th>
<th>Control (n = 126)</th>
<th>P value</th>
</tr>
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<tbody>
<tr>
<td>Complications</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bleed/hematoma</td>
<td>4%</td>
<td>5%</td>
<td>2%</td>
<td>NS</td>
</tr>
<tr>
<td>Correct placement</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Correct overall</td>
<td>60%</td>
<td>65%</td>
<td>54%</td>
<td>NS</td>
</tr>
<tr>
<td>Correct in those with BMI &lt; 30</td>
<td>50%</td>
<td>62%</td>
<td>57%</td>
<td>NS</td>
</tr>
<tr>
<td>Correct in those with BMI ≥ 30</td>
<td><strong>60%</strong></td>
<td><strong>69%</strong></td>
<td>50%</td>
<td><strong>0.02</strong></td>
</tr>
</tbody>
</table>

Proc (Bayl Univ Med Cent) 2009;22(1):7-8
Transfemoral Access – Micropuncture Assisted

4F Sheath/Dilator
.
.018” Wire
Transfemoral Access – Micropuncture Assisted

After introduction of micro puncture sheath, an angiogram is performed.

If access is in an ideal location, the micropuncture sheath accommodates an .035” wire for exchange to a “working sheath.”

If access is NOT in an ideal location, the micropuncture sheath is pulled, and after five minutes of manual compression, vascular access is obtained again with the micropuncture system.
Real-Time Ultrasound Guidance Facilitates Femoral Arterial Access and Reduces Vascular Complications

FAUST (Femoral Arterial Access With Ultrasound Trial)

Arnold H. Seto, MD, MPA,* Mazen S. Abu-Fadel, MD,† Jeffrey M. Sparling, MD,† Soni J. Zacharias, MD,† Timothy S. Daly, MD,† Alexander T. Harrison, MD,* William M. Suh, MD,* Jesus A. Vera, MD,* Christopher F. Aston, PhD,‡ Rex J. Winters, MD,§ Pranav M. Patel, MD,* Thomas A. Hennebry, MB, BCH, BAO,† Morton J. Kern, MD*
Transfemoral Access – Ultrasound Assisted

A

B

C

SFA

PFA

FV

CFA

FV

ACC: CARDIOVASCULAR INTERVENTIONS, VOL. 2, NO. 7, 2010
JULY 2010: 751-8
FAUST: Ultrasound RCT Outcomes

Number of Attempts

- Fluoroscopy: 3
- Ultrasound: 1.3 (p < 0.000001)

First Pass Success Rate

- Fluoroscopy: 46.4%
- Ultrasound: 82.7% (p < 0.000001)

Risk of Venipuncture

- Fluoroscopy: 15.8% (p < 0.000001)
- Ultrasound: 2.4%

Time to Sheath Insertion

- Fluoroscopy: 213 seconds
- Ultrasound: 16 seconds (p = 0.016)

Seto AH et al. JACC CV Interv ’10; 3:751
Modified Seldinger Technique

Manual Compression

- Hold time ~ 2x sheath size?
- Hold location - PROXIMAL
- Possible morbidity associated with prolonged bedrest and compression
- Use sterile technique
Transfemoral Access – Reducing Complications

Manual Sheath Removal

• Immediately after procedure in diagnostic cases

• Delayed removal for PCI
  - ACT < 150s in case heparin was used
  - In 2 hours after stopping bivalirudin
  - After 6-8hrs of last enoxaparin dose
  - Even longer after fondaparinux
  - Increased sheath size increases complications
The Promise of Vascular Closure Devices

- Patient comfort and convenience
  - Early ambulation
  - Early hemostasis
- Decrease complication rate
## Transfemoral Access – Arterial Closure Device (ACD)

### Active

<table>
<thead>
<tr>
<th>Plugs</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Angioseal, Vascade - Collagen</td>
<td></td>
</tr>
<tr>
<td>Mynx – PEG</td>
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</table>

<table>
<thead>
<tr>
<th>Suture</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Perclose A-T</td>
<td></td>
</tr>
<tr>
<td>Prostar XL</td>
<td></td>
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<table>
<thead>
<tr>
<th>Staple/Clip</th>
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<tbody>
<tr>
<td>Angiolink – Titanium staple</td>
<td></td>
</tr>
<tr>
<td>Starclose – Nitinol clip</td>
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### Passive

<table>
<thead>
<tr>
<th>Patch</th>
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<tbody>
<tr>
<td>D-stat</td>
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<table>
<thead>
<tr>
<th>Compression</th>
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<tbody>
<tr>
<td>FemStop</td>
<td></td>
</tr>
<tr>
<td>ClampEase</td>
<td></td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Others</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Boomerang</td>
<td></td>
</tr>
<tr>
<td>SoundSeal</td>
<td></td>
</tr>
<tr>
<td>Quickclose</td>
<td></td>
</tr>
</tbody>
</table>
Vascular Closure Devices

Evidence base = Early hemostasis, early ambulation

- Diagnostic Cath
- PCI
- All Patients

- Arora n=12,937
- Applegate n=21,841
- Nikolsky n=37,066
- Koreny n = 3,200

Favors VCD Favors MC

ACC/AHA Class III indication to lower complication rates
Complication Rates

<table>
<thead>
<tr>
<th></th>
<th>OR (95% CI)</th>
<th>Heterogeneity test</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dx studies</td>
<td>1.44 [0.43, 4.82]†</td>
<td></td>
<td>0.0003</td>
</tr>
<tr>
<td></td>
<td>0.66 [0.18, 2.38]*</td>
<td></td>
<td>0.16</td>
</tr>
<tr>
<td>PCI studies</td>
<td>1.11 [0.94, 1.33]*</td>
<td></td>
<td>0.22</td>
</tr>
<tr>
<td></td>
<td>1.35 [0.87, 2.11]*</td>
<td></td>
<td>0.15</td>
</tr>
<tr>
<td>Both Dx+PCI studies</td>
<td>1.83 [1.15, 2.90]†</td>
<td></td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>1.15 [0.67, 1.98]*</td>
<td></td>
<td>0.43</td>
</tr>
<tr>
<td>All studies</td>
<td>1.34 [1.01, 1.79]†</td>
<td></td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td></td>
<td>1.30 [0.90, 1.87]*</td>
<td></td>
<td>0.19</td>
</tr>
</tbody>
</table>

Favors ACD  Favors Control
Vascular Closure Devices

- Patients considered for vascular closure devices should undergo a femoral angiogram to ensure anatomic suitability for deployment.

- The use of vascular closure devices is reasonable for the purposes of achieving faster hemostasis and earlier ambulation compared with the use of manual compression.

- The routine use of vascular closure devices is not recommended for the purpose of decreasing vascular complications, including bleeding.
Anchored Plugs
Active Approximation

Angio-Seal
- High success rate, short learning curve, short deployment time
- Vascular occlusion, infection

Thrombosing agent
Suture or Staple/Clip Devices
Active Approximation

Perclose
StarClose

No thrombosing agent
Unanchored Plugs

VasoSeal and Duett no longer marketed
Return of the Unanchored Plugs?

- Passive approximation

Mynx

ExoSeal

+ Through procedure sheath, simplified, resorption
- Passive approximation

Sealing agent
Local complications of FA access: 2-10%

- Hematoma (1-12%)
- Pseudoaneurysm (1-6%)
- AV fistula (<1%)
- Vessel laceration (<1%)
  - Free bleeding
- Intimal dissection
  - Ante- or retro-grade
- Acute vessel closure (<1%)
  - Thrombosis (small artery lumen)

- Retroperitoneal hemorrhage (0.2 – 0.9%)
- Thickening of the perivascular tissues
- Neural damage
- Infection
- Venous thrombosis
- Pericatheter clot

Complication rate persistent over many decades

Most common: hematoma
Most lethal: retroperitoneal hemorrhage
Transfemoral Access – Risk Factors for Complications

Patient Related

- Advanced Age
- Female Gender
- Small Vessel Size
- ↓ Body surface area
- Renal failure
- Diabetes
- Vascular disease

Procedure Related

- Increased Sheath size
- High or Low Puncture Site
- Prior procedures
- Anticoagulation (esp. w/IABP)
- GPIIb/IIIa infusion
- Lytic Use
### TABLE II. Independent Correlates of Retroperitoneal Bleeding

<table>
<thead>
<tr>
<th></th>
<th>OR</th>
<th>95% CI</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sheath placement superior to inferior epigastric artery(^a)</td>
<td>17.6</td>
<td>2.21–141.63</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Female sex</td>
<td>3.73</td>
<td>2.55–5.43</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Angioseal(^\text{TM})</td>
<td>2.80</td>
<td>1.95–4.00</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>GP IIb/IIIa inhibitor</td>
<td>1.92</td>
<td>1.31–2.82</td>
<td>0.001</td>
</tr>
<tr>
<td>Weight (per kg)</td>
<td>0.987</td>
<td>0.976–0.997</td>
<td>0.014</td>
</tr>
<tr>
<td>Acute MI</td>
<td>1.82</td>
<td>1.05–3.17</td>
<td>0.035</td>
</tr>
</tbody>
</table>

\(^a\)Adjusted for sheath insertion site (femoral vs. retroperitoneal).
# Transfemoral Access – Complications

**Retroperitoneal Hematoma**

## Clinical Signs

<table>
<thead>
<tr>
<th>Sign</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anemia</td>
<td>100%</td>
</tr>
<tr>
<td>Hypotension</td>
<td>92%</td>
</tr>
<tr>
<td>Abdominal tenderness</td>
<td>69%</td>
</tr>
<tr>
<td>Diaphoresis</td>
<td>58%</td>
</tr>
<tr>
<td>Groin pain</td>
<td>46%</td>
</tr>
<tr>
<td>Low abdominal pain</td>
<td>42%</td>
</tr>
<tr>
<td>Groin hematoma</td>
<td>31%</td>
</tr>
<tr>
<td>Bradycardia</td>
<td>31%</td>
</tr>
<tr>
<td>Back pain</td>
<td>23%</td>
</tr>
</tbody>
</table>

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[Cullen’s Sign]

Grey Turner’s Sign

Farroque JACC 2005

Mookadam NEJM 2005
Transfemoral Access – Complications
Retroperitoneal Hematoma

Management

Step 1. Treat Immediately!

- Reverse Anticoagulation
- Volume Resuscitation
- Manual Compression

Step 2. Diagnosis

If hemodynamically unstable ----> Cath Lab
If hemodynamically stable ------> CT Scan
Transfemoral Access – Complications

Inguinal Hematoma
Transfemoral Access – Complications
Inguinal Hematoma

Most Common Complication
Results from lack of hemostasis

Signs and Symptoms

Swelling
Pain
Ecchymosis
Decreased Hemoglobin (late)
Femoral Neuropathy (late)
Transfemoral Access – Complications

Haematoma after coronary angiography and percutaneous coronary intervention via the femoral artery frequency and risk factors

Kirsten Andersen*, Marianne Bregendahl, Helen Kaestel, Mette Skriver, Jan Ravkilde

Female
SBP > 160
>1 Puncture attempt
Sheath time > 16 minutes
ACT > 175 seconds
GPIIbIIIa use
LMW use
Anti-coagulation use
Personnel change during groin hold
Transfemoral Access – Complications

Inguinal Hematoma

Management

Manual Compression
Analgesics
Volume resuscitation

If unable to control --- > Cath Lab

Any significant hematoma should be evaluated for a pseudo-aneurysm
Transfemoral Access – Complications

Pseudoaneurysm

Signs and symptoms: Pain, swelling, pulsatile mass, bruit...

May not present with any physical finding

Transfemoral Access – Complications

Pseudoaneurysm

Management

Observation
Small PA < 2.0 cms
Anticoagulation decreases rate thrombosis

Compression
Largely abandoned

Surgical Repair
Wide necked

Thrombin injection
Main therapy
Infections

- 0.3%
- Median incubation – 8 days
- Staph aureus 75%
- BC + 86%
- Diabetics 80%
- PSA 42%
- 6% mortality

Sohail Mayo Clinic Proceedings

 Courtesy Dr. John Eidt, UAMS.
Why Femoral Infections Occur

- Bacteria friendly region
- Failure to maintain good sterile technique
- Insertion of foreign body in tissue track
- Sheath left indwelling
- Blood in deep track is great culture medium
Why Pseudoaneurysms

Location of puncture
Time held
Experience of sheath puller
Transfemoral Access – ACD

- Dx studies
  - OR (95% CI)
  - 1.44 [0.43, 4.82]†
  - 0.66 [0.18, 2.38]*
  - Heterogeneity test
  - P-value
  - 0.0003
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- PCI studies
  - OR (95% CI)
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  - 0.22
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- Both Dx+PCI studies
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  - OR (95% CI)
  - 1.34 [1.01, 1.79]†
  - 1.30 [0.90, 1.87]*
  - Heterogeneity test
  - P-value
  - <0.0001
  - 0.19

Favors ACD
Favors Control

Meta Analysis:
30 Studies
37,066 Patients

Transfemoral Access – Complications
ACD Associated Injury

Early Diagnosis
- Document pre-VCD deployment vascular exam
- Have staff evaluate distal pulse after deployment
- Evaluate the foot for temperature difference, pallor

Management
- Reasonable to try an endovascular approach
- But remember the injury site is an area easily accessible to surgeons
Transfemoral Access – Complications

ACD Associated Injury

- Device-related Complications
  - Vessel obstruction
    - Direct mechanical – foot plates
    - Embolization of plugs
  - Bleeding
    - Mechanical secondary to device
    - Secondary to early sheath pull (with subsequent failed closure)
    - Infection
- Some of these complications are arguably additive to those seen with manual compression
- There is no FDA database for complications of manual compression
How to Decrease Risk of Complications

1. Access using fluoroscopy and/or ultrasound
2. Needle entry below centerline of femoral head
3. Femoral angiogram regardless of closure device use
4. Proceed to PCI (and anticoagulate) only if puncture in safe zone
5. Use micropuncture / active visualization
Limitation of Femoral Access

- Obese patients
- Inability to lie flat
- Peripheral arterial disease
- Abdominal aortic aneurysm
- Evidence of prior vascular surgery involving the site or path of access
The Way To The Heart Is Through The Wrist: Radial Catheterization Comes To America (Finally)

Zoltan G. Turi, MD
Acknowledgements

• Douglas E. Drachman, MD, FACC: Vascular access. Cath. Sap 4, 2014

• Robert T. Pyo, MD: Arterial Vascular Access for Coronary Procedures, fellow course 2014

• Robert T. Pyo, MD: Arterial Vascular Access for Coronary Procedures, fellow course 2014

• Zoltan G. Turi: femoral vascular access and closure: step by step. fellow course 2013
UPCOMING ACTIVITIES

• THURSTHDAY 16 OCTOBER: FIRST EPS MEETING

• MONDAY 3 NOVOMBER: Cath SAP 4 INTERVENTIONAL CARDIOLOGY MEETING
THANK YOU