FEMORAL ARTERIAL LINE PLACEMENT

Introduction

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You may return to previous slides, and this module will be available to you for future reference.

Indications

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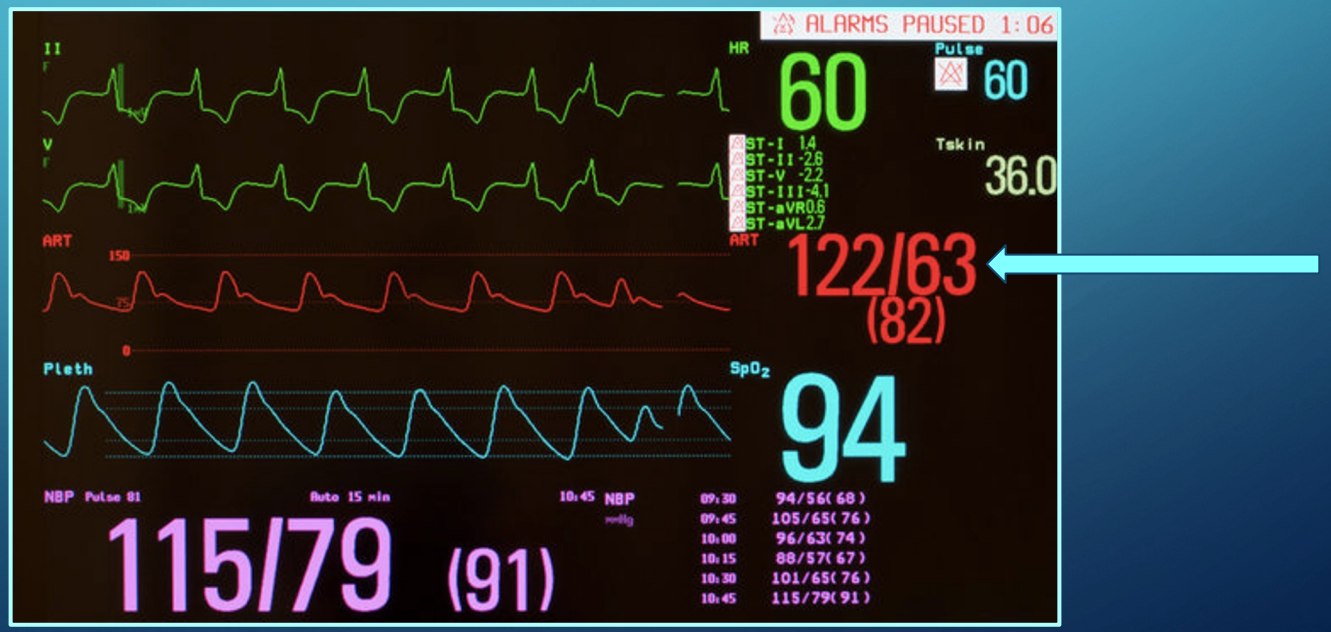
- Continuous and/or more accurate blood pressure monitoring, as compared to non-invasive measurements, particularly in the unstable or critically ill patient



Indications

Indications for femoral arterial line placement include:

- Continuous and/or more accurate blood pressure monitoring, as compared to non-invasive measurements, particularly in the unstable or critically ill patient
- Repeat arterial blood gas measurements

Indications

Of note, arterial lines should NOT be used to administer medications. Injecting medications through an arterial line may lead to serious tissue damage.

Relative Contraindications:

Potential reasons to choose an alternate site for arterial access include:

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- Local site infection

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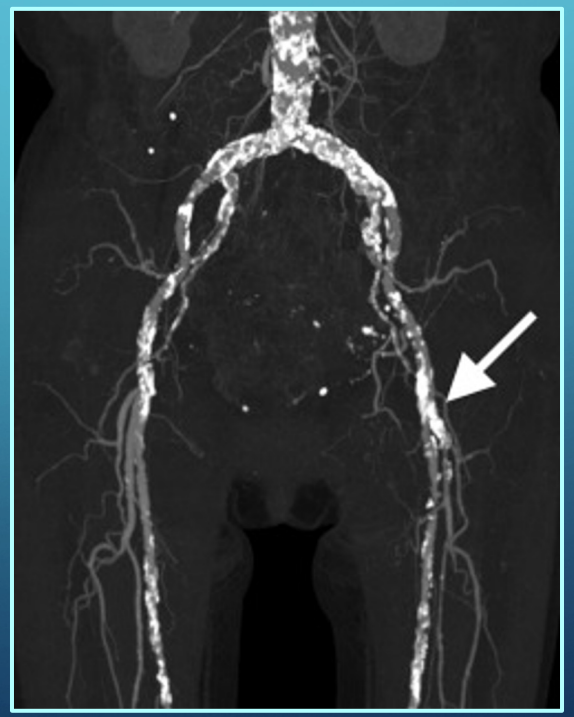
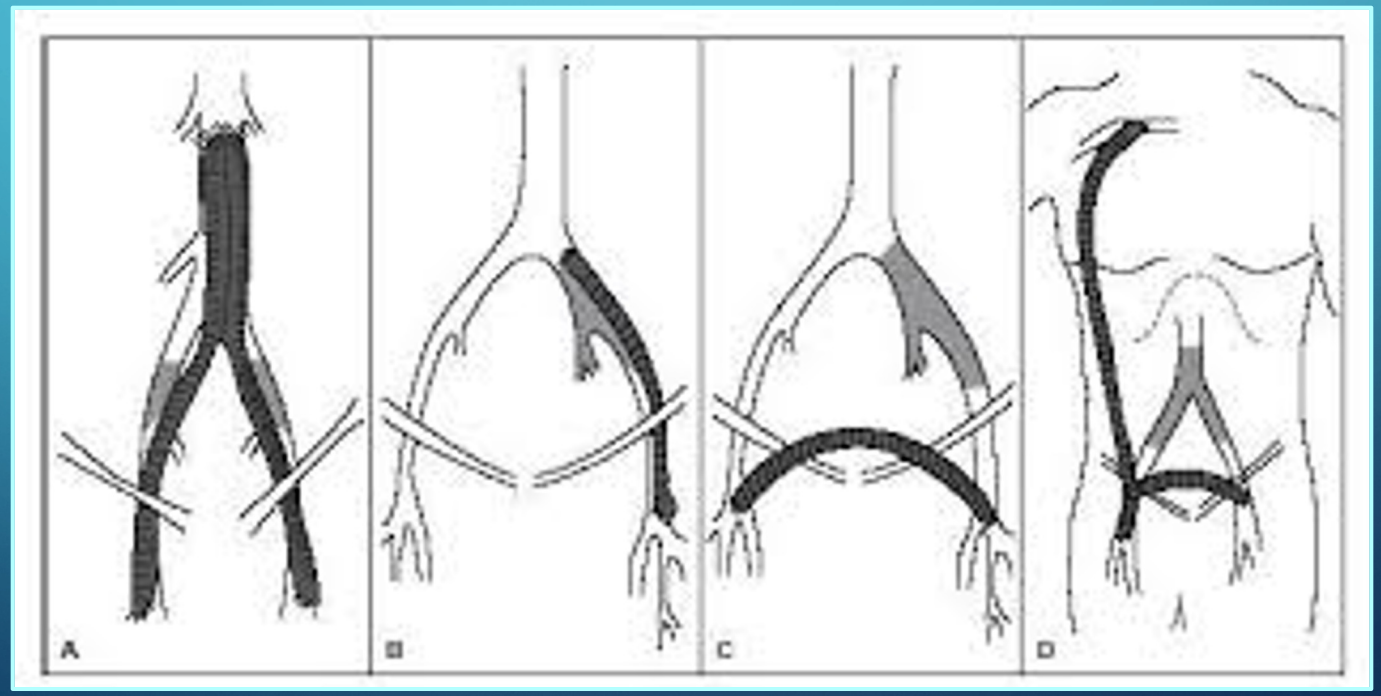
Potential reasons to choose an alternate site for arterial access include:

- Local site infection
- Significant peripheral arterial disease or poor perfusion (e.g. weak or absent femoral pulse)



Relative Contraindications:

- Presence of arterial grafts at the site (e.g. aortofemoral, iliofemoral, femoropopliteal bypass grafts)



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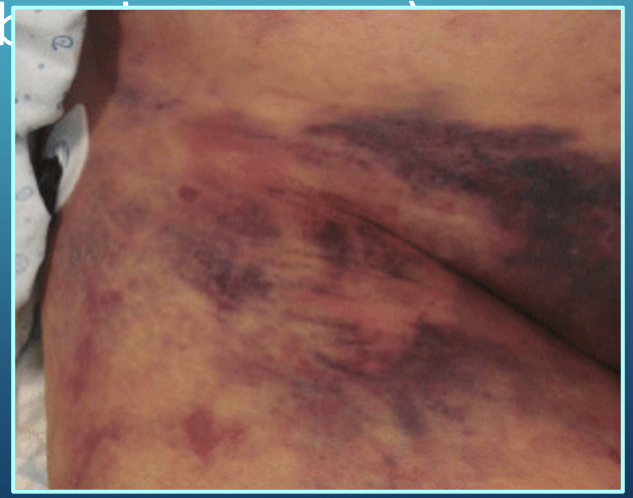
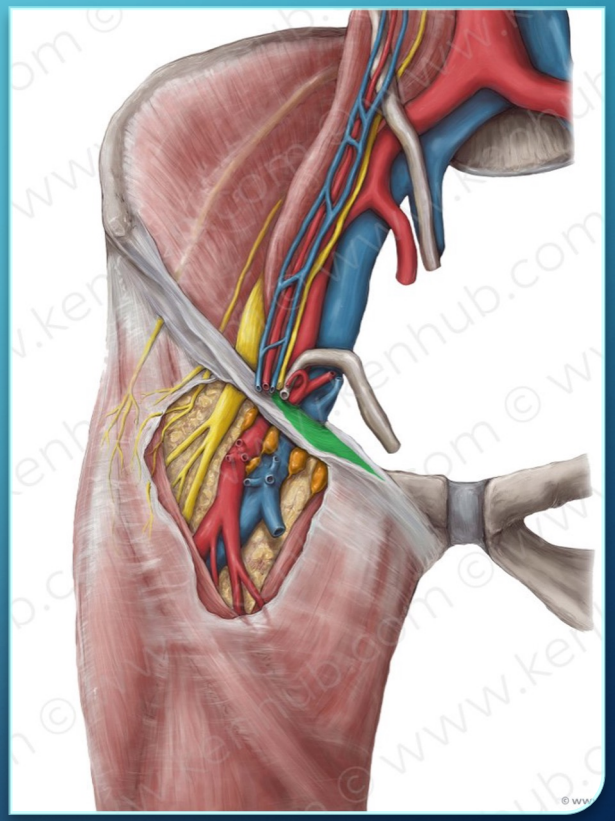
- Previous groin operations, radiation therapy, or burns with resultant scarring
- Previous vascular complications (e.g. pseudoaneurysm, arteriovenous fistula, dissection, thromb



Anatomical Landmarks

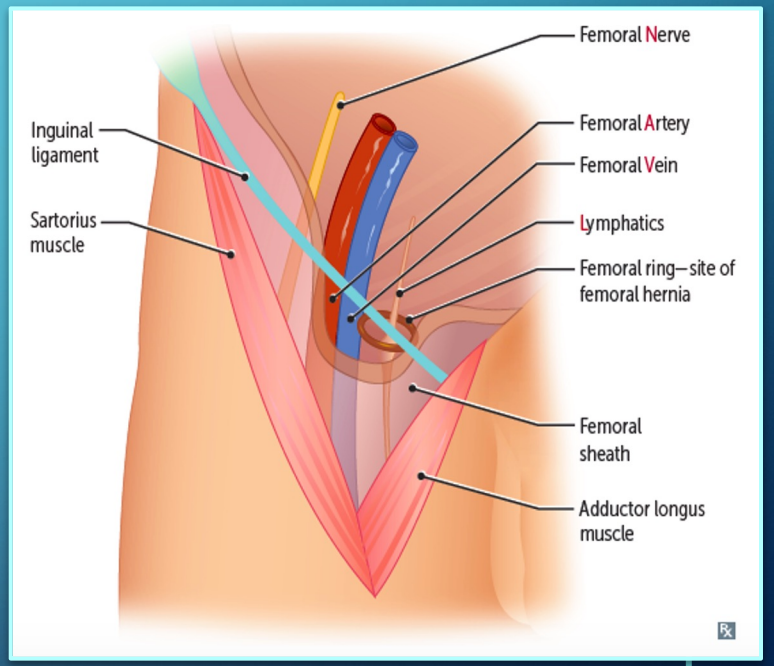
The inguinal ligament runs from the anterior superior iliac spine to the pubic tubercle and serves as the anterior border for structures running between the pelvis and lower extremity.



Anatomical Landmarks

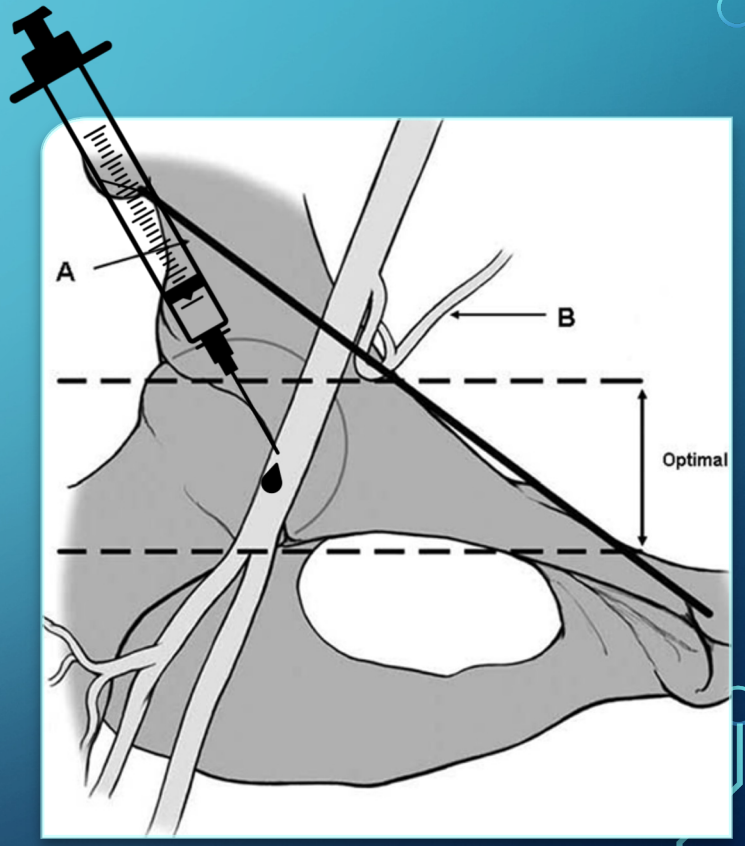
The inguinal ligament runs from the anterior superior iliac spine to the pubic tubercle and serves as the anterior border for structures running between the pelvis and lower extremity.

- From lateral to medial, these structures are the femoral nerve, femoral artery, femoral vein, and lymphatics (NAVEL).
- The vessels run under the medial 1/3 of the ligament.



Anatomical Landmarks

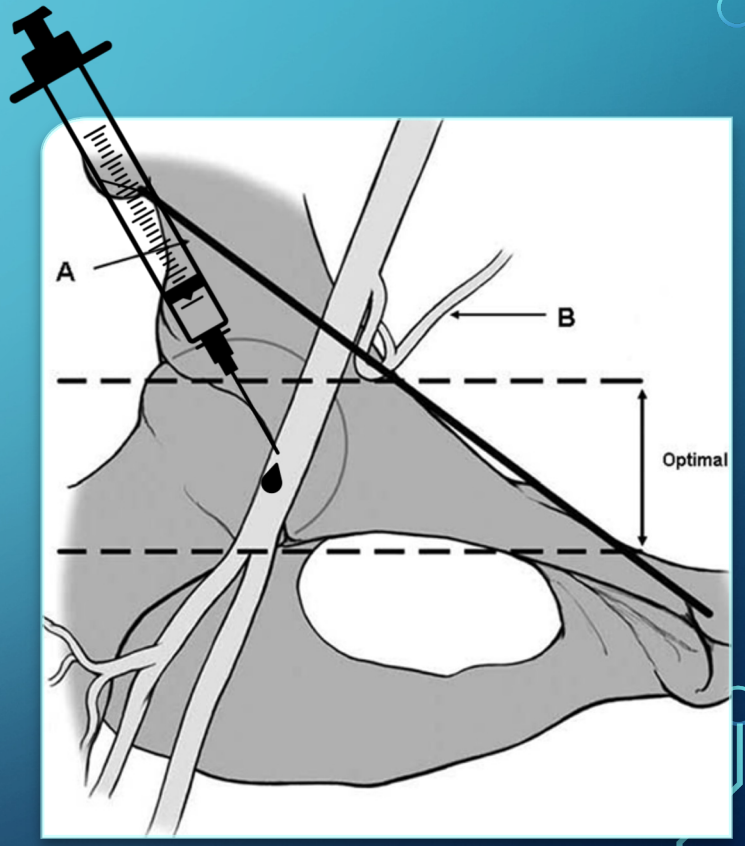
The optimal access site for femoral arterial access is within the common femoral artery distal to the inguinal ligament and proximal to the femoral bifurcation.



Anatomical Landmarks

The optimal access site for femoral arterial access is within the common femoral artery distal to the inguinal ligament and proximal to the femoral bifurcation.

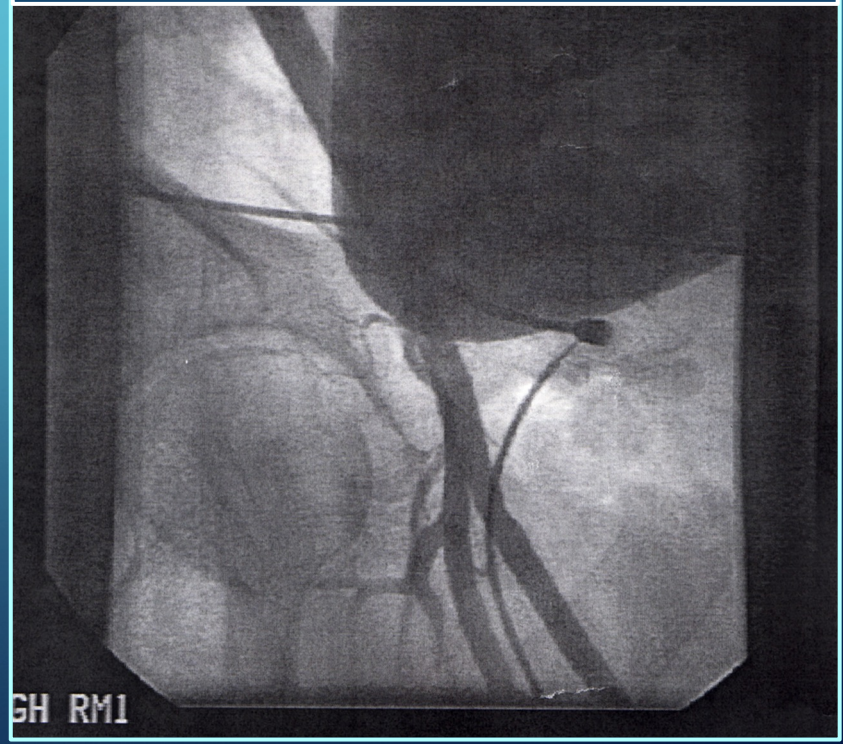
When the line is removed, this site allows for the femoral artery to be pressed against the femoral head to close the arteriotomy and obtain hemostasis.



Anatomical Considerations: Obesity

Patient obesity can make identification of anatomical landmarks more challenging.

High stick in an obese patient:



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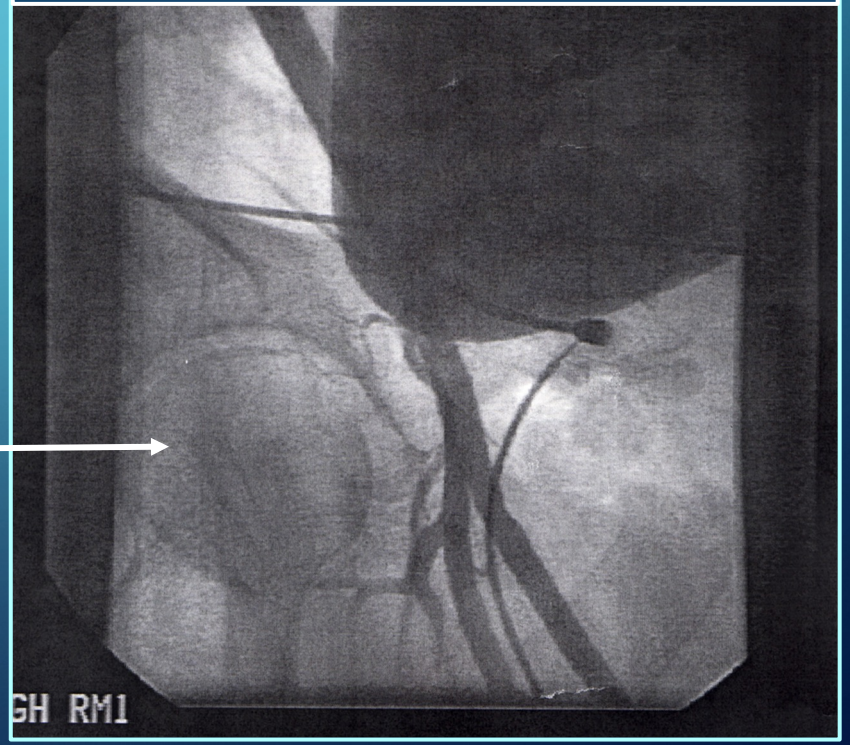

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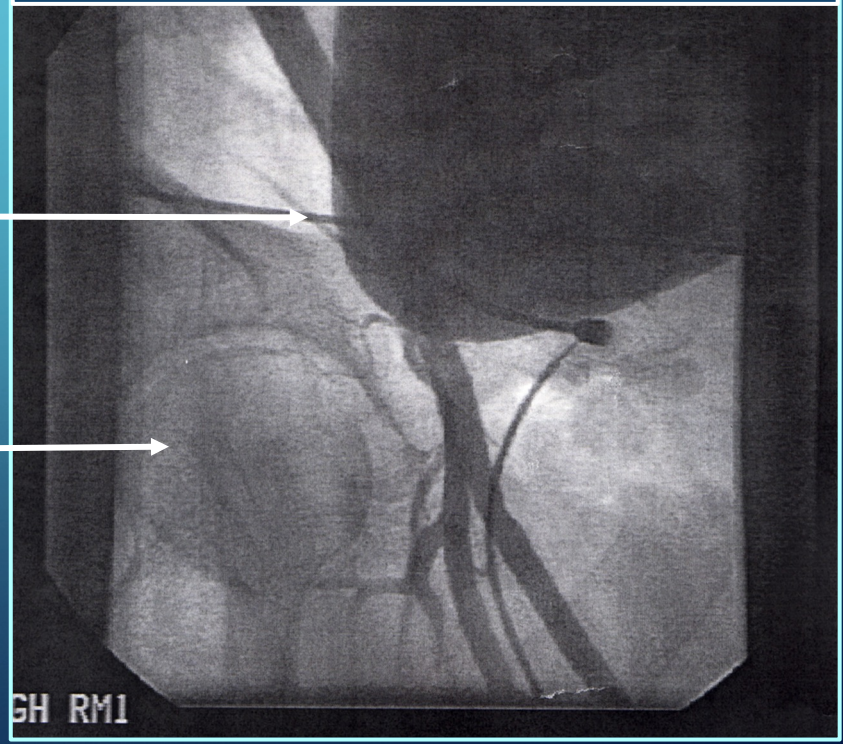

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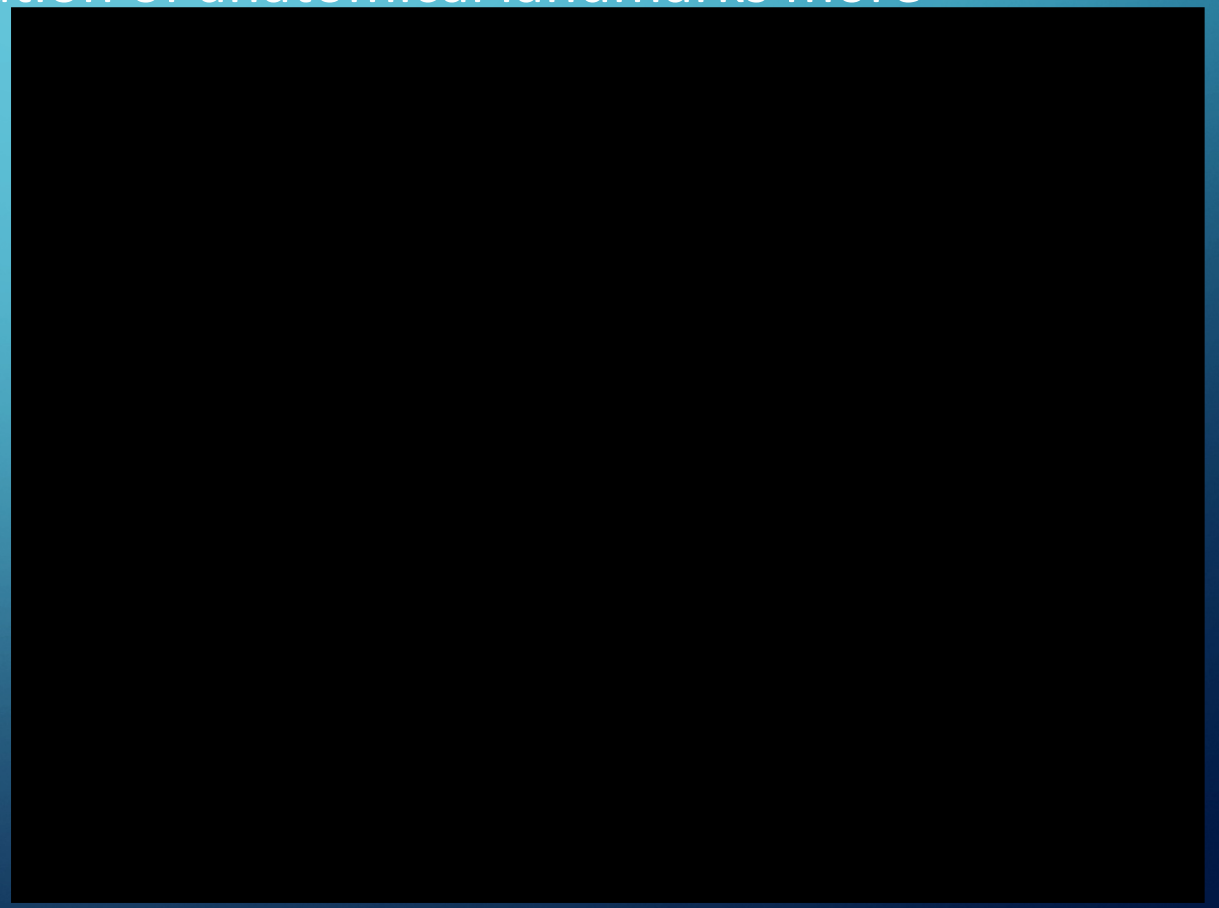
Demonstration under fluoroscopy of the impact of displacement of the pannus on needle entry position:



Anatomical Considerations: Obesity

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Demonstration under fluoroscopy of needle entry position once pannus is elevated:

Ultrasound

- Ultrasound-guided arterial access is now the standard of care and should always be used in non-emergent settings.

Ultrasound

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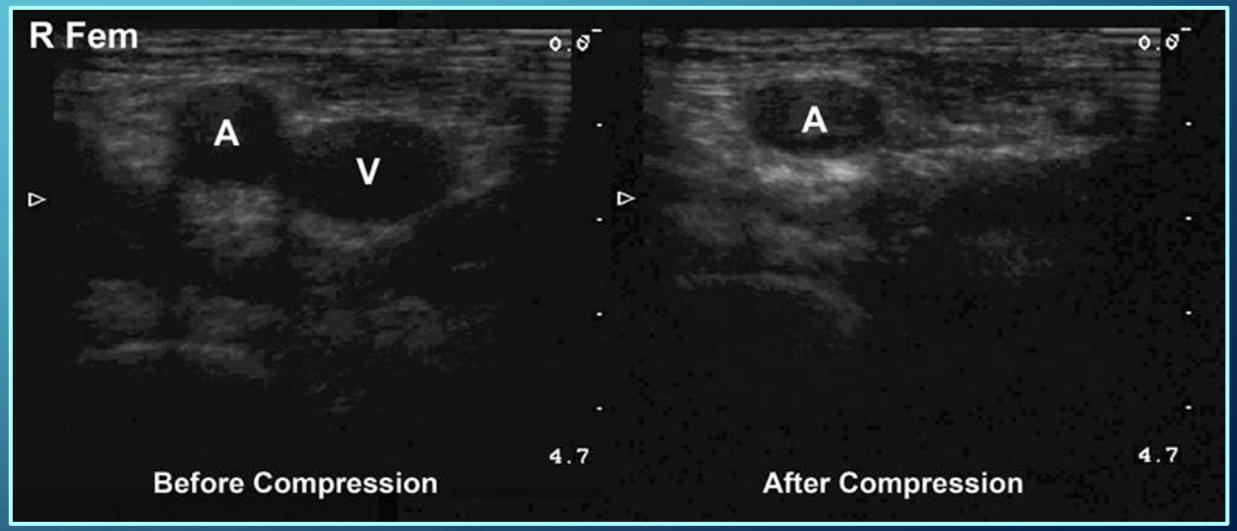
- Tuna Katırcıbaşı et al. in 2018 demonstrated that use of ultrasound for femoral artery access resulted in:
  - Higher first attempt success rate
  - Shorter access time
  - Lower patient-reported pain
  - Lower complication rates
- Other studies, assessing non-femoral arterial a
  demonstrated the use of ultrasound to have a higher first attempt success rate, decreased failure rate, and shorter mean time to success

Ultrasound Visualization

- The femoral artery and vein under ultrasound can look similar and care should be taken to identify the appropriate structure prior to initiation of the procedure. In addition to anatomical location, several factors can be used to differentiate the two:



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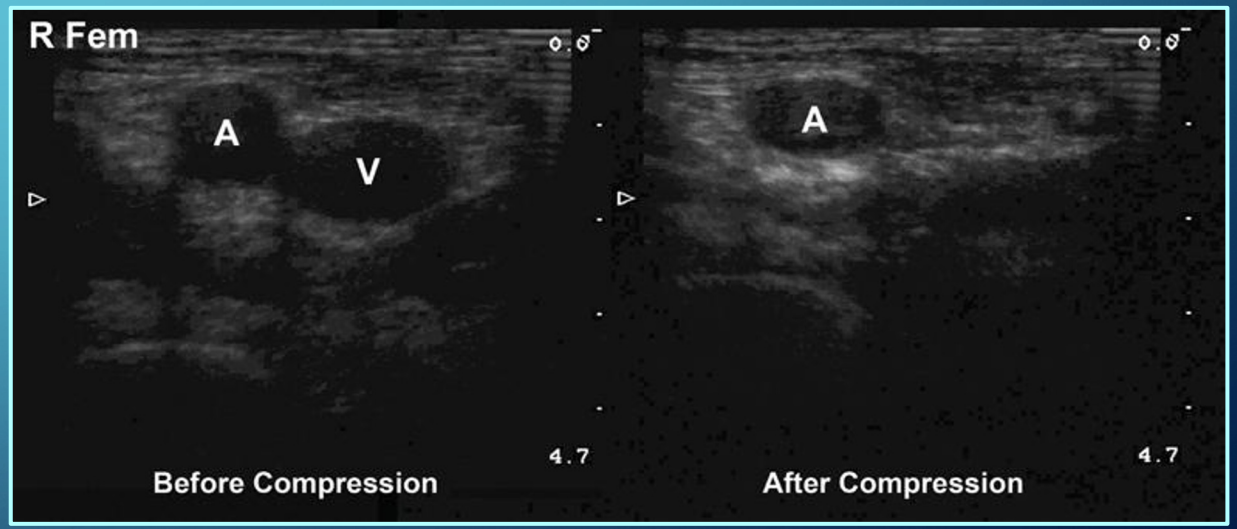
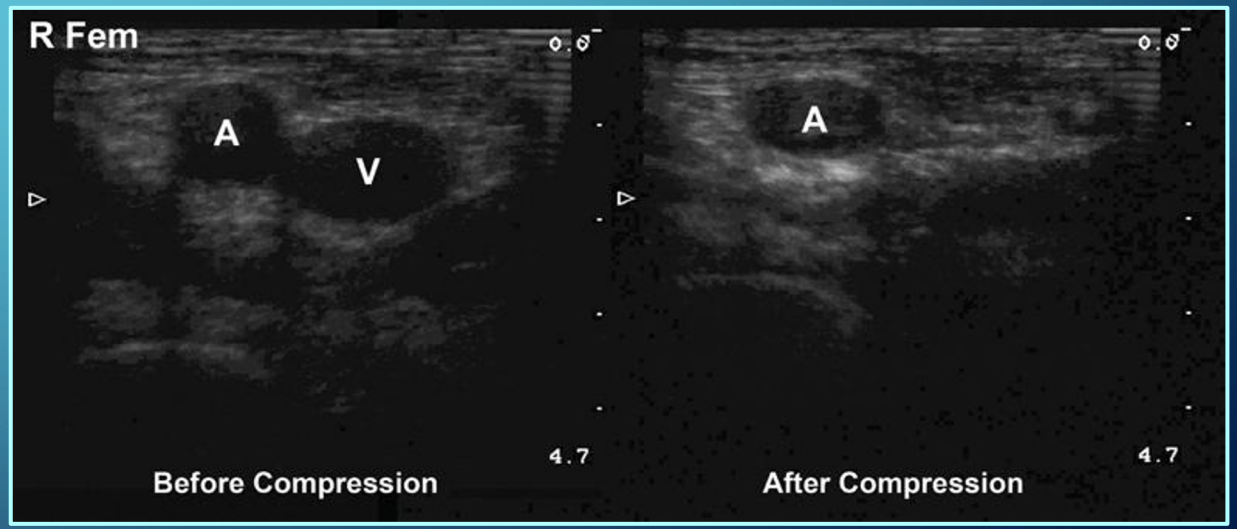


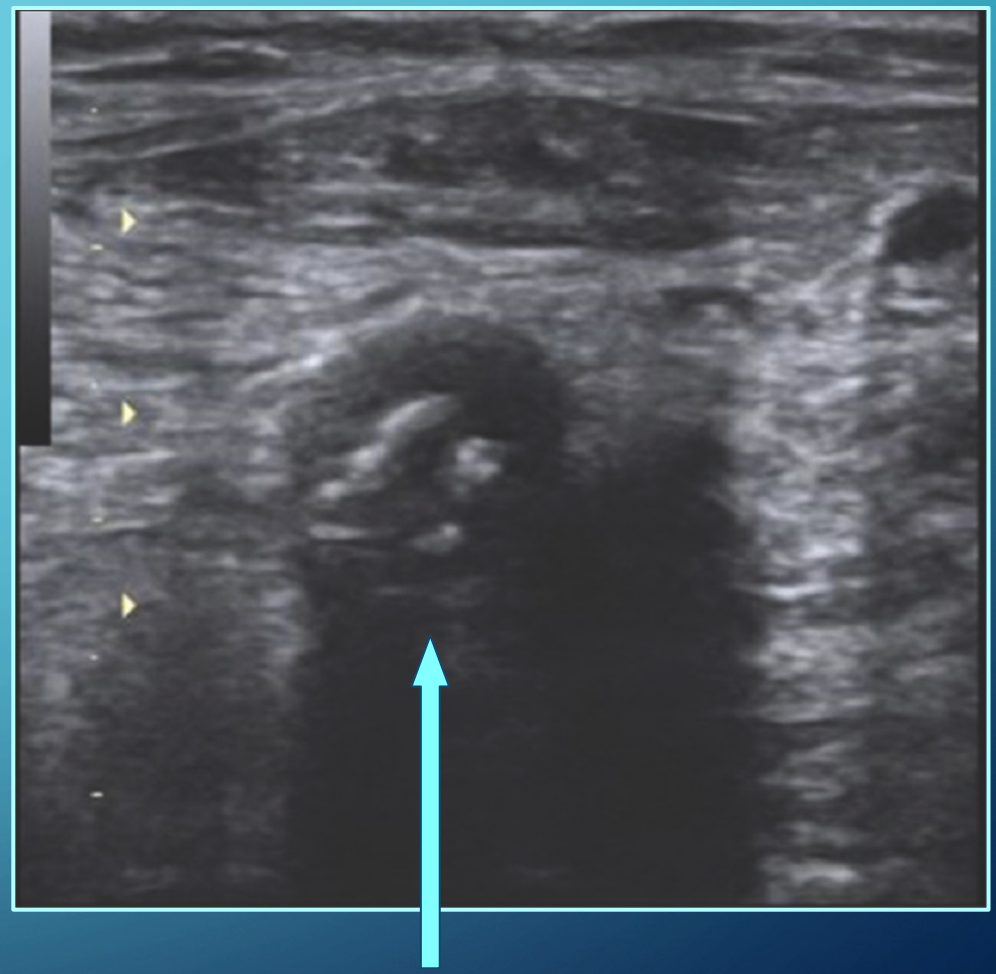
Ultrasound Visualization

- The femoral artery and vein under ultrasound can look similar and care should be taken to identify the appropriate structure prior to initiation of the procedure. In addition to anatomical location, several factors can be used to differentiate the two:
  - Arteries will generally have a thicker wall and be more difficult to compress; the pulsation of the artery may also be visible
  - Veins are thin-walled and often easily compressible



Ultrasound Visualization

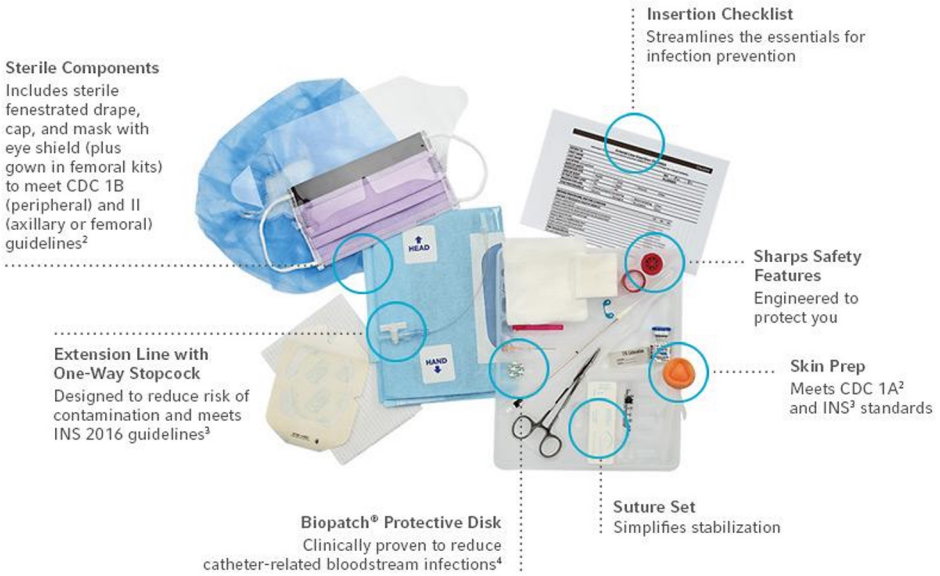
If significant calcification, thrombus or another pathology is present in the artery (as mentioned in prior slides), consider an alternate access site.



Thrombus within the common femoral artery

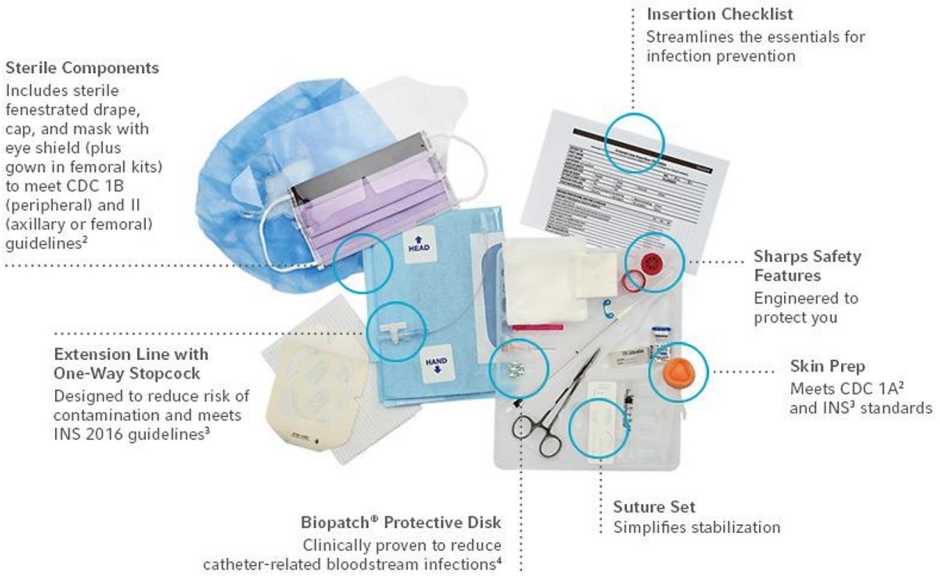
Pre-Procedural Steps

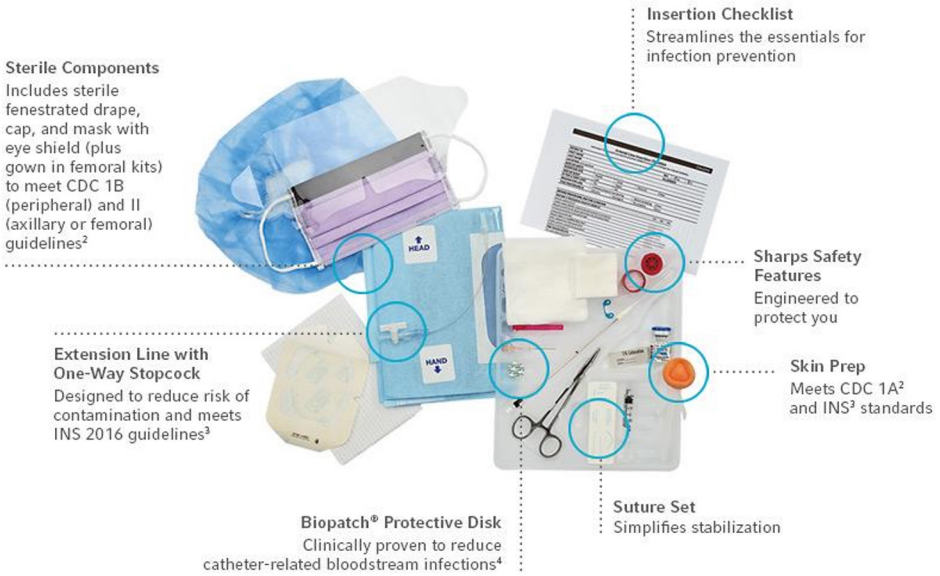
1. Obtain consent



Pre-Procedural Steps

1. Obtain consent
2. Gather all required materials and equipment





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3. "Time-out" to confirm the correct patient and correct procedure

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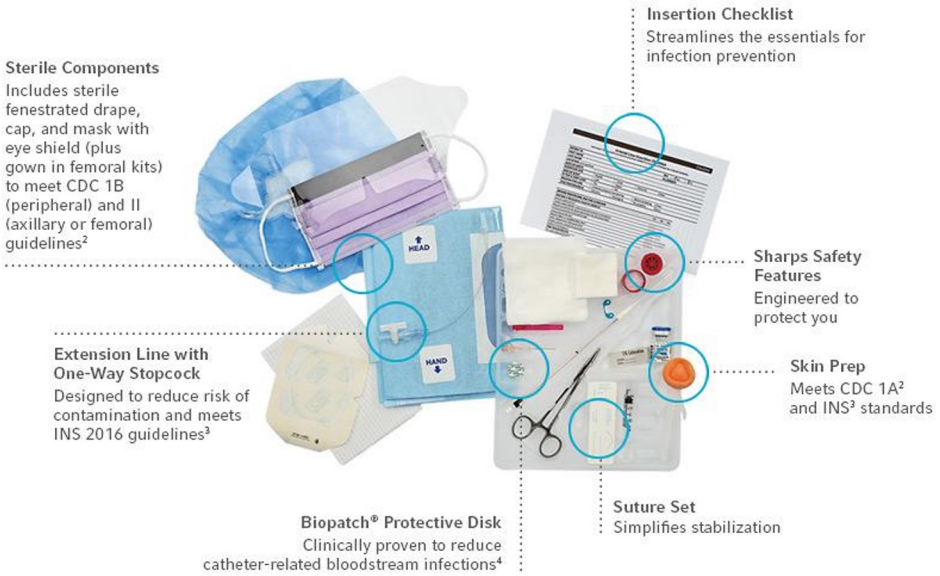

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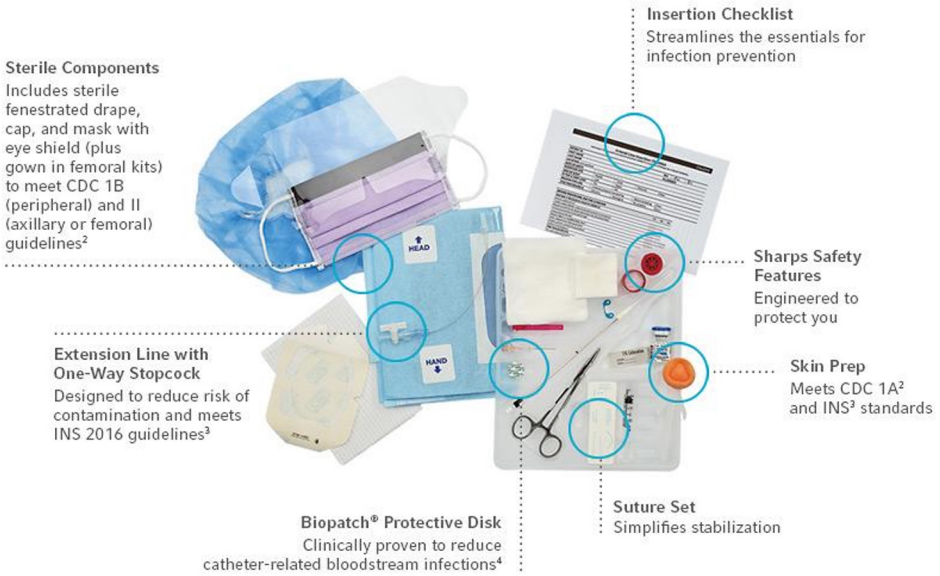
4. Prep the site with chlorhexidine or other antiseptic skin cleanser



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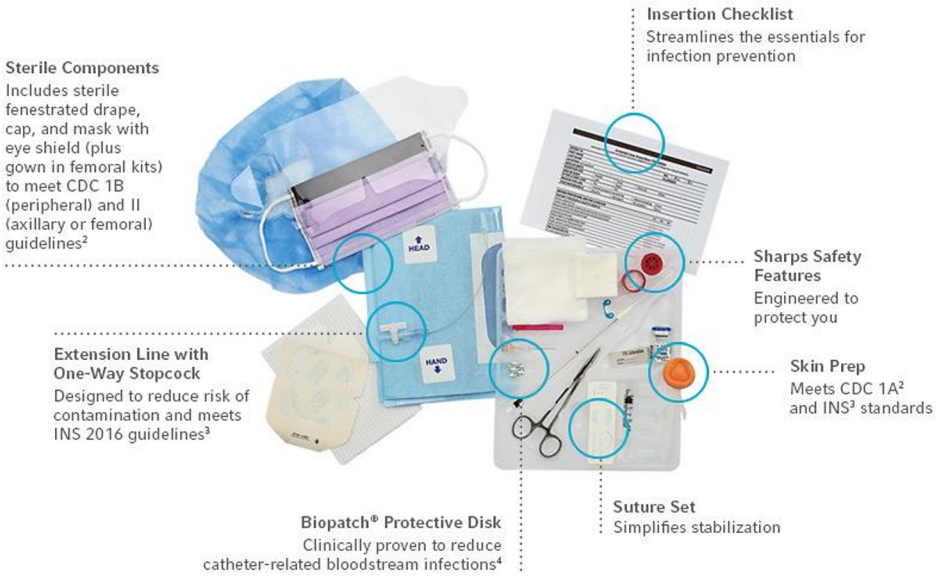
5. Don sterile gloves



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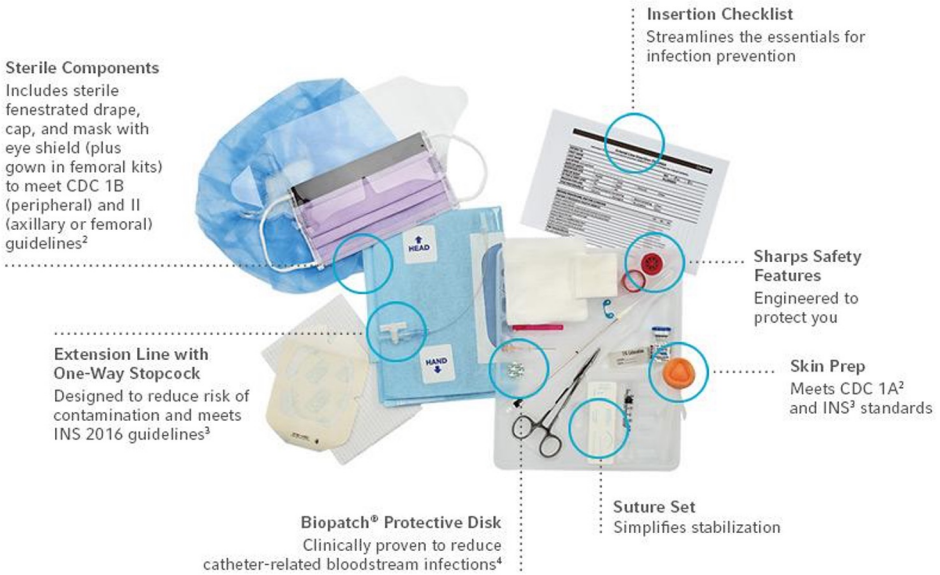
5. Don sterile gloves
6. Apply sterile drape surrounding the access site and drape the ultrasound probe with sterile cover



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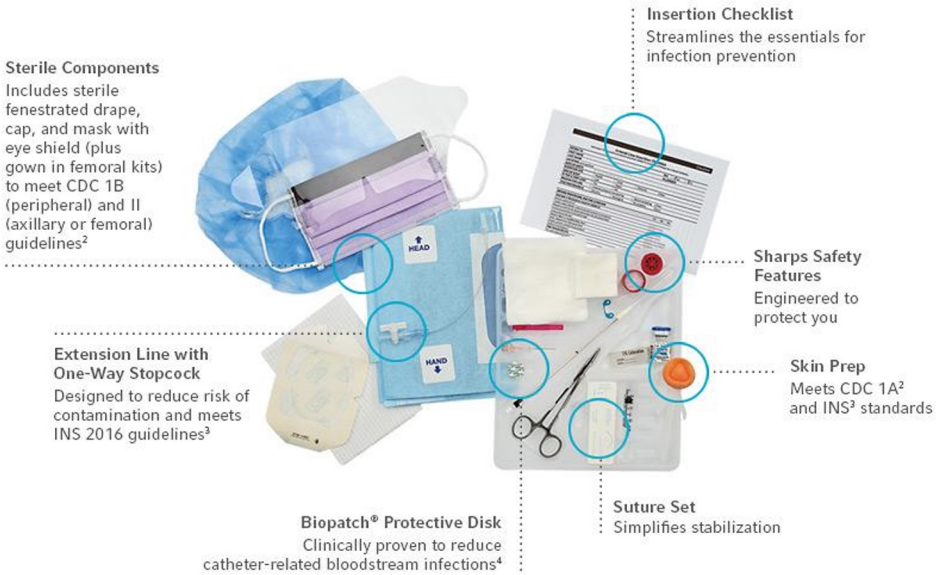
7. Identify the ideal access location



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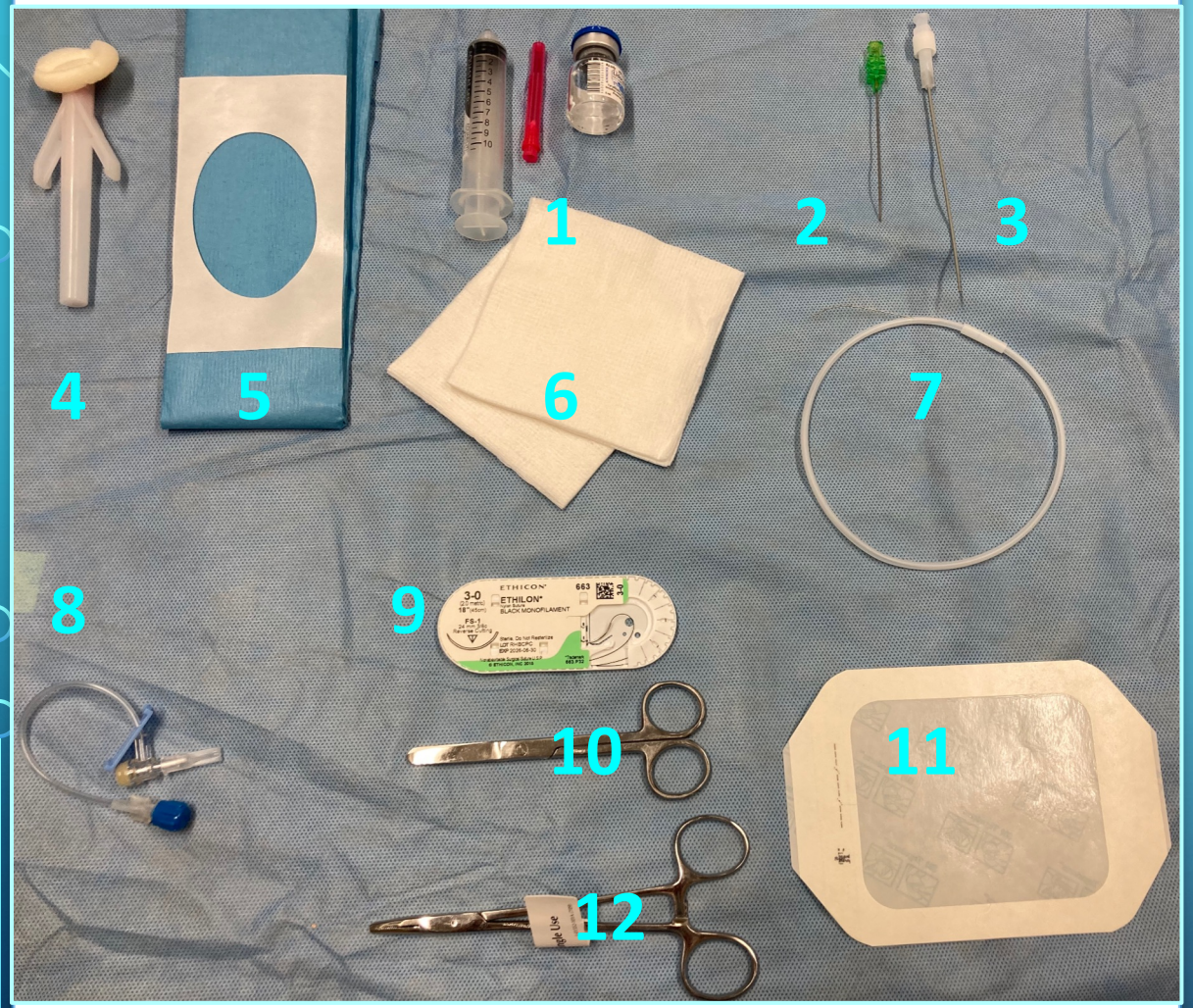
7. Identify the ideal access location
8. Administer local anesthesia at anticipated access location making sure to draw back before injection to ensure no injection into the vasculature – warn the patient of pain from injection

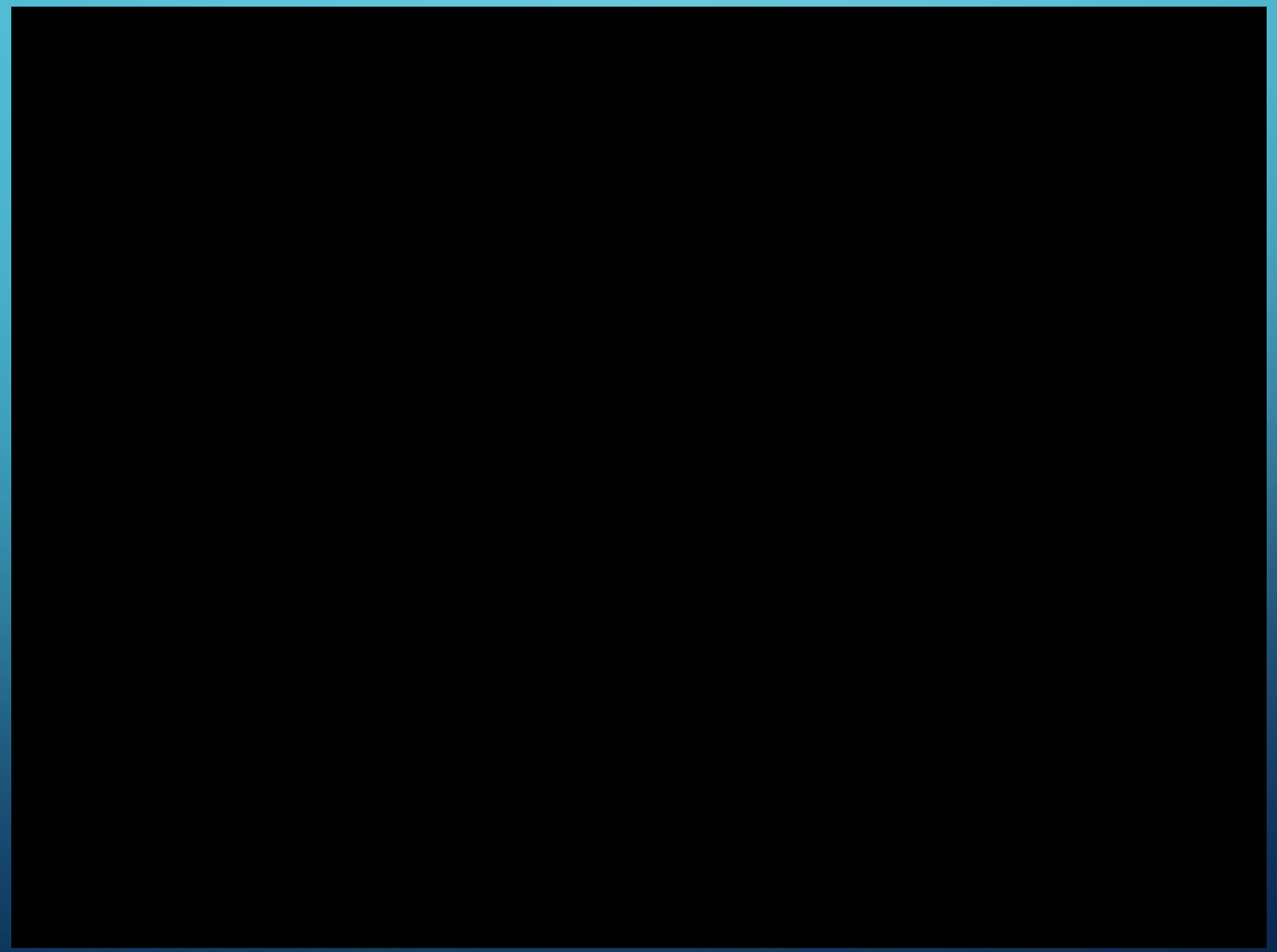


MGH Materials

1. Lidocaine and needle/syringe
2. Micropuncture needle
3. Micropuncture catheter
4. Sterile prep
5. Sterile drape
6. Sterile gauze
7. Micropuncture wire
8. T-piece
9. Suture
10. Scissors
11. Tegaderm
12. Needle driver

Procedural Steps

This video demonstrates correct placement of a femoral arterial line on the SimuLab FemoraLineMan System



Procedural Steps Summary:

1. Access the artery retrograde with an introducer needle using ultrasound – confirm pulsatile blood flow through the needle
2. Insert a guidewire through the needle to maintain access to the artery
3. Remove introducer needle over the wire
4. Insert an arterial catheter into the vessel over the wire and hub the catheter to the skin
5. Remove the guidewire
6. Confirm pulsatile blood flow from the catheter
7. Attach the catheter to a T-piece or pressure tubing
8. Secure catheter to skin with suture
9. Place a sterile covering over the access point and catheter

***Here, we describe the Seldinger technique, but a modified Seldinger technique with integrated needle-catheter units may also be used.**

Complications

Ultrasound-guided access halves the rate of complications for femoral arterial access as compared to traditional palpation techniques.[1]

Rates of access site complications for ultrasound-guided femoral artery line placement have been reported at <3-4%.

[1] Sobolev, M., Slovut, D. P., Lee Chang, A., Shiloh, A. L., & Eisen, L. A. (2015). Ultrasound-Guided Catheterization of the Femoral Artery: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. *The Journal of Invasive Cardiology*, *27*(7), 318–323.

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- Hematoma
  - May be seen in as high as 6% of femoral catheterizations.[2]
  - Ultrasound guidance reduces the risk of hematoma by 49%.[3]

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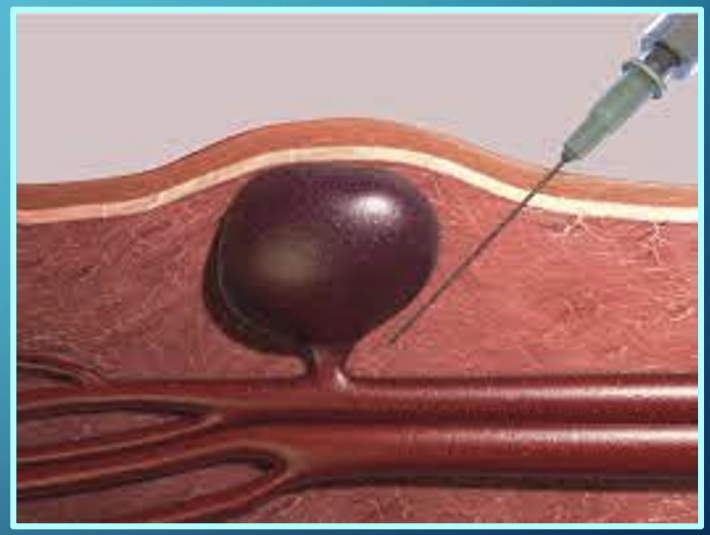
[2] Scheer, B., Perel, A., & Pfeiffer, U. J. (2002). Clinical review: complications and risk factors of peripheral arterial catheters used for haemodynamic monitoring in anaesthesia and intensive care medicine. *Critical Care / the Society of Critical Care Medicine*, *6*(3), 199–204.

[3] Gu, W.-J., Wu, X.-D., Wang, F., Ma, Z.-L., & Gu, X.-P. (2016). Ultrasound Guidance Facilitates Radial Artery Catheterization: A Meta-analysis With Trial Sequential Analysis of Randomized Controlled Trials. *Chest*, *149*(1), 166–179.

Complications

- Pseudoaneurysm:
  - Though rare, occurs when a walled-off collection of blood forms in communication with the arterial lumen
  - Risk factors include obesity and inadequate manual compression following arterial line removal, such as with a distal stick in the superficial femoral artery



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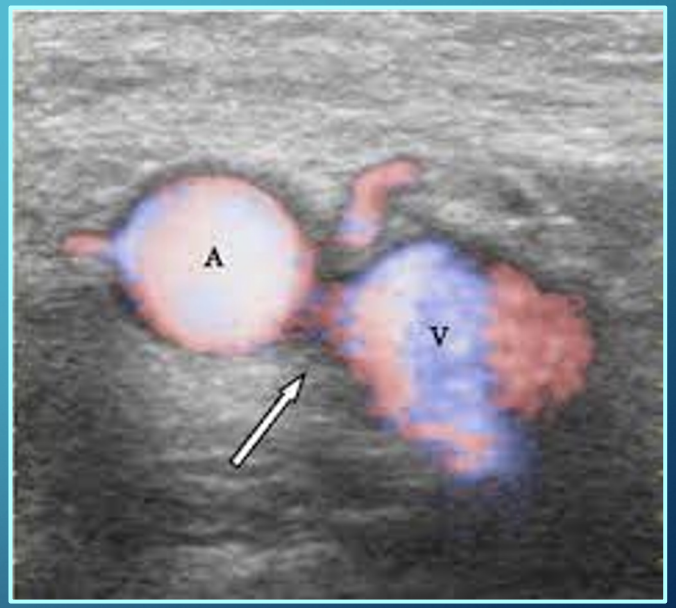
- Arteriovenous fistula:
  - An abnormal communication between the femoral artery and vein that may occur due to multiple punctures, through and through punctures from vein to artery, or with a distal stick



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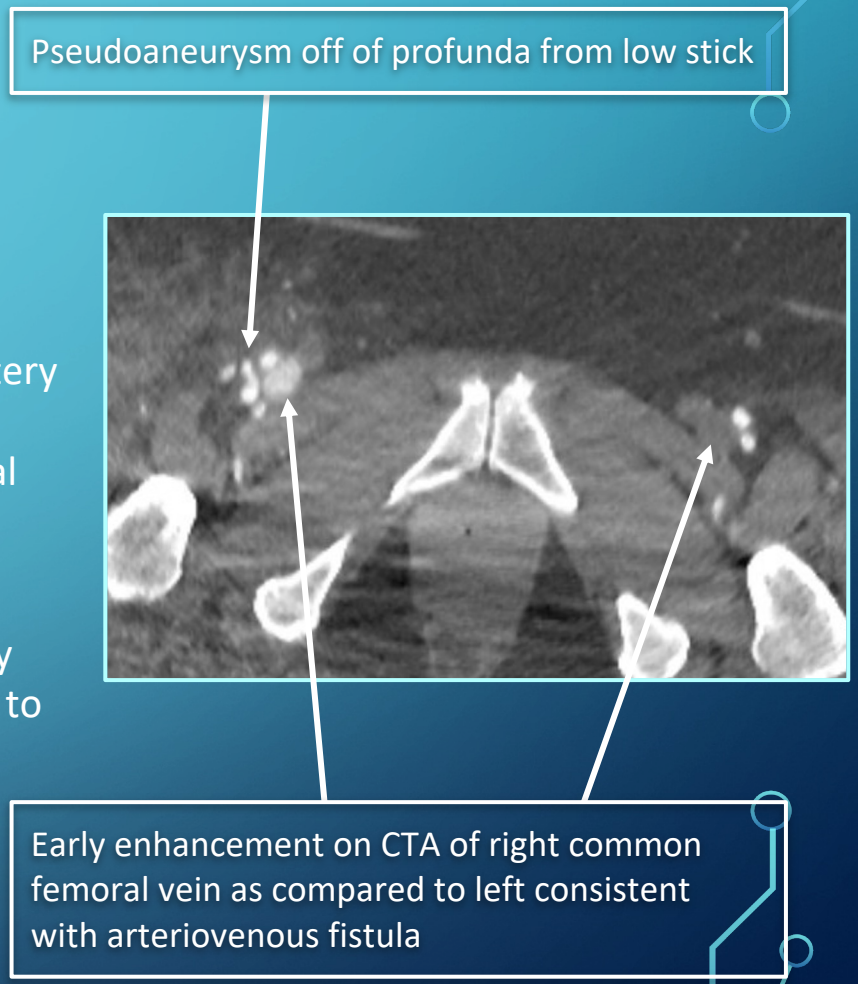

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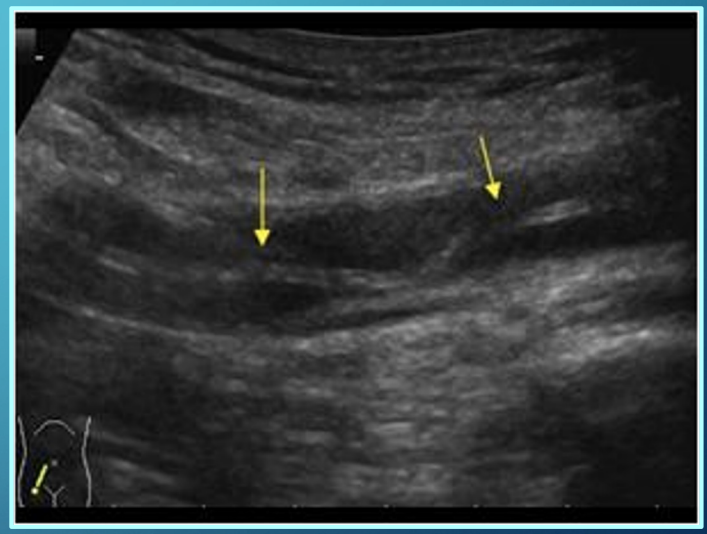
- Dissection:
  - Occurs due to the needle or guidewire entering a dissection plane between the intima and media
  - Frequently asymptomatic, but rarely may propagate resulting in thrombosis or acute limb ischemia



Complications

- Infection:
  - Infection risk is higher for femoral arterial lines than for radial arterial lines
  - The incidence of catheter-related local infections is 3/1,000 catheter-days for femoral lines as compared to 0.75/1,000 catheter-days for radial lines
  - The incidence of catheter-related blood stream infections is 1.92/1,000 catheter-days for femoral lines as compared to 0.25/1,000 catheter days for radial lines[1]

[1] Lorente, L., Santacreu, R., Martín, M. M., Jiménez, A., & Mora, M. L. (2006). Arterial catheter-related infection of 2,949 catheters. *Critical Care / the Society of Critical Care Medicine*, *10*(3), R83.

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  - The incidence of catheter-related blood stream infections is 1.92/1,000 catheter-days for femoral lines as compared to 0.25/1,000 catheter days for radial lines[1]
- Thrombotic/Embolic Events ± Limb Ischemia:
  - The rate of thrombosis is higher for radial arterial lines (20%) as compared to femoral arterial lines (1.5%)
  - Risk factors include small vessel diameter, female sex, low cardiac output, multiple cannulation attempts, and catheter duration >72 hours[2]

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  - Infection risk is higher for femoral arterial lines than for radial arterial lines
  - The incidence of catheter-related local infections is 3/1,000 catheter-days for femoral lines as compared to 0.75/1,000 catheter-days for radial lines
  - The incidence of catheter-related blood stream infections is 1.92/1,000 catheter-days for femoral lines as compared to 0.25/1,000 catheter days for radial lines[1]
- Thrombotic/Embolic Events ± Limb Ischemia:
  - The rate of thrombosis is higher for radial arterial lines (20%) as compared to femoral arterial lines (1.5%)
  - Risk factors include small vessel diameter, female sex, low cardiac output, multiple cannulation attempts, and catheter duration >72 hours[2]
- Pain:
  - May occur secondary to needle puncture of femoral nerve or compression by pseudoaneurysm/hematoma
  - Incidence of peripheral nerve injury is <1% for femoral access as compared to nearly 9% for brachial/axillary access[3]

[1] Lorente, L., Santacreu, R., Martín, M. M., Jiménez, A., & Mora, M. L. (2006). Arterial catheter-related infection of 2,949 catheters. *Critical Care / the Society of Critical Care Medicine*, *10*(3), R83.
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Removal

- Prior to removal, ensure that the patient does not have significant coagulopathy or on anticoagulation that may warrant correction prior to removal or need for longer manual pressure.

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- While applying pressure, remove the arterial catheter, and subsequently, maintain direct pressure over the access site for a minimum of 15 minutes.

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- While applying pressure, remove the arterial catheter, and subsequently, maintain direct pressure over the access site for a minimum of 15 minutes.
- Afterwards, gently release pressure – if there is continued bleeding, hold pressure for 5-10 more minutes before checking again.

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- Prior to removal, ensure that the patient does not have significant coagulopathy or on anticoagulation that may warrant correction prior to removal or need for longer manual pressure.
- Once ready to remove, optimize patient positioning (e.g. make sure groin is flat and bed is low) to allow for direct pressure over the access site.
- While applying pressure, remove the arterial catheter, and subsequently, maintain direct pressure over the access site for a minimum of 15 minutes.
- Afterwards, gently release pressure – if there is continued bleeding, hold pressure for 5-10 more minutes before checking again.
- Once hemostasis has been achieved, apply a small transparent dressing over the access site to allow for visualization of hematoma formation.

Module Conclusion

Thank you for completing this module.

You will be invited to participate in an in-person simulation training within the next few days to apply the skills learned here.

Please contact Alaska Pendleton, MD at aapendleton@partners.org if you have any questions or comments.

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