Vascular access: Radial and femoral

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Part 1: Femoral access

Common believes

- Groin access is considered bread and butter for cardiologist
- It is easy because it is “big”
- Usually it is the job of the junior fellows
- We seldom need groin access as we are proficient in radial access

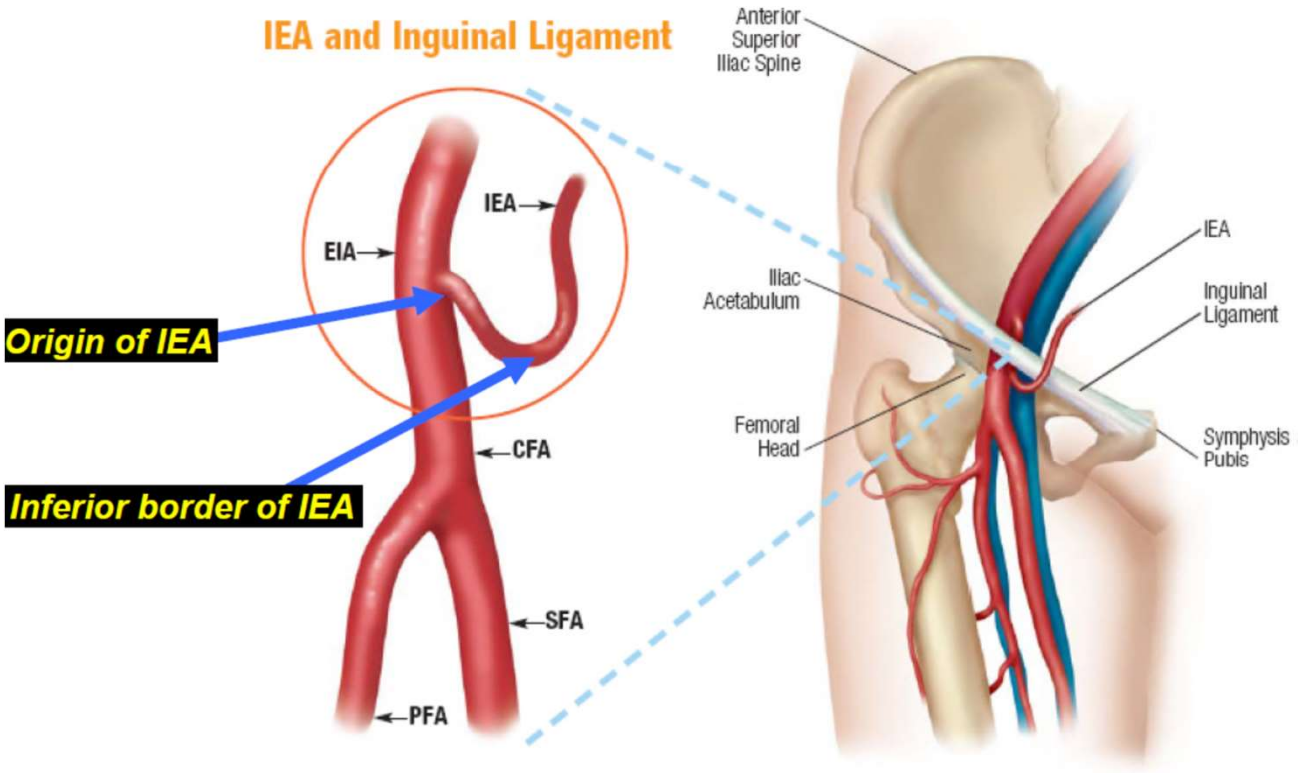
Femoral access

- Femoral access is still required in some complex coronary procedures and IABP
- Large bore access for impella or TAVI can only be done from the groin
- Big sheath management is now a basic requirement for training in interventional cardiologist
- Complications are more frequent in femoral access and potentially life-threatening
- Knowledge on endovascular management of vascular complications is essential for every independent interventional cardiologist

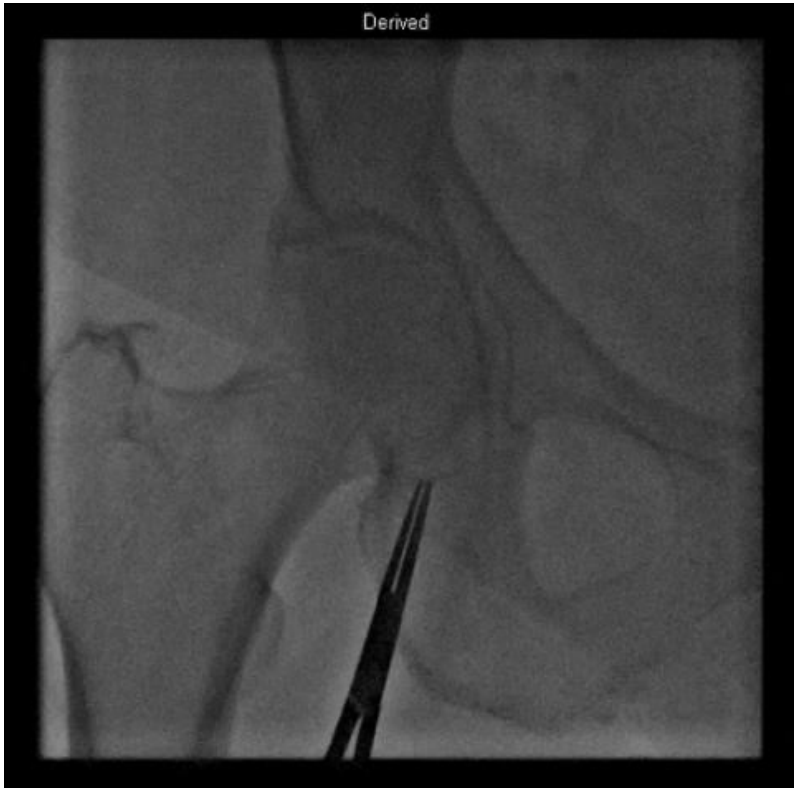
Vascular access complications

- Risk factors: female sex, extremes of weight, renal insufficiency, anticoagulation and use of GpIIbIIIa
- Cannulation above the inguinal ligament is associated with RPH
- Cannulation below bifurcation is associated with pseudo-aneurysm and AV fistula

Anatomy of the femoral region



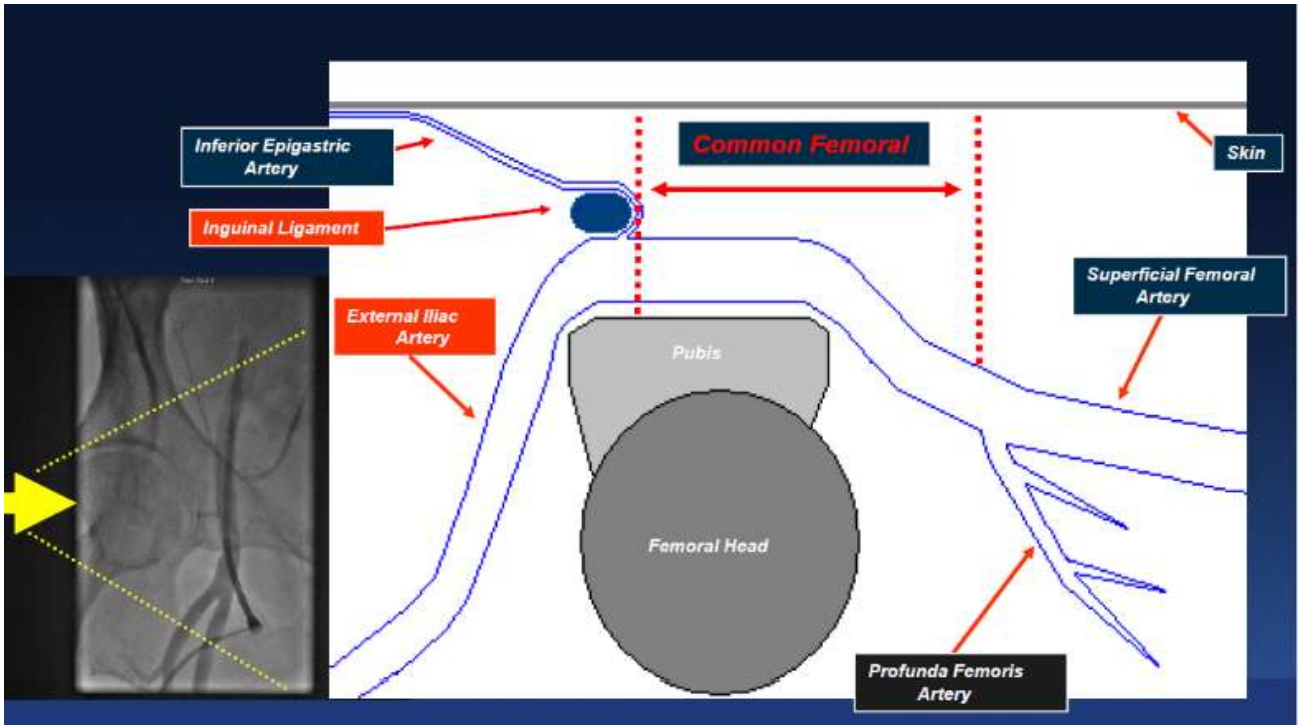
This is how you were taught to get femoral access



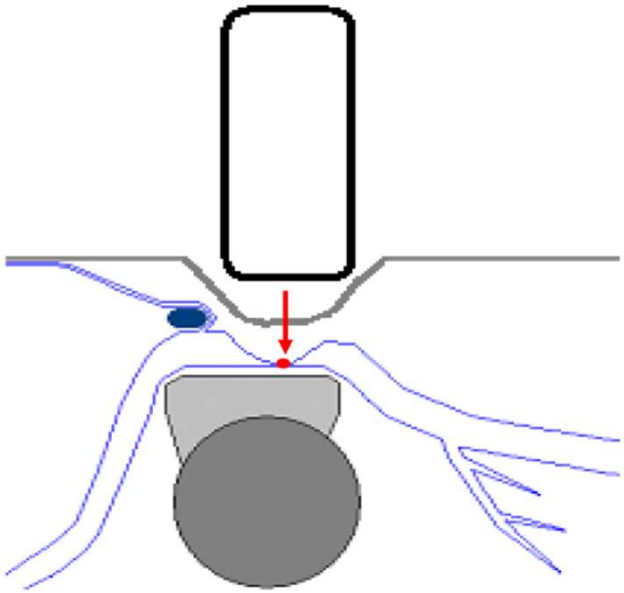
Fluroscopic guidance

- Based on the observation that 65% of femoral artery bifurcations occur below the inferior border of the femoral head
- Despite nonrandomized date supporting its use, RCTs failed to demonstrate a benefit for fluoroscopic guidance

Lateral diagram of femoral region

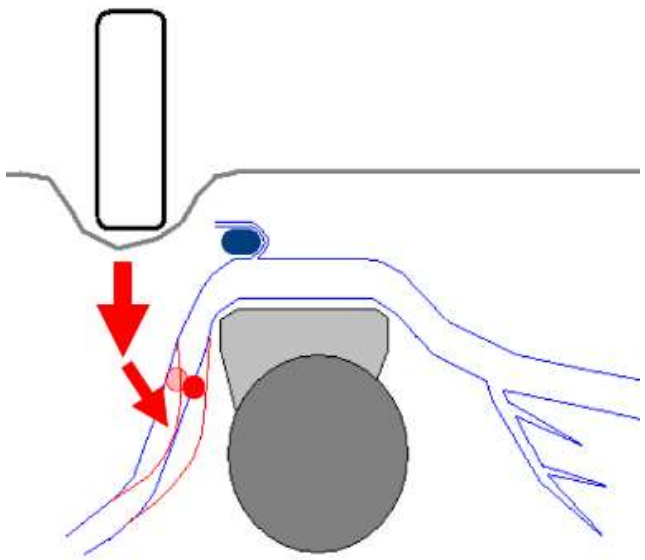


Correct stick



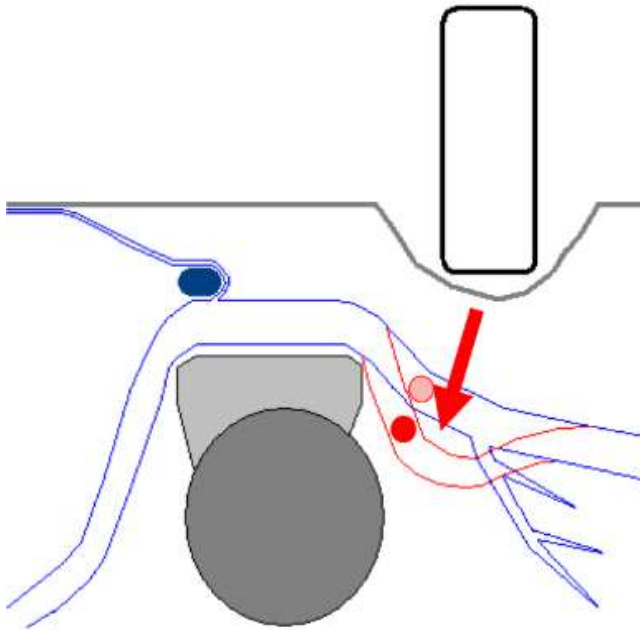
- External compression controls access site due to presence of bony structure

High stick



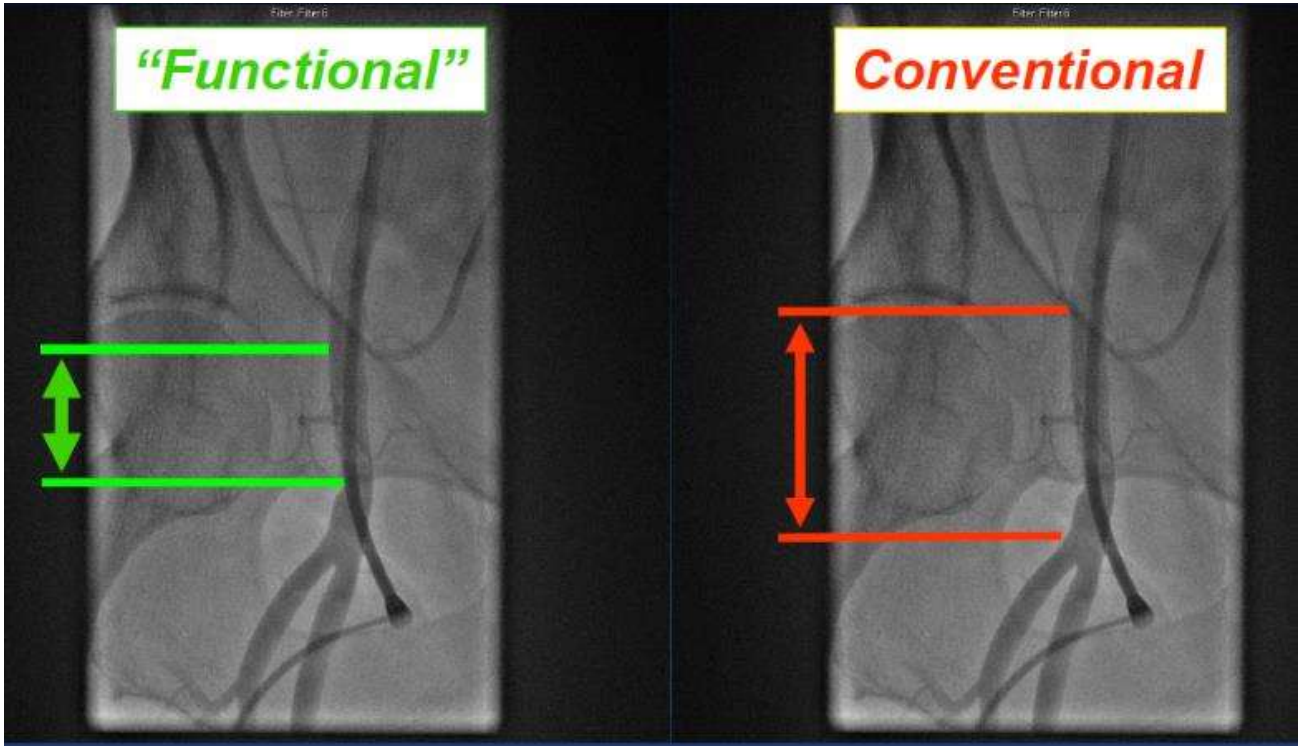
- External compression fails to control high access bleeding due to lack of bony structure to compress against

Low stick

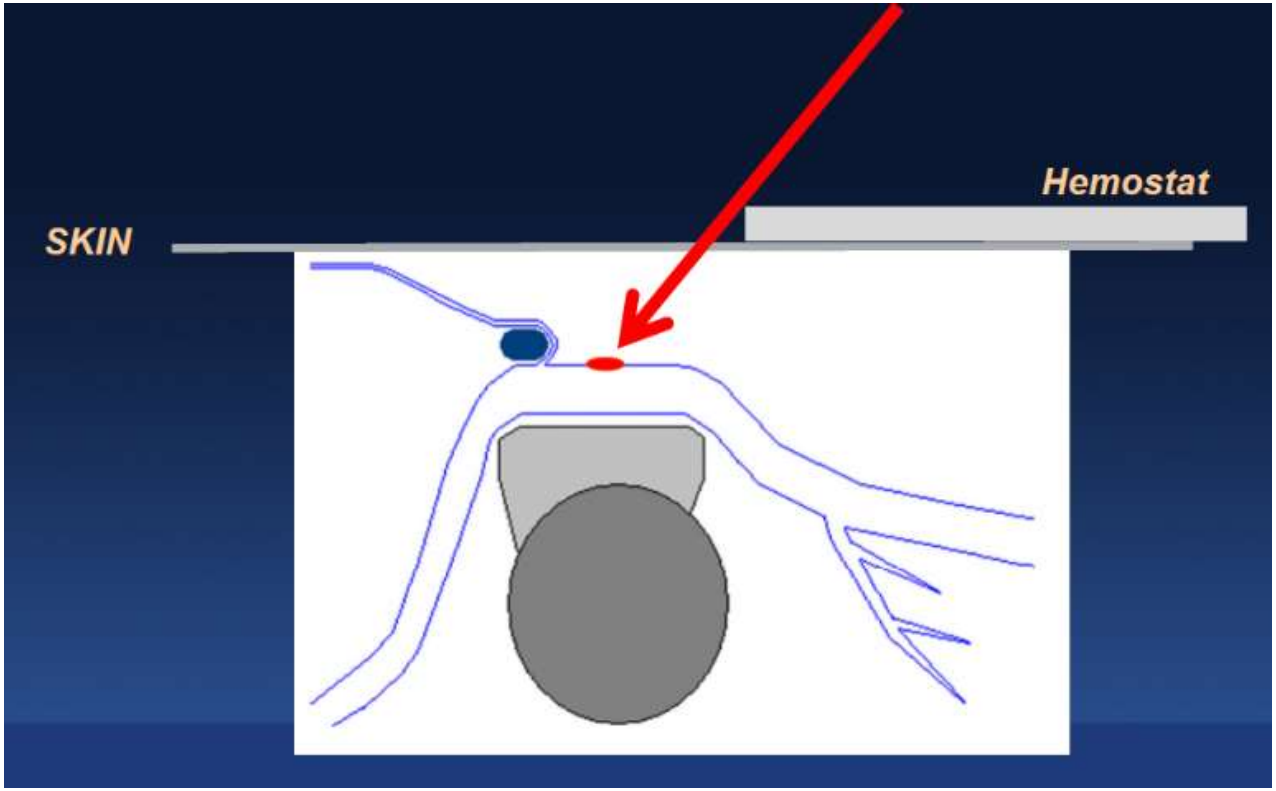


- External compression fails to control low access site bleeding due to lack of bony structure to compress against

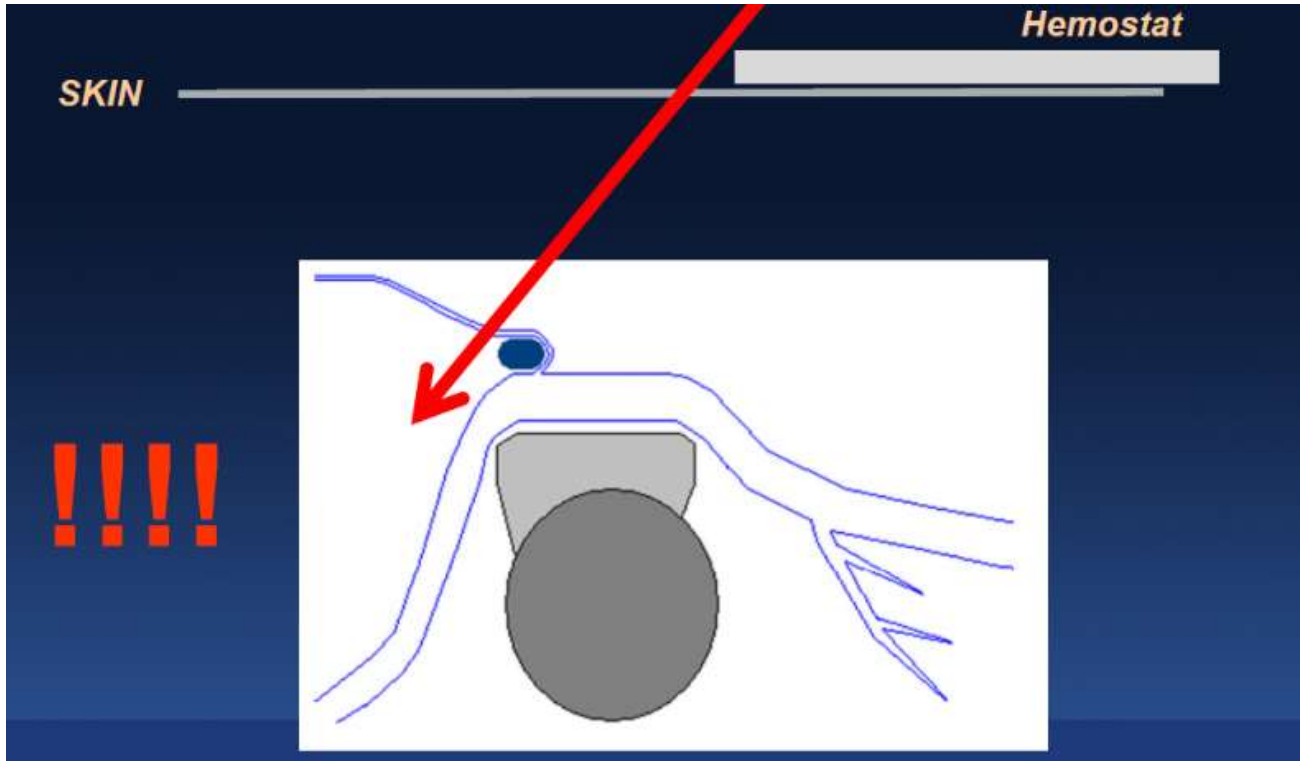
The common femoral artery



Thin patient

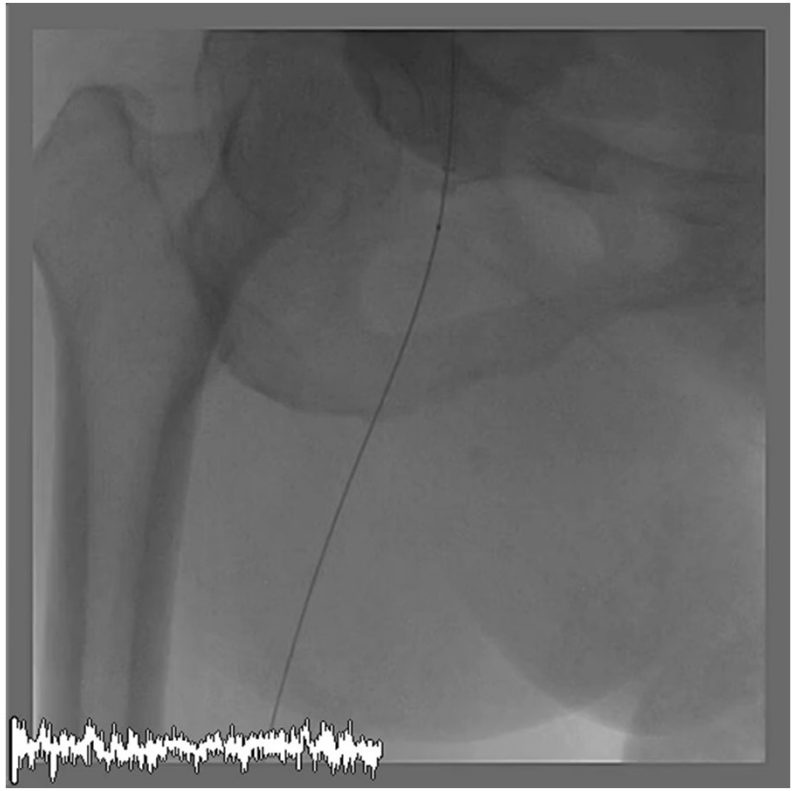


Obese patient

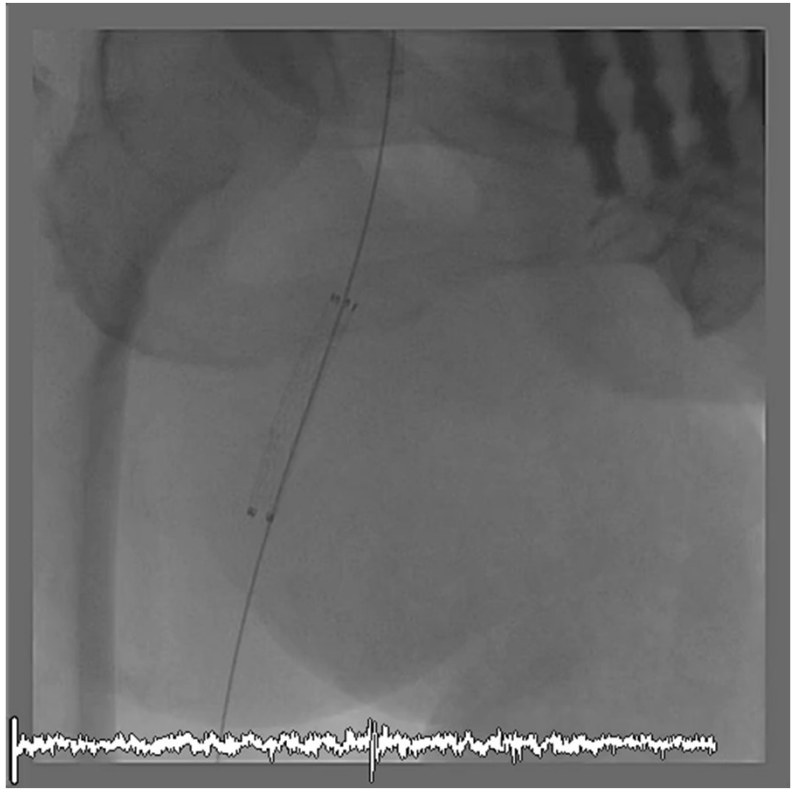


Case 1

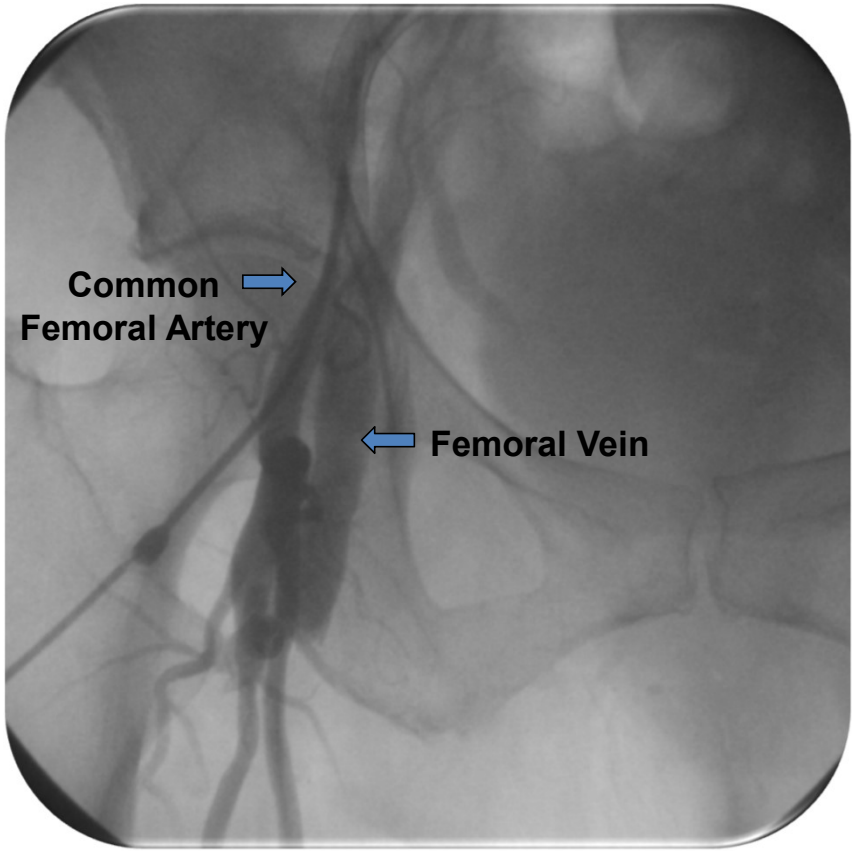
- F/83
- ADLi
- Known HT, DM, AF, CHF, hx of PRB on anticoagulation, obesity (BMI = 35)
- Admitted for LAAO with Watchman device
- After the sheath removal with figure of 8 stitch, patient developed growing hematoma in right groin



Fluency 6x40mm deployed



Femoral Artery Complication: AV Fistula

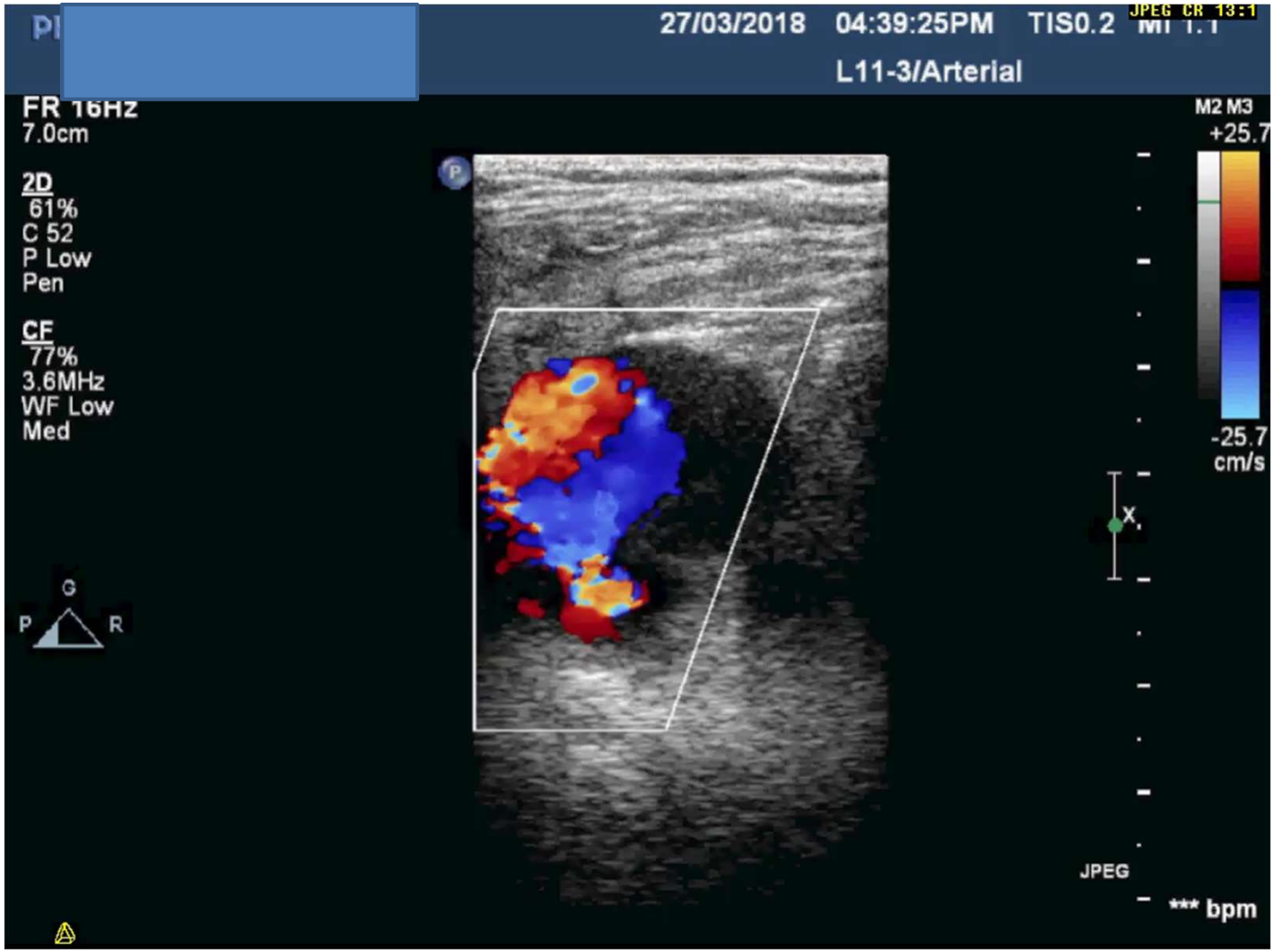


RAO View

- Incidence: ≤ 0.4%
- Risk factors:
  - Low femoral puncture
  - Puncture of overlying vein
  - Ineffective manual compression
- Signs: Bruit, swelling
- Treatment:
  - Small - observation and serial ultrasound
  - Large - ultrasound guided compression
    - Surgical
    - Covered stent
    - Balloon tamponade

Case 2

- M/60
- Known HT, DM, symptomatic PAF for AF albation
- Painful left groin swelling with bruit the next day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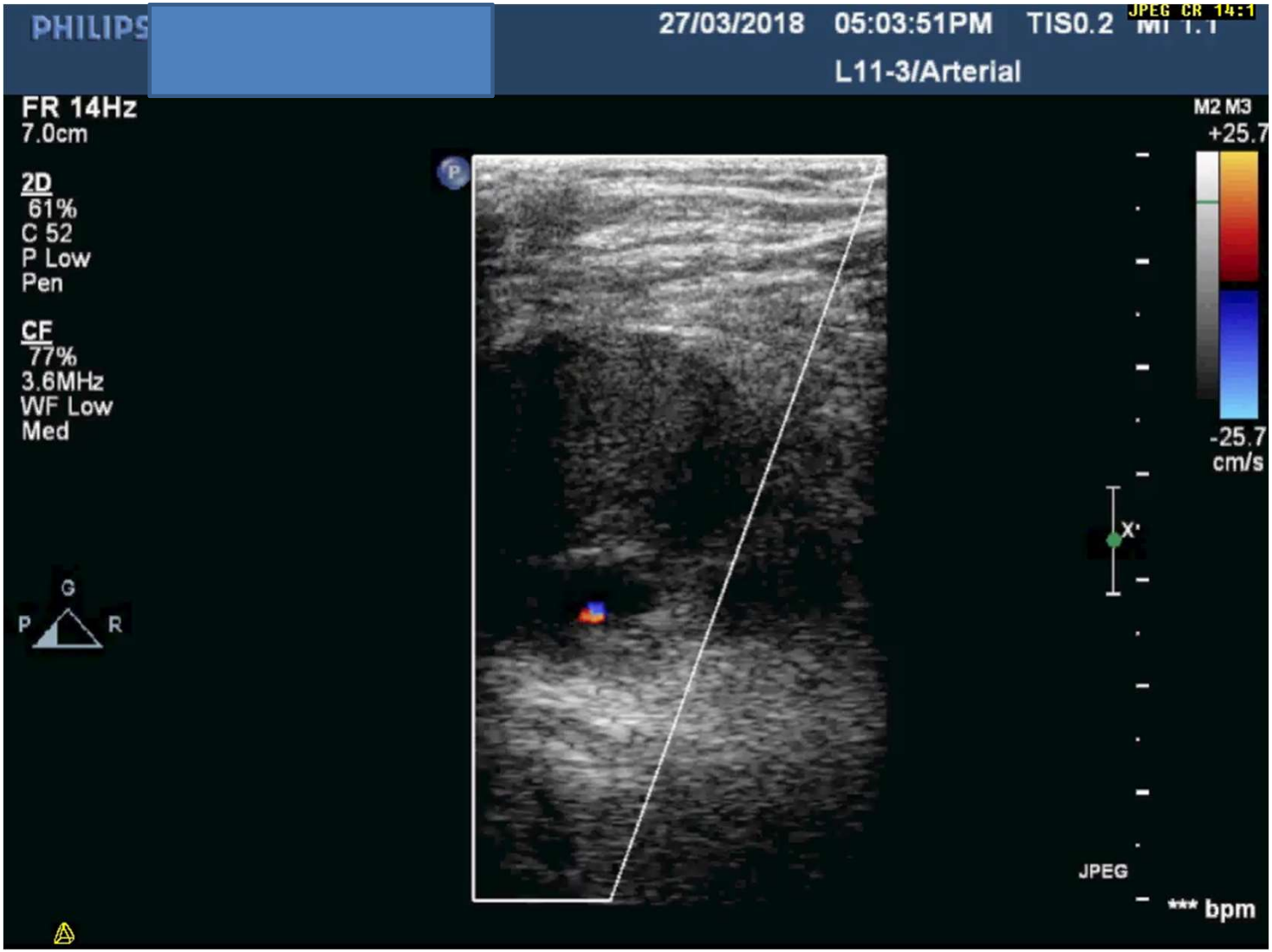
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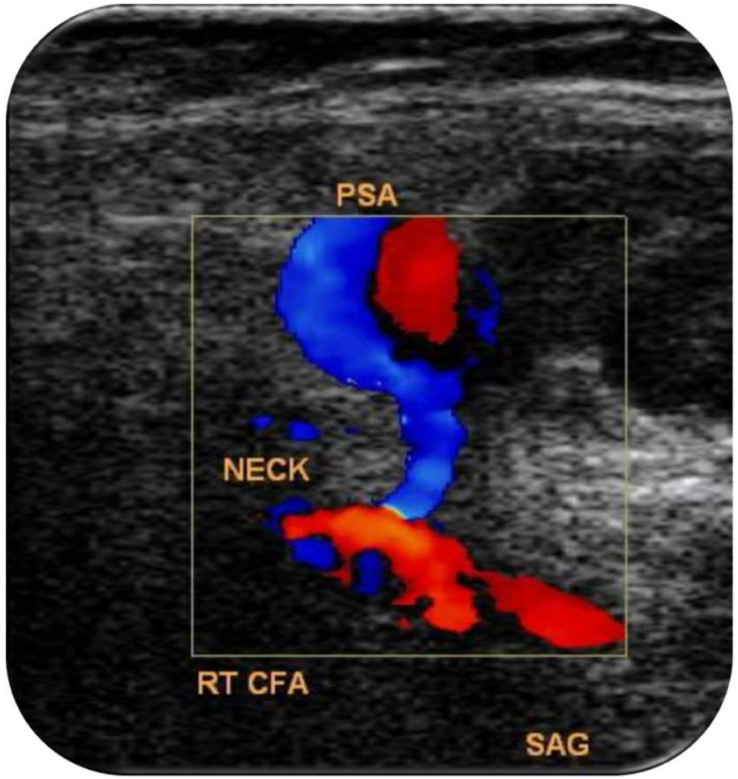
Femoral Artery Complication: Pseudoaneurysm



- Incidence: 1-3%
- Symptoms: Pain, swelling
- Physical Exam: Pulsatile swelling, bruit
- Risk Factors: Low femoral puncture, ineffective manual compression
- Diagnosis: Ultrasonogram
- Treatment:
  - Small (≤ 2 cm) - observation and serial ultrasonography
  - Large - ultrasound guided compression (30-300 mins)/thrombin injection
    - surgical repair

Case 3

- F/20
- Known ASD with dilated right heart
- Admitted for ASD occluder
- Difficult venous access with multiple sticks
- Finally got the femoral vein access and ASD occluder was successfully implanted
- Complained of lower abdominal pain and hypotension

CT abdomen


Se:4
Im:27
[A]
Study Date:21/2/2017
Study Time:16:42:53
MRN:
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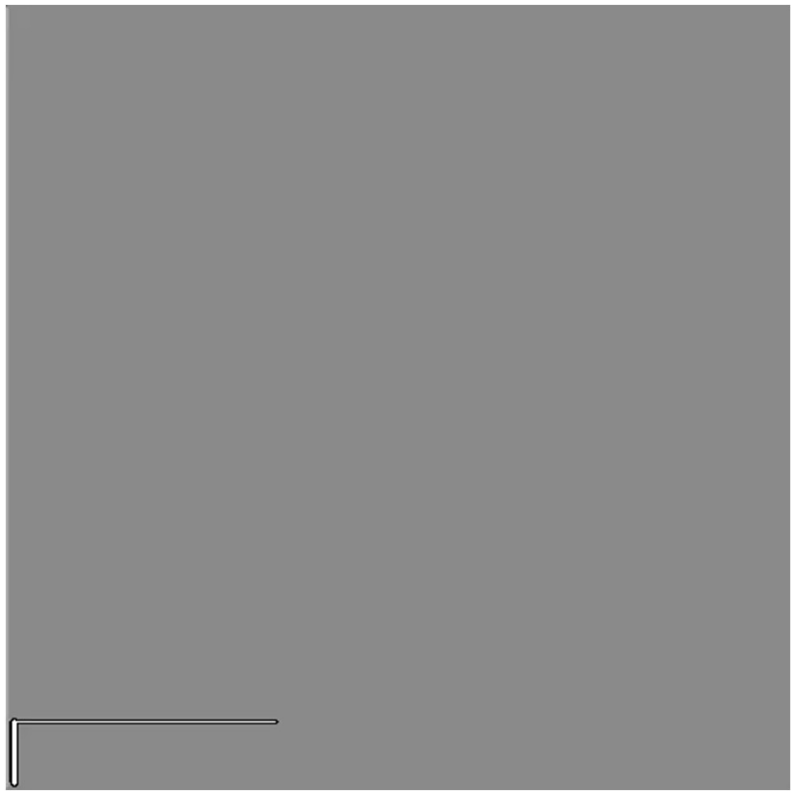
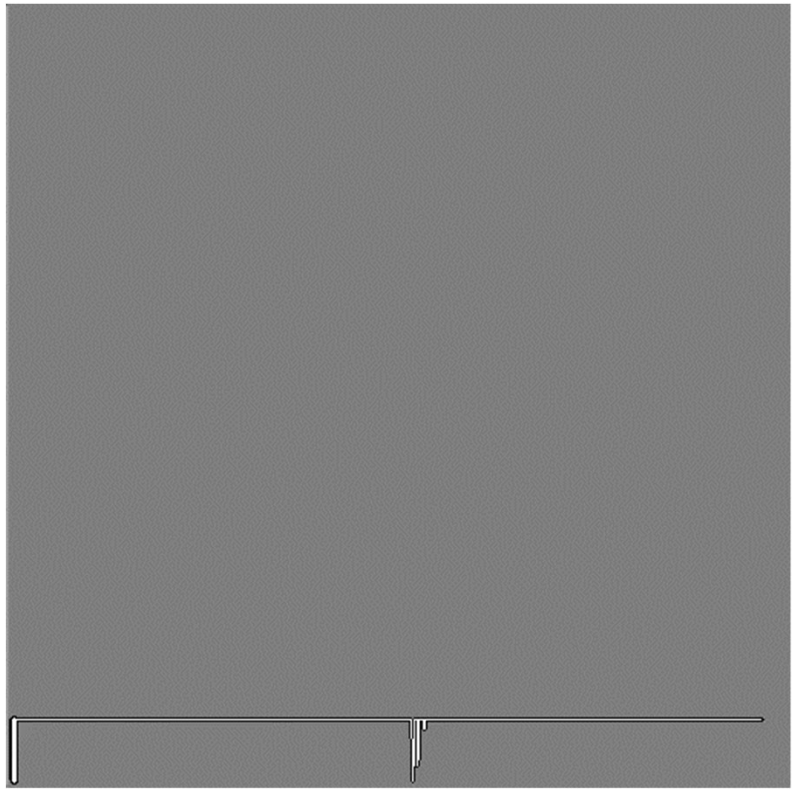
OMNI300 100ML
[P]
C40
W400





Retroperitoneal Hemorrhage

- Incidence: < 1-3%
- Risk Factors: High puncture, use of glycoprotein IIb-IIIa inhibitors, posterior wall puncture
- Symptoms: Flank/back pain
- Physical Exam: Hypotension, tachycardia, Turner’s sign, Cullen's sign
- Diagnosis: Clinical suspicion, CT abdomen and pelvis, conventional angiogram +/- intervention
- Treatment:
  - Fluid resuscitation and blood transfusion
  - Contralateral access, balloon tamponade, coil embolization, covered stent
  - Surgery

Femoral Artery Complication: Limb Ischemia

- Incidence: ≤ 1.0%
- Risk Factors: Small caliber artery (women, those with PAD, diabetics), using larger size sheaths, or superficial femoral or profunda cannulation
- Signs and Symptoms: 5 Ps- Pain, Pallor, Paresthesia, Pulselessness, Power (loss)
- Treatment:
  - Contralateral access and angiography and possible angioplasty and stenting
  - Intra-arterial fibrinolytics
  - Surgery

Infections

- 0.8%
- Median incubation: 8 days
- Staph aureus 76%
- DM 80%
- PSA 42%
- 6% mortaliy

Tips and tricks on femoral access

History and physical exam

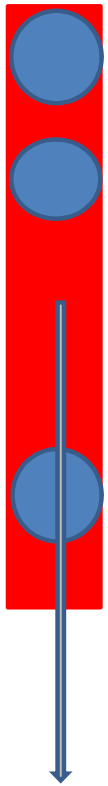
- Evaluate for symptoms of PVD, prior vascular surgery/stenting, recent femoral access, surgery/radiation at the groin site and presence of active groin infection
- Palpate and auscultate bilateral femoral artery and peripheral pulses +/- doptone
- Choose the side with the stronger pulse
- If femoral pulses are equal, choose the side with the stronger peripheral pulse

Contraindications/caution

- Absent/weak femoral arterial pulse
- Ilio-femoral bypass grafts
- Prior femoral access site complication (dissection, PA, ischemic limb)
- Active groin infection
- Prior groin surgery (excessive scarring), radiation therapy
- Known aneurysms of the ilio-femoral or aorto-iliac system
- Morbidly obese

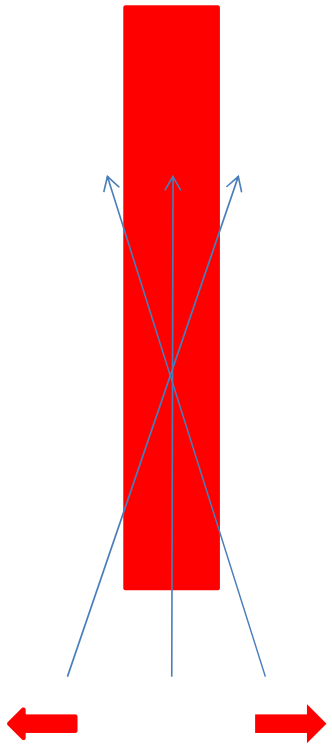
Landing an aircraft carrier

Femoral stick



- 3 fingers to locate the artery course
- Align the needle along the course of artery
- Feel the pulsation transmitted from the needle
- Observe the movement of the needle end

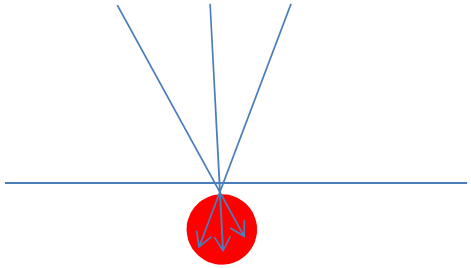
“Nodding” sign



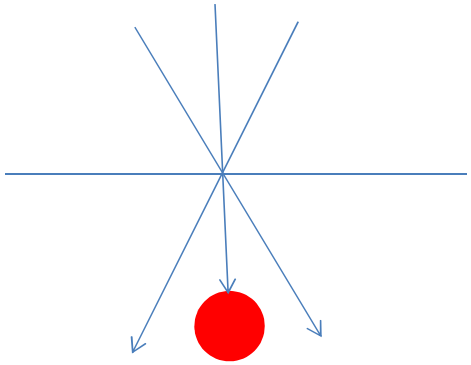
- Needle on the left side:
  - End of needle move right, then left
- Needle on the right side:
  - End of needle move left, then right
- Needle on top of the artery
  - Needle nods to you

Femoral artery

Superficial in thin patient

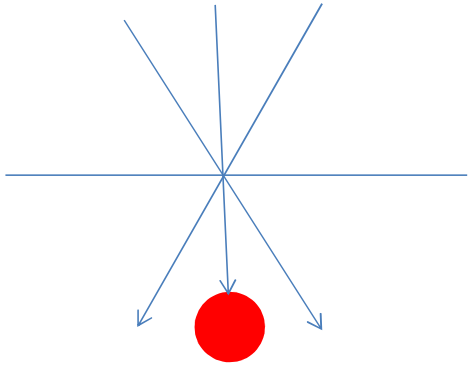


Deep in obese patient

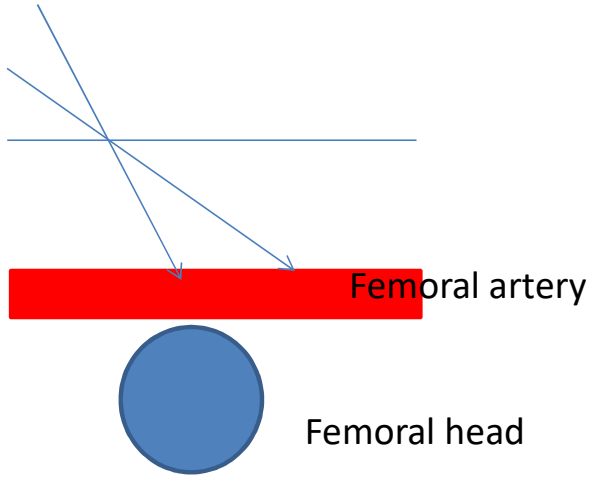


Femoral artery

Cross section



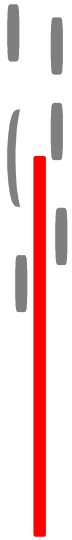
Longitudinal



Site of needle entry depends on the entry point, angle of attack and the depth of artery.

Puncture by using calcium as landmark

Calcification as landmark



- Femoral artery sometime not well palpable if artery is heavily calcified
- Align the needle parallel to the course of artery outline by calcium
- Advance the needle under screening by fluoroscopy

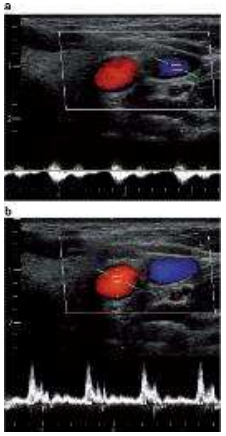
USG guided puncture

Static Vs Dynamic USG guidance

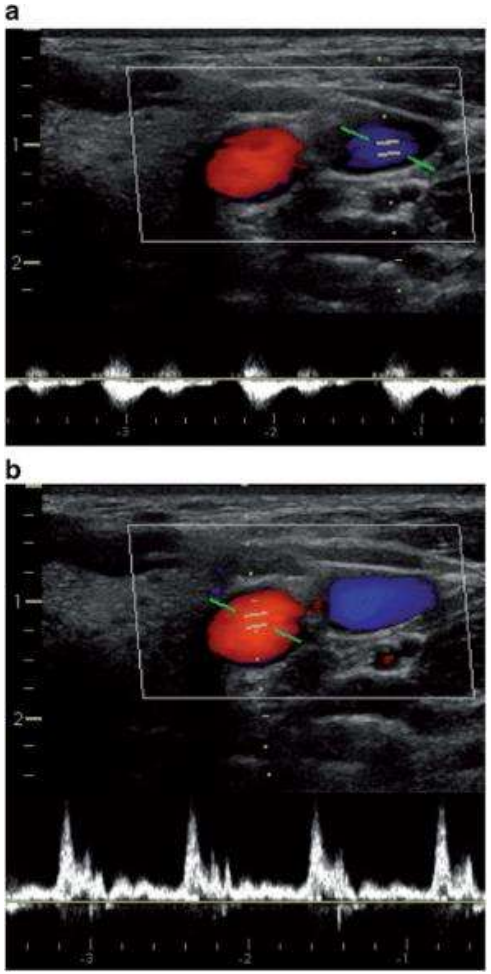
- Static approach is to determine the vessel location and patency, mark the local for needle entry
- Dynamic approach is to perform the real time USG to observe the needle entry and placement
- Dynamic approach is usually recommended than static approach

Differentiate arteries from veins

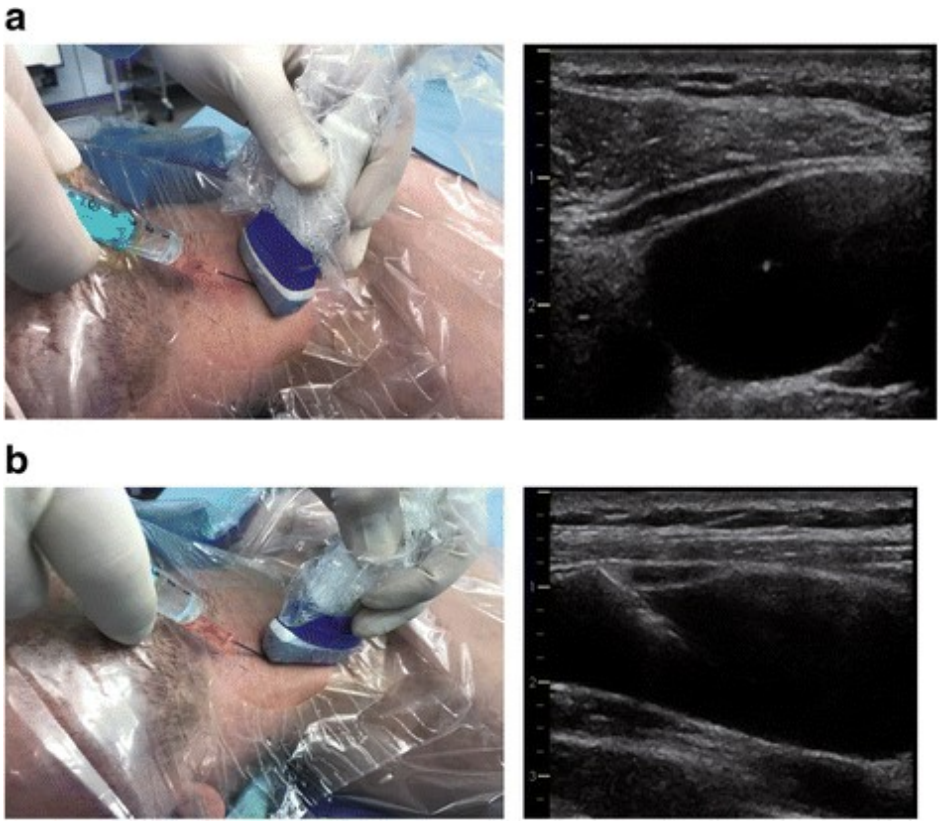
- Arteries are less compressible than vein, but both are compressible with enough pressure
- Arteries have a thicker wall and slightly more hyperechoic walls than veins
- PW doppler to diffentiate between artery and vein



PW Doppler to differentiate artery and vein

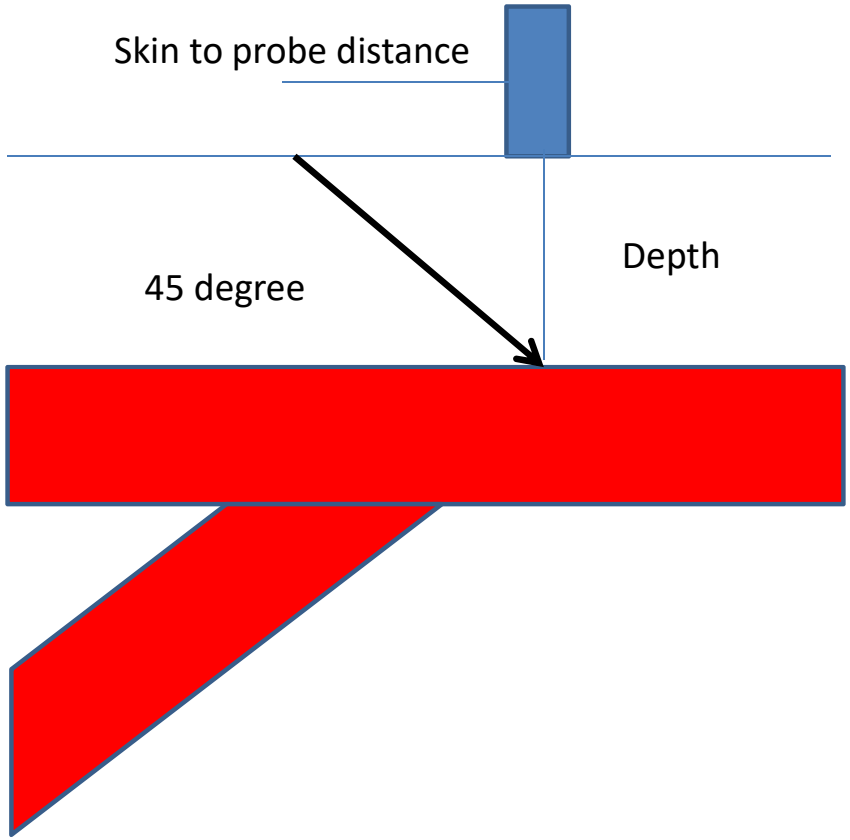


Short Axis (a) Vs Long Axis (b)

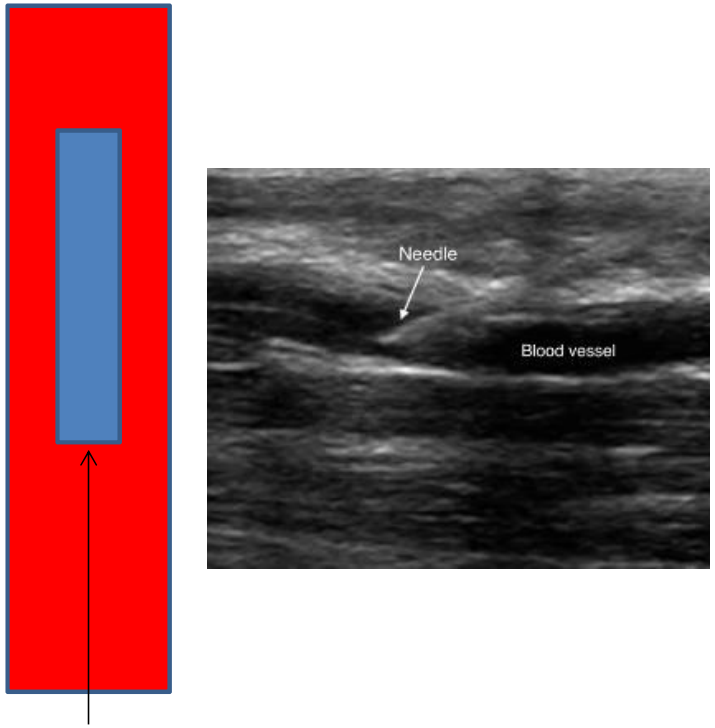


Short Axis

Skin to probe distance = depth of artery

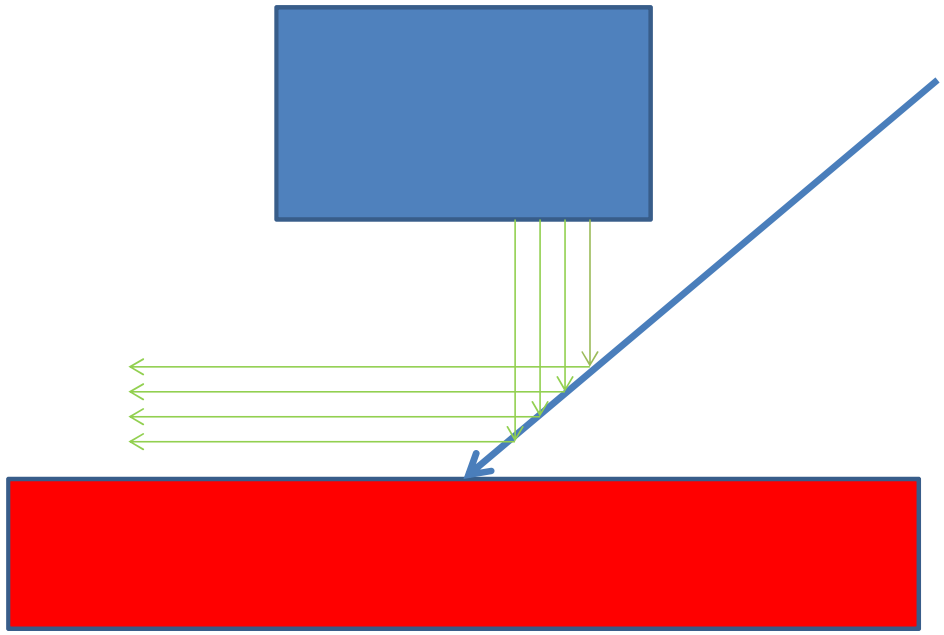


Long axis approach



- It can visualize the whole needle track
- Shallow angle of attack is recommended to enhance needle visualization

USG reflected away from probe



Part 2: Radial access

RCTs

- RIVAL trial (stable and ACS)
- RIFLE-STEACS trial (STEACS)
- MATRIX trial (ACS)
- Meta-analysis

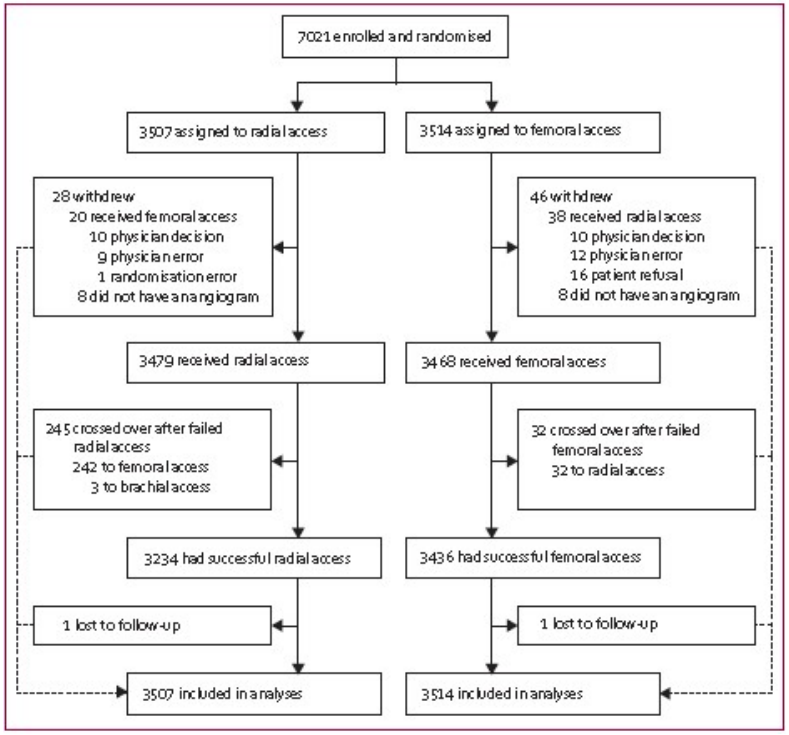
A randomized comparison of RadIal Vs. femorAL access for coronary intervention in ACS (RIVAL)

SS Jolly, S Yusuf, J Cairns, K Niemela, D Xavier, P Widimsky, A Budaj, M Niemela, V Valentin, BS Lewis, A Avezum, PG Steg, SV Rao, P Gao, R Afzal, CD Joyner, S Chrolavicius, SR Mehta on behalf of the RIVAL investigators

Lancet 2011; 377: 1409–20

Courtesy: Sanjit Jolly, MD

RIVAL Trial



	Radial (n=3507)	Femoral (n=3514)
Demographics		
Age (years)	62 (12)	62 (12)
Age >75 years	506 (14·4%)	529 (15·1%)
Men	2599 (74·1%)	2561 (72·9%)
Diagnosis at admission		
Unstable angina	1554 (44·3%)	1606 (45·7%)
NTSTEMI	998 (28·5%)	905 (25·8%)
STEMI	955 (27·2%)	1003 (28·5%)
Ethnic origin		
European	2558 (72·9%)	2575 (73·3%)
Black	18 (0·5%)	32 (0·9%)
South Asian	483 (13·8%)	475 (13·5%)
East Asian	149 (4·2%)	137 (3·9%)
Other	299 (8·5%)	293 (8·3%)
History		
Present smoker	1083 (30·9%)	1097 (31·2%)
Hypertension	2118 (60·4%)	2076 (59·1%)
Diabetes mellitus	781 (22·3%)	722 (20·5%)
Myocardial infarction	658 (18·8%)	622 (17·7%)
PCI	431 (12·3%)	408 (11·6%)
Coronary artery bypass graft surgery	79 (2·3%)	75 (2·1%)
Peripheral vascular disease	91 (2·6%)	82 (2·3%)

Sanjit S Jolly et al. RIVAL trial Group Lancet 2011;377: 1409-20

RIVAL Trial

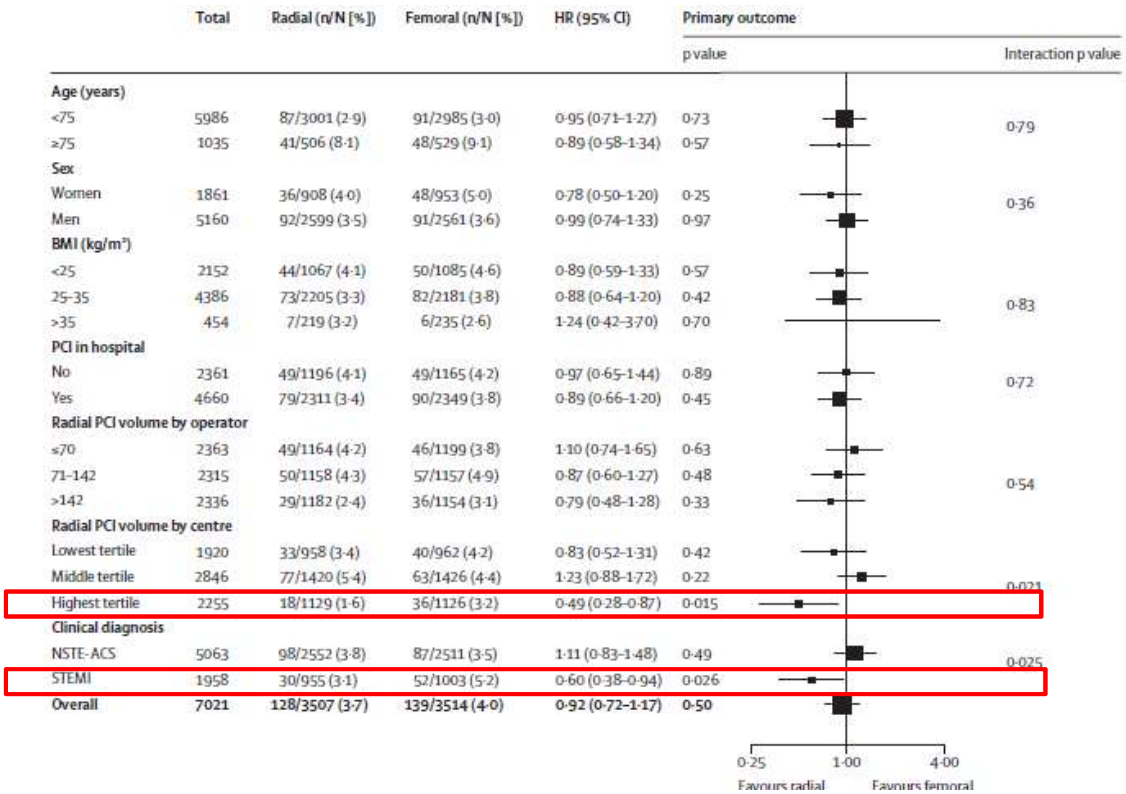
Primary Outcomes at 30 Days

	Radial (n=3507) %	Femoral (n=3514) %	HR	95% CI	P
Death, MI, Stroke, Non-CABG Major Bleed	3.7	4.0	0.92	0.72-1.17	0.50

	Radial (n=3507)	Femoral (n=3514)	Hazard ratio (95% CI)	p value
Secondary outcomes at 30 days				
Death, MI, or stroke	112 (3·2%)	114 (3·2%)	0·98 (0·76–1·28)	0·90
Non-CABG major bleeding	24 (0·7%)	33 (0·9%)	0·73 (0·43–1·23)	0·23
Death	44 (1·3%)	51 (1·5%)	0·86 (0·58–1·29)	0·47
MI	60 (1·7%)	65 (1·9%)	0·92 (0·65–1·31)	0·65
Stroke	20 (0·6%)	14 (0·4%)	1·43 (0·72–2·83)	0·30
Secondary outcomes at 48 h				
Death, MI, stroke, or non-CABG bleeding	50 (1·4%)	65 (1·8%)	0·77 (0·53–1·11)	0·17
Non-CABG major bleeding	11 (0·3%)	18 (0·5%)	0·61 (0·29–1·30)	0·20
Death	9 (0·3%)	15 (0·4%)	0·60 (0·26–1·37)	0·23
MI	29 (0·8%)	31 (0·9%)	0·94 (0·56–1·56)	0·80
Stroke	7 (0·2%)	6 (0·2%)	1·17 (0·39–3·48)	0·78

Sanjit S Jolly et al. RIVAL trial Group Lancet 2011;377: 1409-20

Subgroup Analysis



	Total	Radial (n/N [%])	Femoral (n/N [%])	HR (95% CI)	Primary outcome p value	Interaction p value
Age (years)						
<75	5986	87/3001 (2·9)	91/2985 (3·0)	0·95 (0·71–1·27)	0·73	0·79
≥75	1035	41/506 (8·1)	48/529 (9·1)	0·89 (0·58–1·34)	0·57	
Sex						
Women	1861	36/908 (4·0)	48/953 (5·0)	0·78 (0·50–1·20)	0·25	0·36
Men	5160	92/2599 (3·5)	91/2561 (3·6)	0·99 (0·74–1·33)	0·97	
BMI (kg/m²)						
<25	2152	44/1067 (4·1)	50/1085 (4·6)	0·89 (0·59–1·33)	0·57	
25–35	4386	73/2205 (3·3)	82/2181 (3·8)	0·88 (0·64–1·20)	0·42	0·83
>35	454	7/219 (3·2)	6/235 (2·6)	1·24 (0·42–3·70)	0·70	
PCI in hospital						
No	2361	49/1196 (4·1)	49/1165 (4·2)	0·97 (0·65–1·44)	0·89	0·72
Yes	4660	79/2311 (3·4)	90/2349 (3·8)	0·89 (0·66–1·20)	0·45	
Radial PCI volume by operator						
≤70	2363	49/1164 (4·2)	46/1199 (3·8)	1·10 (0·74–1·65)	0·63	
71–142	2315	50/1158 (4·3)	57/1157 (4·9)	0·87 (0·60–1·27)	0·48	0·54
>142	2336	29/1182 (2·4)	36/1154 (3·1)	0·79 (0·48–1·28)	0·33	
Radial PCI volume by centre						
Lowest tertile	1920	33/958 (3·4)	40/962 (4·2)	0·83 (0·52–1·31)	0·42	
Middle tertile	2846	77/1420 (5·4)	63/1426 (4·4)	1·23 (0·88–1·72)	0·22	0·021
Highest tertile	2255	18/1129 (1·6)	36/1126 (3·2)	0·49 (0·28–0·87)	0·015	
Clinical diagnosis						
NSTE-ACS	5063	98/2552 (3·8)	87/2511 (3·5)	1·11 (0·83–1·48)	0·49	0·025
STEMI	1958	30/955 (3·1)	52/1003 (5·2)	0·60 (0·38–0·94)	0·026	
Overall	**7021**	**128/3507 (3·7)**	**139/3514 (4·0)**	**0·92 (0·72–1·17)**	**0·50**	

Radial versus Femoral Randomized Investigation in ST Elevation Acute Coronary Syndrome

the RIFLE STEACS study

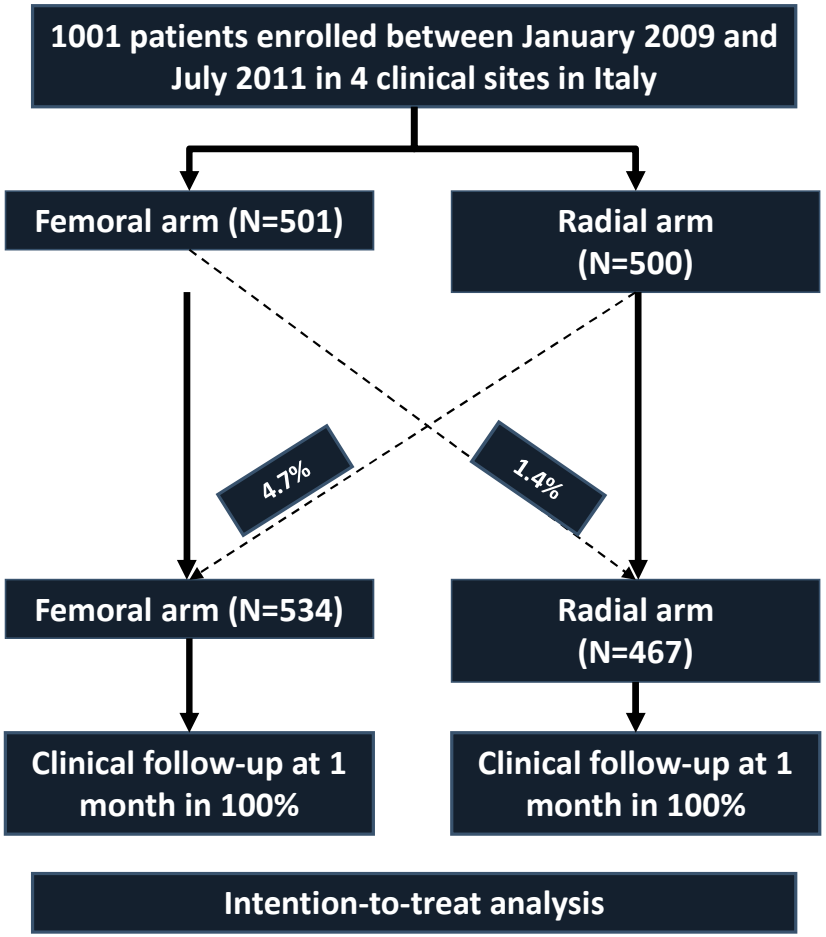
Principal investigators:
Enrico Romagnoli, MD PhD
Giuseppe Biondi-Zoccai, MD
Giuseppe Sangiorgi, MD

RIFLE STEACS - flow chart

Design

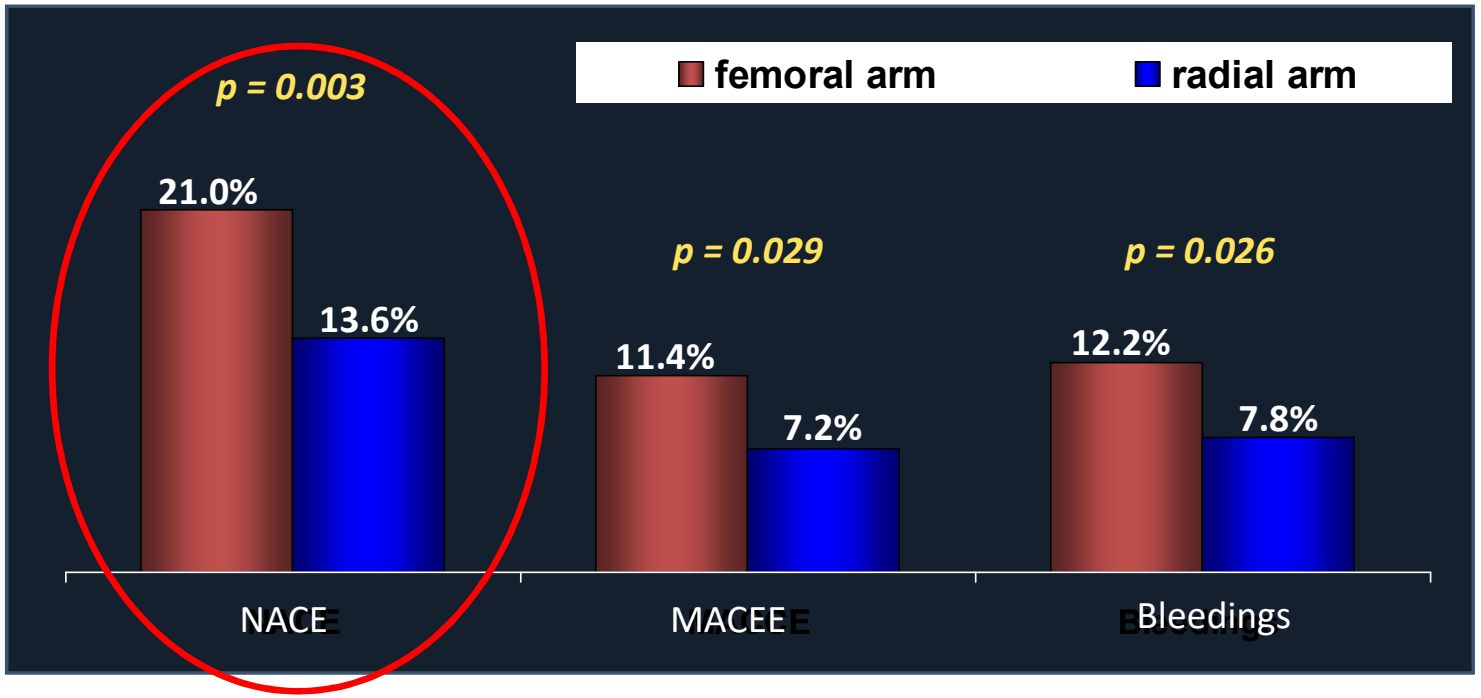
- **DESIGN:**
  Prospective, randomized (1:1), parallel group, multi-center trial.
- **INCLUSION CRITERIA:**
  all ST Elevation Myocardial infarction (STEMI) eligible for primary percutaneous coronary intervention.
- **ESCLUSION CRITERIA:**
  contraindication to any of both percutaneous arterial access.

  international normalized ratio (INR) > 2.0.



RIFLE STEACS - Results

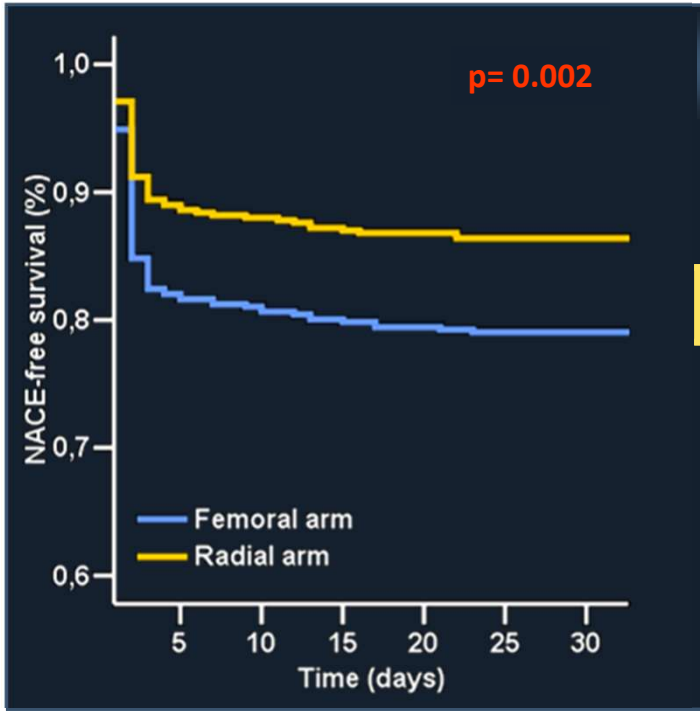
30-day NACE rate



- Net Adverse Clinical Event (*NACE*) = MACCE + bleeding
- Major Adverse Cardiac and Cerebrovascular event (*MACCE*) = composite of cardiac death myocardial infarction, target lesion revascularization, stroke

RIFLE STEACS – Results

30-day NACE predictors



	OR	CI 95%	p value
Female gender	1.5	(1.1-2.3)	0.037
CKD	2.1	(1.4-3.1)	0.001
Radial access	0.6	(0.4-0.9)	0.012
Killip class	1.8	(1.5-2.2)	0.001
LAD culprit	1.7	(1.2-2.6)	0.006
TIMI 0 basal	1.4	(1.0-2.1)	0.073
LVEF <50%	1.6	(1.1-2.5)	0.025
TIMI 0-1 final	2.4	(1.1-5.1)	0.024

RIFLE STEACS – Conclusions

- Radial access in patients with STEMI is associated with significant clinical benefit, in terms of both bleeding and cardiac mortality.

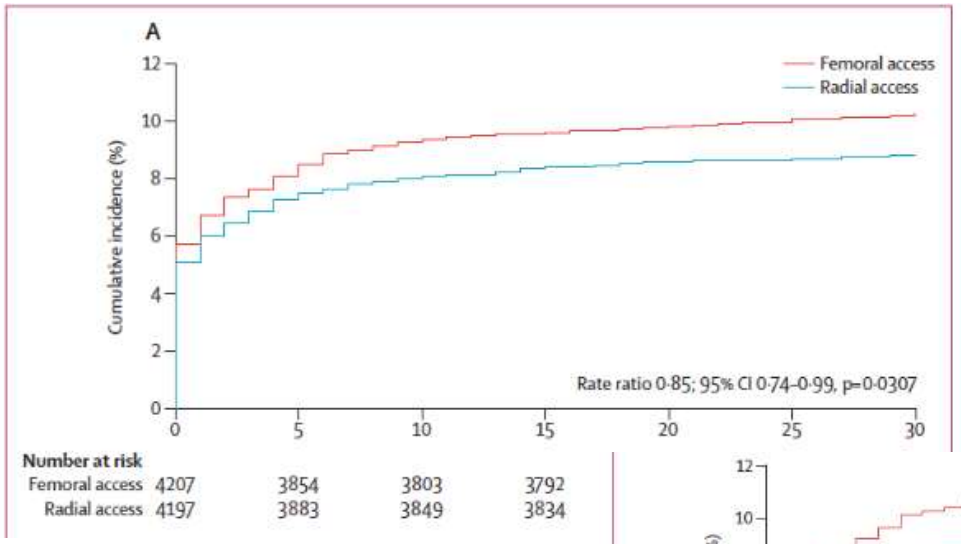
- Radial approach should thus no more be considered a valid alternative to femoral one, but become the recommended access site for STEMI (international guideline).

MATRIX trial

- Randomized, multicenter, superiority trial comparing transradial against transfemoral access in patients with ACS with or without ST segment elevation
- 8404 pts randomized into radial (4197) or femoral access (4207)
- 30 days coprimary endpoint
  - Death, MI, stroke
  - Net adverse clinical events, defined as major adverse CV events or Bleeding Academic Research Consortium (BARC) major bleeding unrelated to CABG

Valgimigli et all. Lancet June 2015

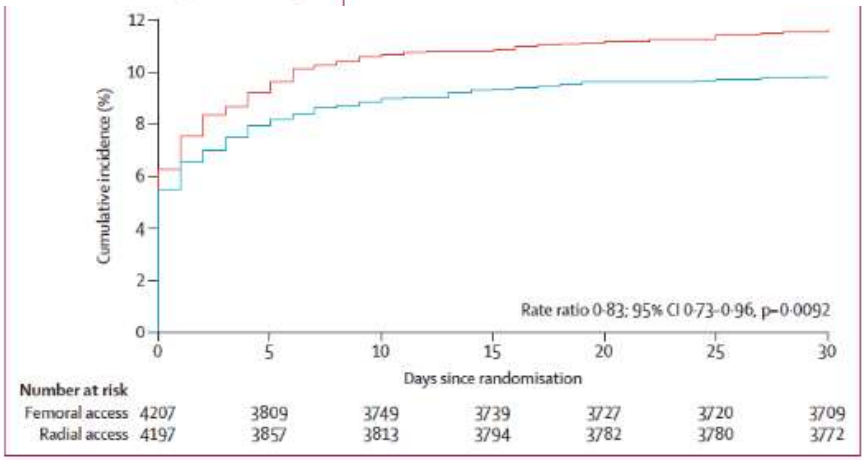
MATRIX Primary endpoints



Death, MI, Stroke:
8.8% rad vs. 10.3% fem
HR 0.85 (0.74-0.99)
p= 0.0307

Death, MI, Stroke, BARC 3 or 5 bleeding
9.8% rad vs. 11.7% fem
HR 0.83 (0.73-0.96)
P=0.0092

Valgimigli et al. Lancet 2015.



Radial Versus Femoral Access for Primary Percutaneous Interventions in ST-Segment Elevation Myocardial Infarction Patients

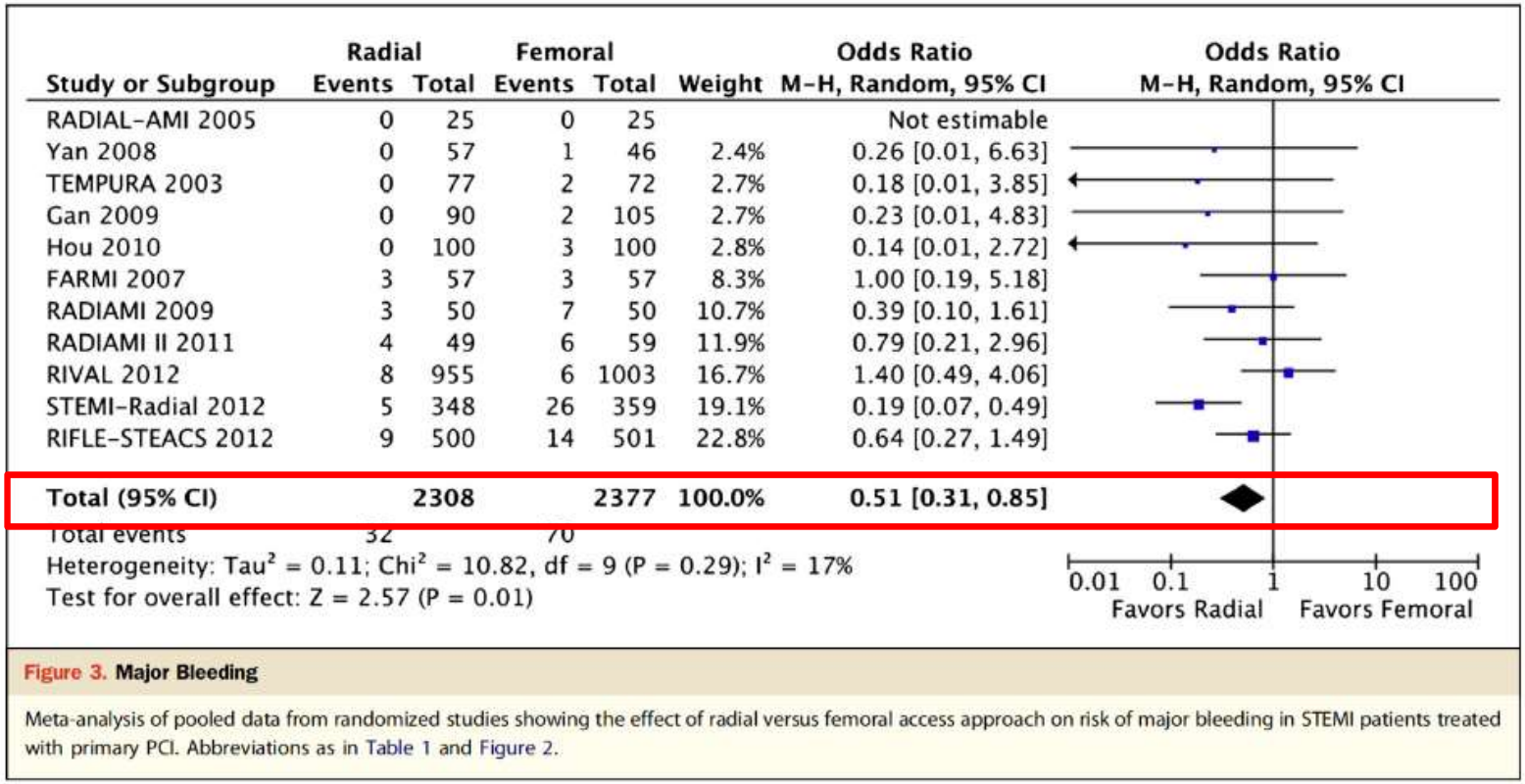
A Meta-Analysis of Randomized Controlled Trials

Wassef Karrowni, MD,* Ankur Vyas, MD,* Bria Giacomino, DO,* Marin Schweizer, PHD,†
Amy Blevins, MALS,* Saket Girotra, MD, SM,* Phillip A. Horwitz, MD*

Iowa City, Iowa

- Meta-analysis included 12 studies, N = 5055 were included
- Primary outcome death and bleeding evaluate at longest available FU
- Secondary outcomes included access site bleeding, stroke and procedure time

STEMI – where access site matters the most?



Study or Subgroup	Radial Events	Radial Total	Femoral Events	Femoral Total	Weight	Odds Ratio M-H, Random, 95% CI
RADIAL-AMI 2005	0	25	0	25		Not estimable
Yan 2008	0	57	1	46	2.4%	0.26 [0.01, 6.63]
TEMPURA 2003	0	77	2	72	2.7%	0.18 [0.01, 3.85]
Gan 2009	0	90	2	105	2.7%	0.23 [0.01, 4.83]
Hou 2010	0	100	3	100	2.8%	0.14 [0.01, 2.72]
FARMI 2007	3	57	3	57	8.3%	1.00 [0.19, 5.18]
RADIAMI 2009	3	50	7	50	10.7%	0.39 [0.10, 1.61]
RADIAMI II 2011	4	49	6	59	11.9%	0.79 [0.21, 2.96]
RIVAL 2012	8	955	6	1003	16.7%	1.40 [0.49, 4.06]
STEMI-Radial 2012	5	348	26	359	19.1%	0.19 [0.07, 0.49]
RIFLE-STEACS 2012	9	500	14	501	22.8%	0.64 [0.27, 1.49]
Total (95% CI)		**2308**		**2377**	**100.0%**	**0.51 [0.31, 0.85]**
Total events	32		70			

Heterogeneity: $Tau^2 = 0.11$; $Chi^2 = 10.82$, df = 9 (P = 0.29); $I^2 = 17\%$

Test for overall effect: Z = 2.57 (P = 0.01)

Figure 3. Major Bleeding

Meta-analysis of pooled data from randomized studies showing the effect of radial versus femoral access approach on risk of major bleeding in STEMI patients treated with primary PCI. Abbreviations as in Table 1 and Figure 2.

Karrowni, et al. JACC Cardiovascular Intv. 2013.

MACE

Study or Subgroup	Radial Events	Radial Total	Femoral Events	Femoral Total	Weight	Odds Ratio M-H, Random, 95% CI
Gan 2009	2	90	5	105	2.5%	0.45 [0.09, 2.40]
Hou 2010	4	100	5	100	3.8%	0.79 [0.21, 3.04]
RADIAMI 2009	1	50	1	50	0.9%	1.00 [0.06, 16.44]
RADIAMI II 2011	1	49	1	59	0.9%	1.21 [0.07, 19.83]
RIFLE-STEACS 2012	36	500	57	501	36.2%	0.60 [0.39, 0.94]
RIVAL 2012	26	955	46	1003	28.9%	0.58 [0.36, 0.95]
STEMI-Radial 2012	12	348	15	359	11.5%	0.82 [0.38, 1.78]
TEMPURA 2003	17	77	22	72	12.8%	0.64 [0.31, 1.34]
Yan 2008	3	57	3	46	2.5%	0.80 [0.15, 4.14]
Total (95% CI)		**2226**		**2295**	**100.0%**	**0.64 [0.49, 0.83]**
Total events	102		155			

Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 1.22$, df = 8 (P = 1.00); $I^2 = 0\%$

Test for overall effect: Z = 3.36 (P = 0.0008)

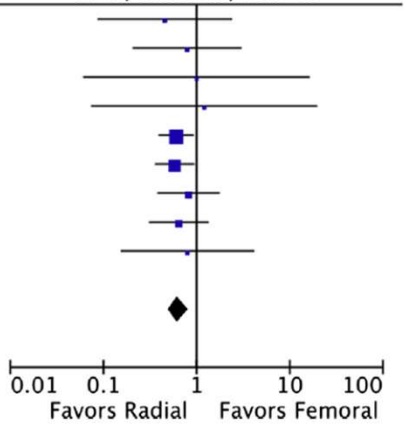


Figure 4. MACE

Meta-analysis of pooled data from randomized studies showing the effect of radial versus femoral access approach on risk of MACE in STEMI patients treated with primary PCI. MACE = major adverse cardiovascular event; other abbreviations as in Table 1 and Figure 2.

All-Cause Mortality

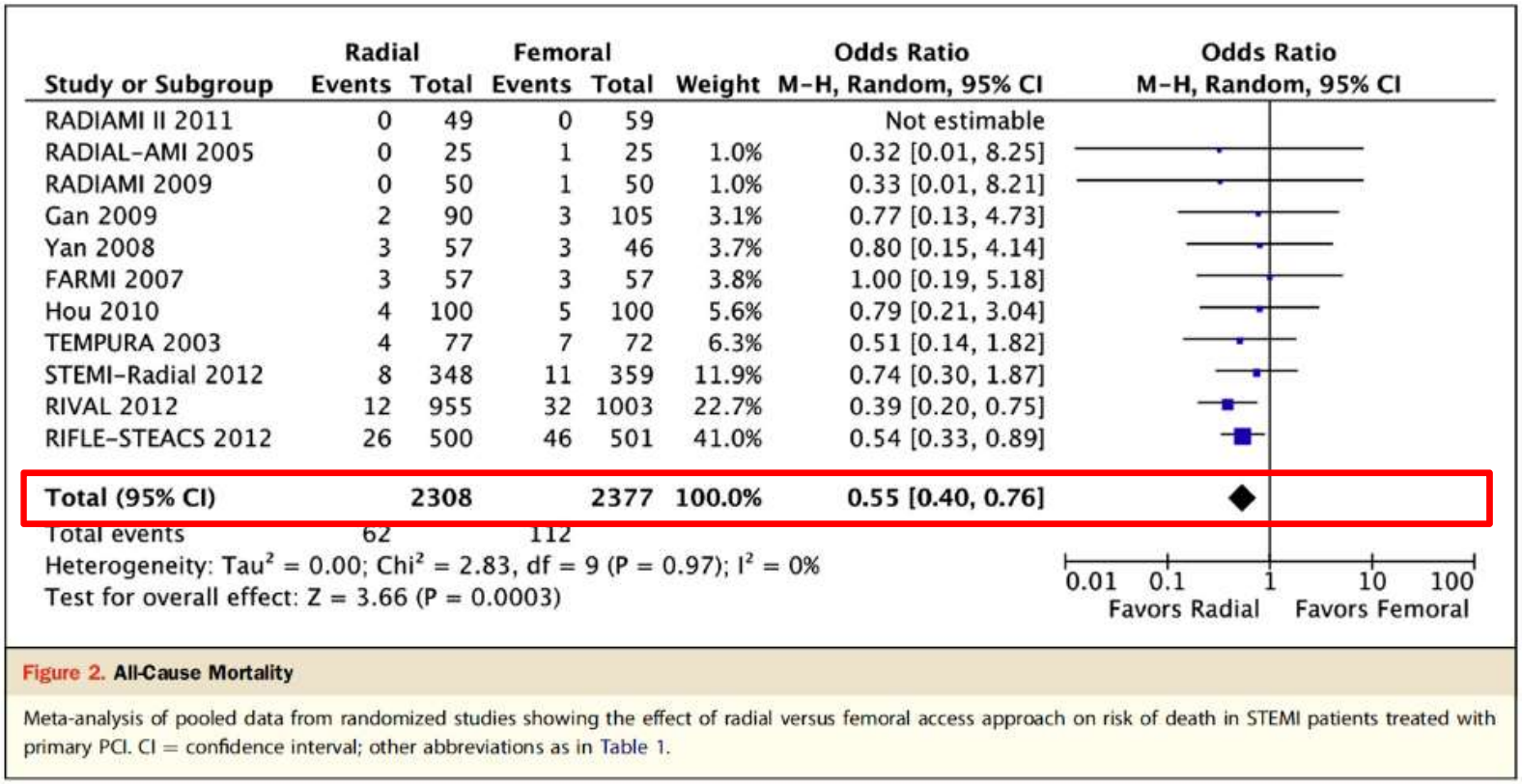


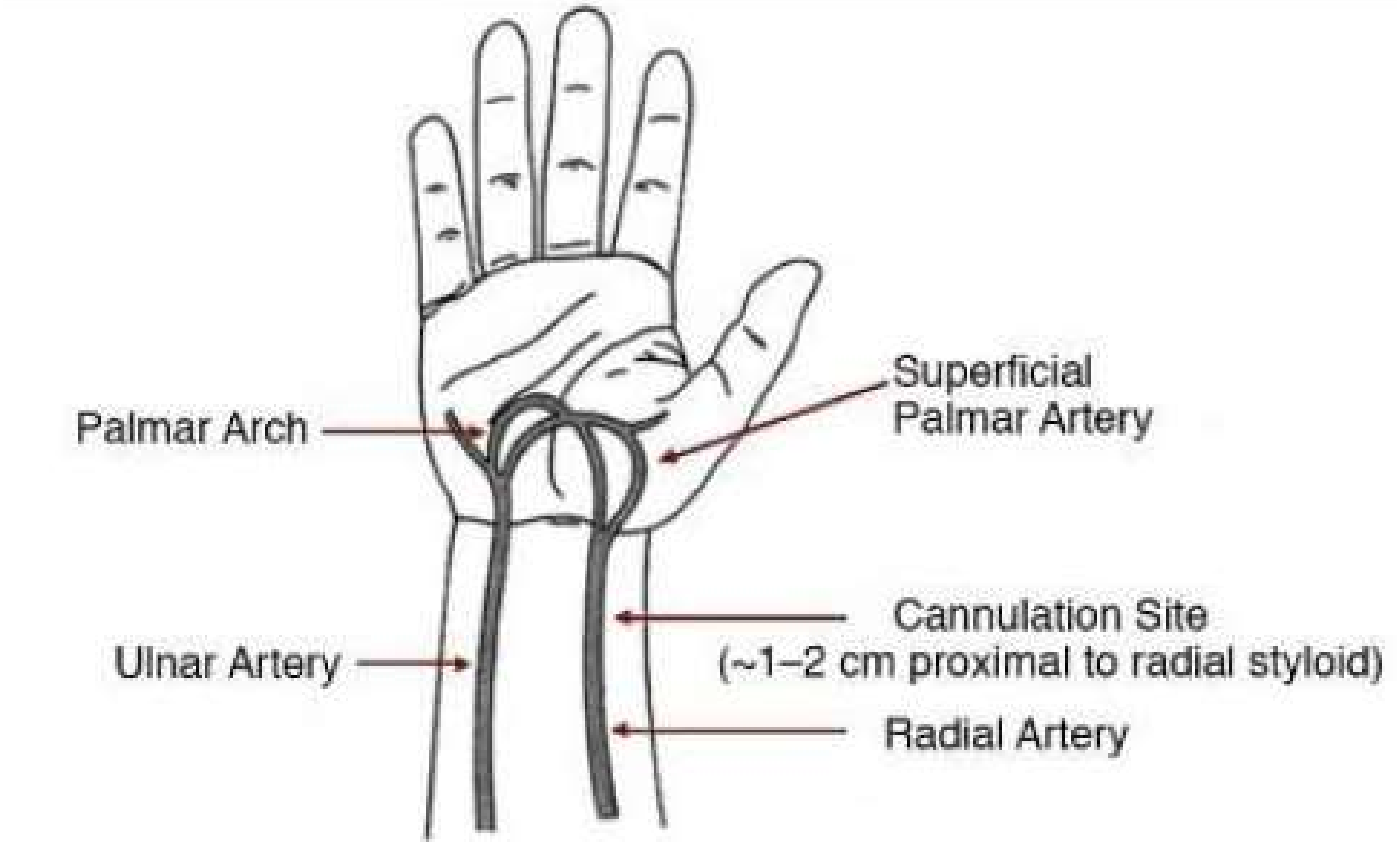
Figure 2. All-Cause Mortality

Meta-analysis of pooled data from randomized studies showing the effect of radial versus femoral access approach on risk of death in STEMI patients treated with primary PCI. CI = confidence interval; other abbreviations as in Table 1.

Karrowni, et al. JACC Cardiovascular Intv. 2013.

RADIAL ACCESS

Arterial supply to hand



Radial Access

- No adjacent major Nerve
  - Median – carpal tunnel
  - Ulnar nerve – near ulnar artery
- Dual circulation – Allen's test (>90%)
- Easily compressible
  - Lower chance of PSA, hematoma
- Tight space
  - Lower chance for large PSA

Why not brachial access?

- Sole arterial feeder to the hand
- No effective hemostasis device
- Complications
  - Pseudoaneurysms
  - Median neuropathy

Special indications

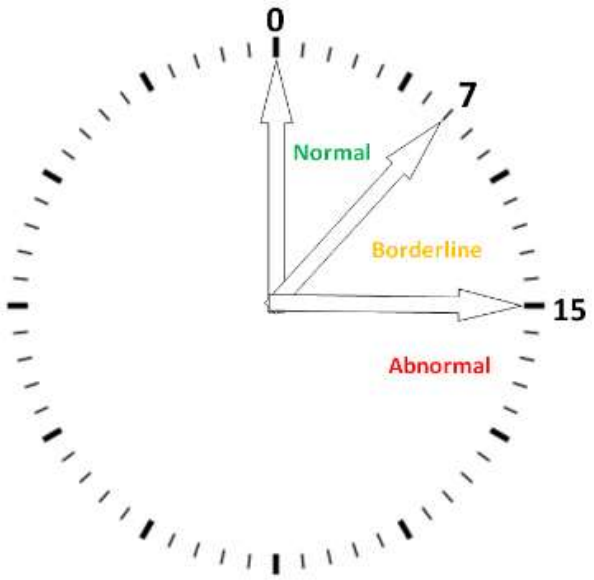
- Peripheral Vascular disease
- Morbid Obesity
- Patient Preference
- Anticoagulation
- Difficult IMA cannulation

Contraindication

- Known deficiencies in collateral circulation
  - Peripheral vascular disease, Raynaud's phenomenon, thromboangiitis obliterans
- Infection at the site of insertion
- Patient on hemodialysis

Radial artery cannulation

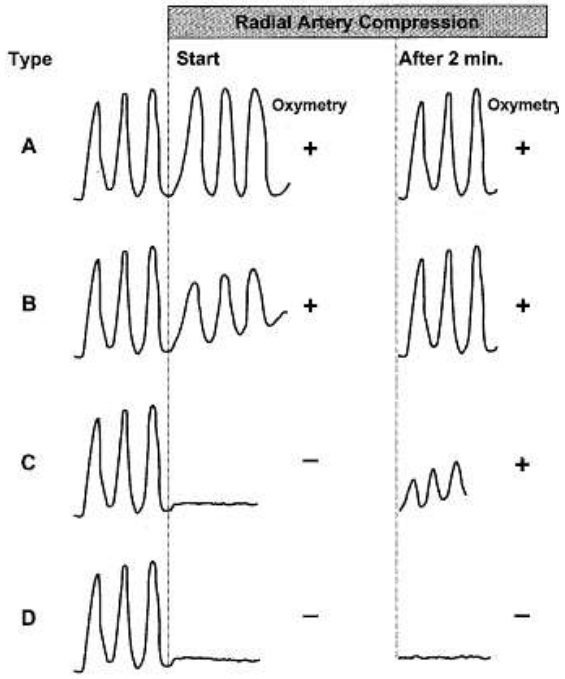
- Confirm adequate collateral blood supply
  - Allen's test



Allen's test

- Arbitrary cutoff
- Subjective
- Assessment limited by
  - Pallor, inadequate patient cooperation, unconsciousness, overextension of wrist/finger

Plethysmography and pulse oximetry



Drawing representing the 4 types of ulnopalmar arch patency findings with PL and OX, as recorded with the finger clamp applied on the thumb.

- PL and Ox test[1]
  - Pulse oximetry at thumb
  - Compression on radial artery

Table III. McNemar's test of 1009 patients meeting access criteria for any side PTRA with MAT ≤9 seconds and PI and Ox types A, B and C. ($P < .0001$)

	PI & Ox Types A, B, C		
MAT ≤9 s	**No**	**Yes**	**Total**
No (%)	13 (20)	52 (80)	65
Yes (%)	2 (0.2)	942 (99.8)	944
Total	15	994	1009

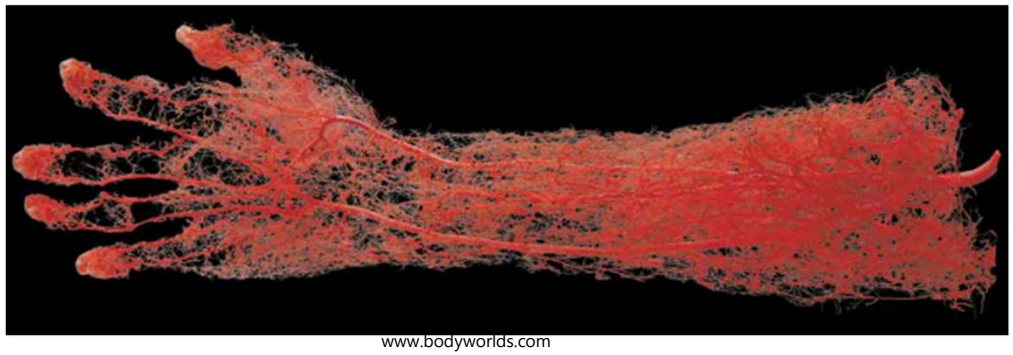
1: R. Barbeau et al. Am Heart J 2004; 147:489-93

- In series of 7049 patients with type A,B, C and excluding patients with type D, no single case of acute hand ischemia has been reported[2]

R. Barbeau et al. [abstract]. Ciculation 1999;100:-306

Arm is very well collateralized

- *No correlation to hand ischemia & arterial lines*[1]
- Extensive radial CABG experience without ischemia
- Radial harvest with abnormal Allen's Test is possible[2]



www.bodyworlds.com

Theoretical fears from an abnormal Allen's Test is a poor excuse for a real risk of groin complications

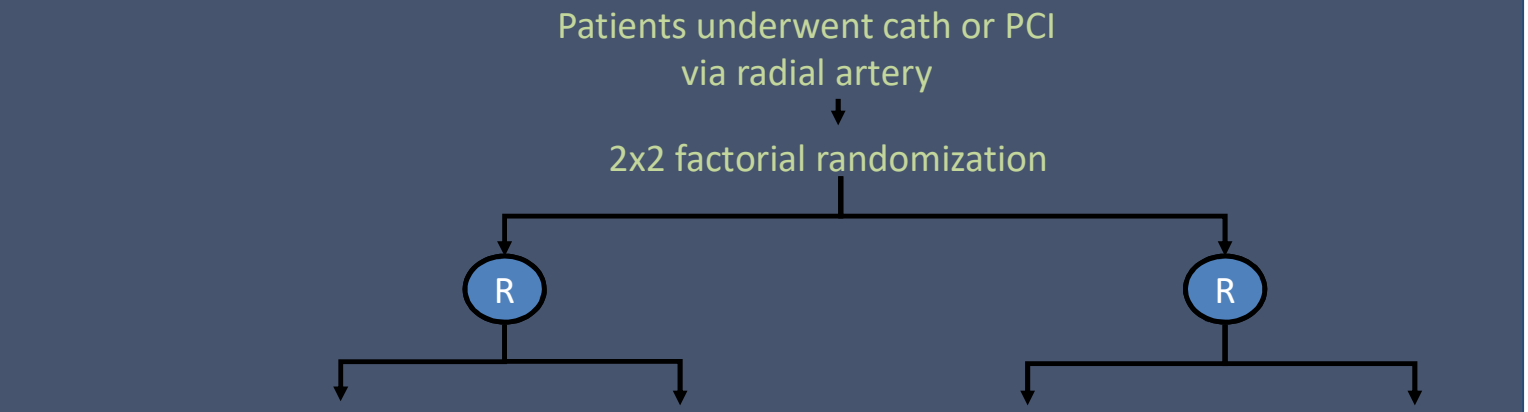
1. J Trauma 2006;206:468-70
2. Surg Today 2006;36(9):790-2

RADIAL ACCESS: STEP BY STEP

Access techniques

- Access the radial artery more than 2cm proximal to the radial styloid process
- Avoid access over the flexor retinaculum
- Back-wall puncture technique
  - Seldinger method
  - 20 or 22G Angiocath
- Single wall technique
  - Short 2.5cm stainless steel 21G needle

Sheath Selection

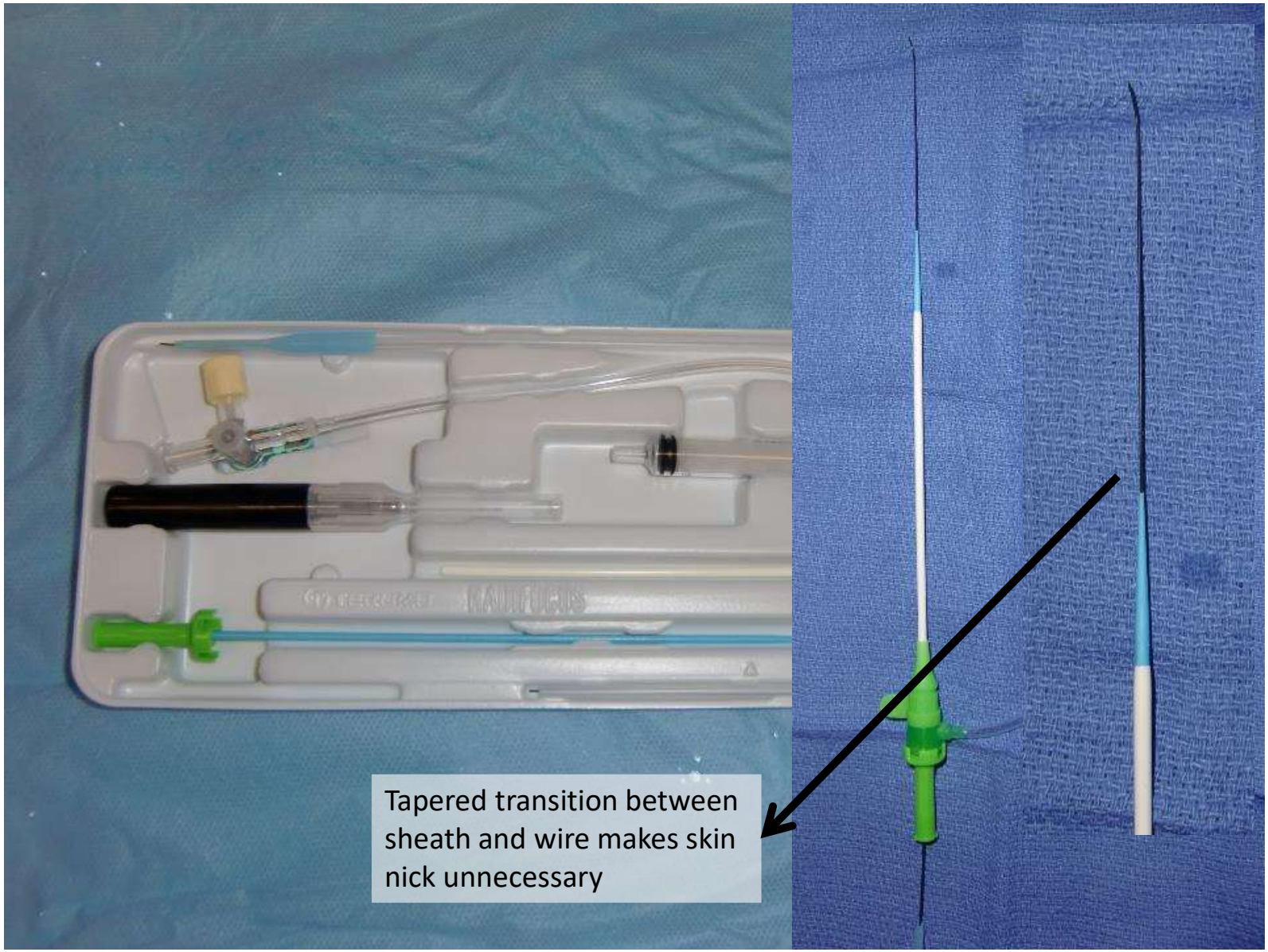


	Long (23 cm) n=396	*Short (13 cm) n=394*	*Coated n=397*	*Uncoated n=393*
Operator RAS	***110 (27.9%)***	***120 (30.8%)****	***75 (19.0%)***	***155 (39.9%)^***
Patient discomfort	***85 (21.5%)***	***87 (22.2%)****	***60 (15.1%)***	***112 (28.5%)^***

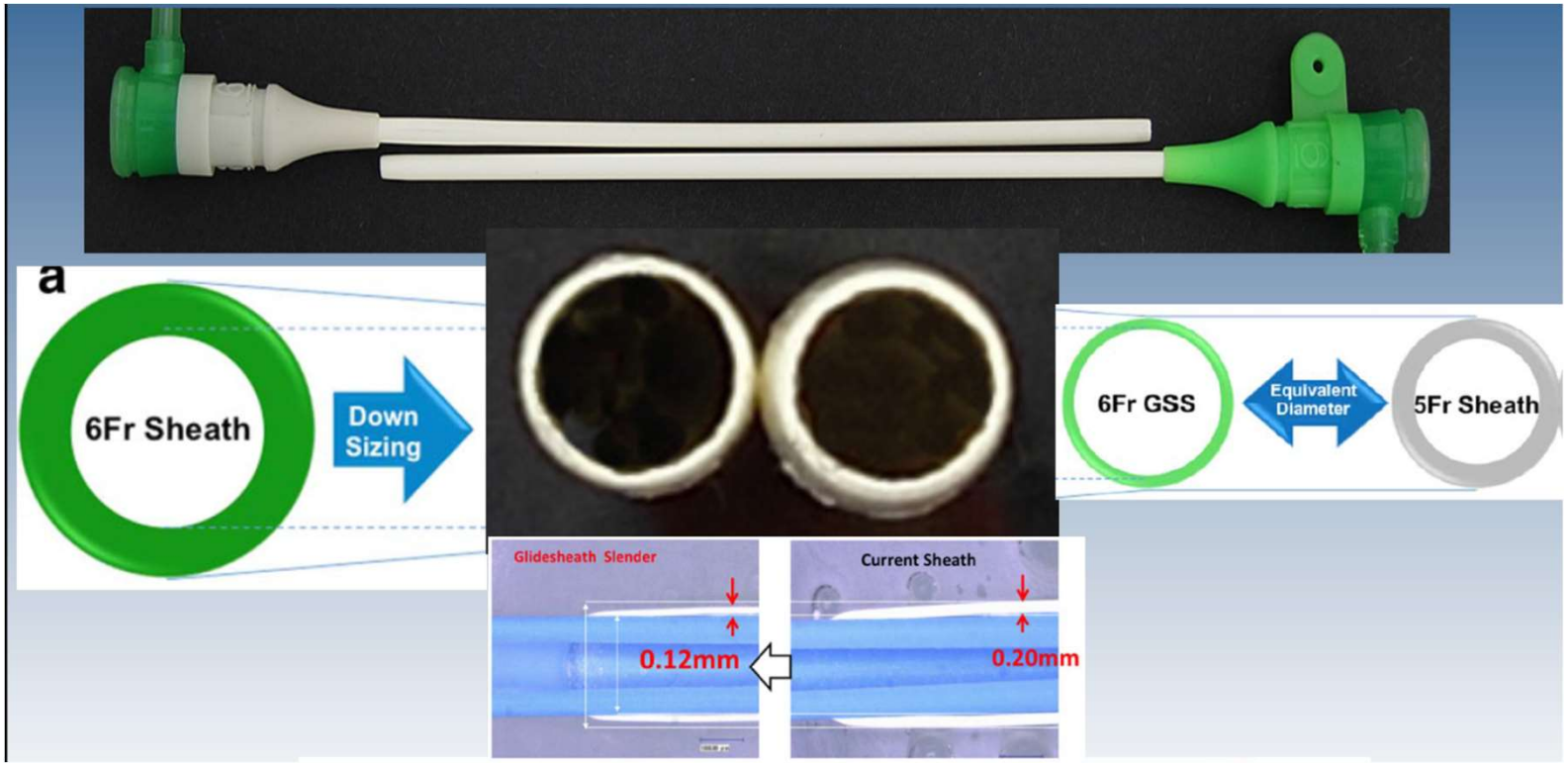
*p=NS
^p<0.001

Young age, female sex, diabetes, and low BMI to be independent predictors of RAS

Rathore S et al. JACC Interv, 2010; 3:475-483


Tapered transition between sheath and wire makes skin nick unnecessary

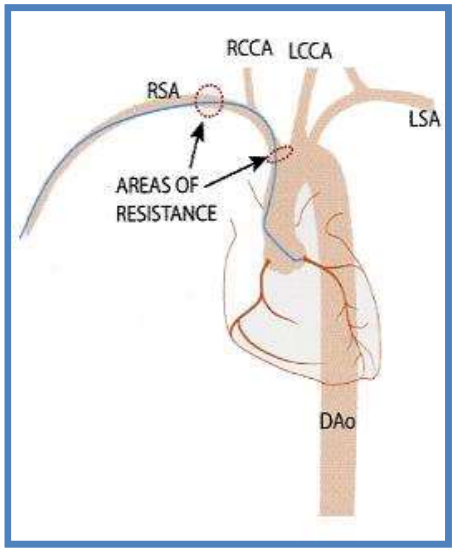
Glidesheath Slender



Left radial vs Right radial

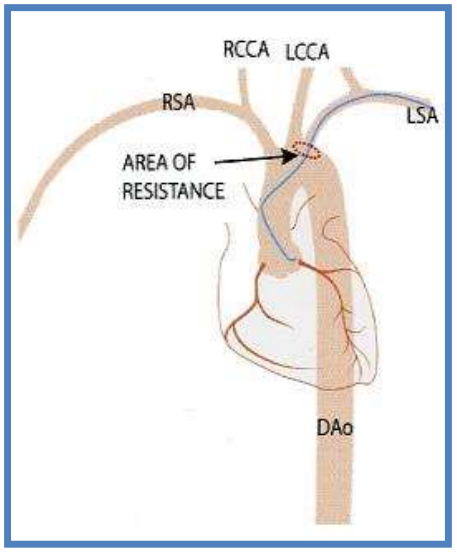
Understanding the Catheter's Course

Right Radial



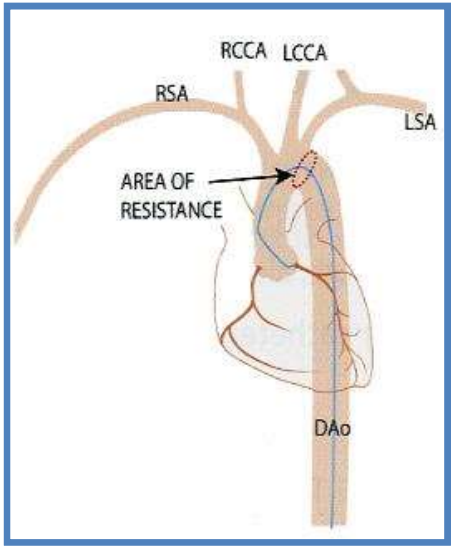
2 points of resistance

Left Radial



1 point of resistance

Femoral



1 point of resistance

Patel's Atlas of Transradial Intervention: The Basics and Beyond. 2nd ed.

Left vs Right radial access

Left radial

- Same as femoral approach
- Same catheters used
- Less subclavian tortuosity
- Left is usually the non-dominant hand
- Not operator friendly

Right radial

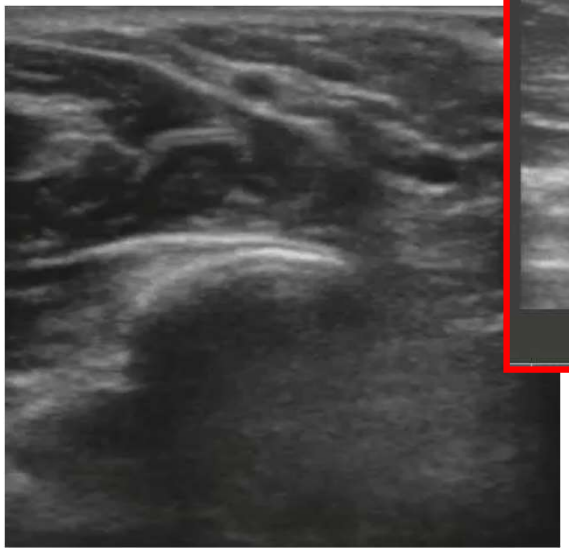
- More than 2 points of resistance
- For LCA cannulation, catheter used should be downsized by 0.5
  - JL4 for femoral = JL3.5 for right radial
- More subclavian tortuosity
- Difficult to cannulate the LIMA

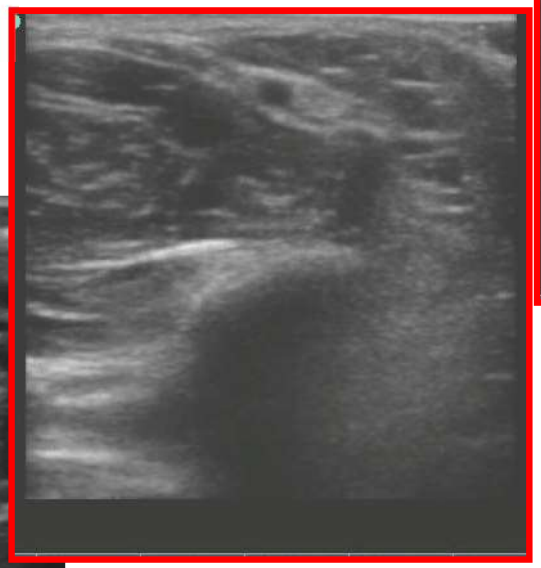
Challenges

Radial Access – Challenges

- Inability to cannulate the radial artery
- Spasm
- Tortuosity
  - Radial, brachial and subclavian loop
- Radial artery occlusion


TITAN





Radial artery spasm

Challenges: Spasm

- Radial artery is more spastic than others vessels.
- An α-adrenoceptor-dominant artery with little β-adrenoceptor function and is extremely sensitive to circulating catecholamines
- First stick
- Wait before re-attempt
- Medication
- Hydrophilic Sheath

5mg Verapamil + 200mcg nitro Vs No cocktail

- Use automatic pullback device to quantify RAS
- 1st 50 patients: (Verapamil + Nitro) vs 2nd 50 patients: received no cocktail

TABLE II. Results

Parameters	Group A (n = 50), cocktail	Group B (n = 50), no cocktail	*P*
MPF (kg)	0.53 ± 0.52	0.76 ± 0.45	0.013
MPF > 1.0	4 (8%)	11 (22%)	0.029
Pain felt (score ≥ III)	7 (14%)	17 (34%)	0.019
Pain score	1.7 ± 0.94	2.08 ± 1.07	0.03

MPS = max force during pullback

Ferdinand Kiemeneij et al. Cathet. Cardiovasc. Intervent. 2003; 58:281-284

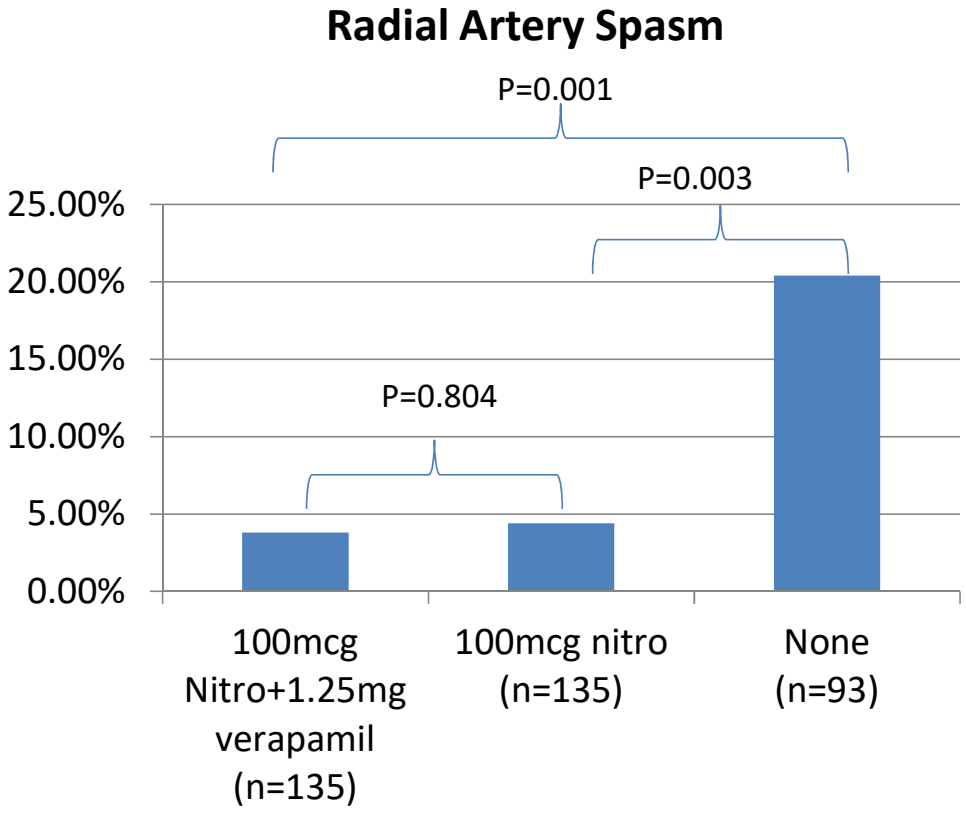
IVUS assessment 200mcg nitro + 2.5mg Verapamil vs 2.5mg Verapamil

Table 2. Radial artery measurements using intravascular ultrasound.

	Group 1 (n = 15)	Group 2 (n = 15)	*p*-Value
Baseline volume (mm^3)	451 ± 177	456 ± 188	0.92
Post-treatment volume (mm^3)	508 ± 192	509 ± 170	0.82
Absolute volume increase (mm^3)	58 ± 56	53 ± 60	0.65
Relative volume increase (%)	14 ± 15	20 ± 37	0.69
Baseline diameter (mm)	2.7 ± 0.5	2.7 ± 0.6	0.92
Post-treatment diameter (mm)	2.9 ± 0.6	2.9 ± 0.5	0.82
Relative diameter increase (%)	6.6 ± 6.7	8.6 ± 14.5	0.69
Group 1: nitroglycerin plus verapamil; Group 2: verapamil alone. Data given as mean ± SD.			

Xavier Carrillo et al. J INVASIVE CARDIOL 2011;23(10):401–404

Nitro similar to Nitro + verapamil



- All patients are treated with 3000 unit heparin
- Operator was blinded to treatment group
- Spasm was defined as
  - Patient's feeling of pain and in advancing or withdrawing the catheters or guidewires detected by operators
  - It was documented by radial artery angio

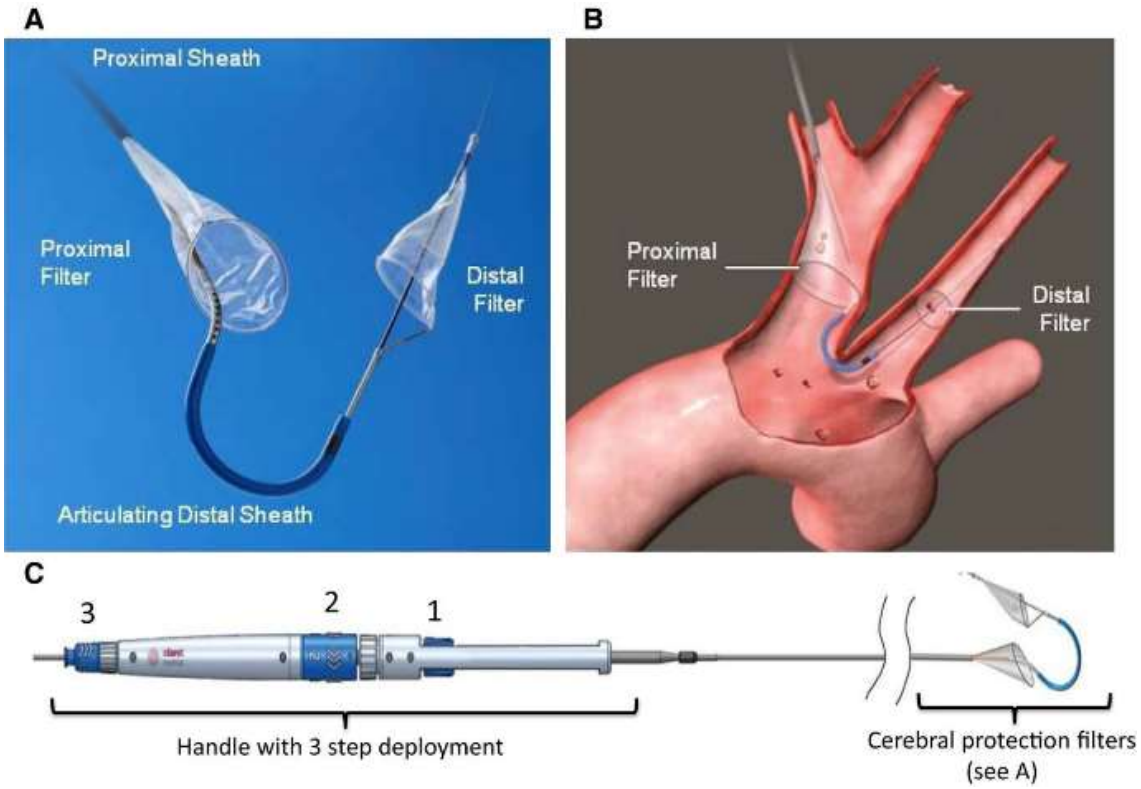
Chih-wei Chen et al. Cardiology 2006;105:43-47

Radial artery variants

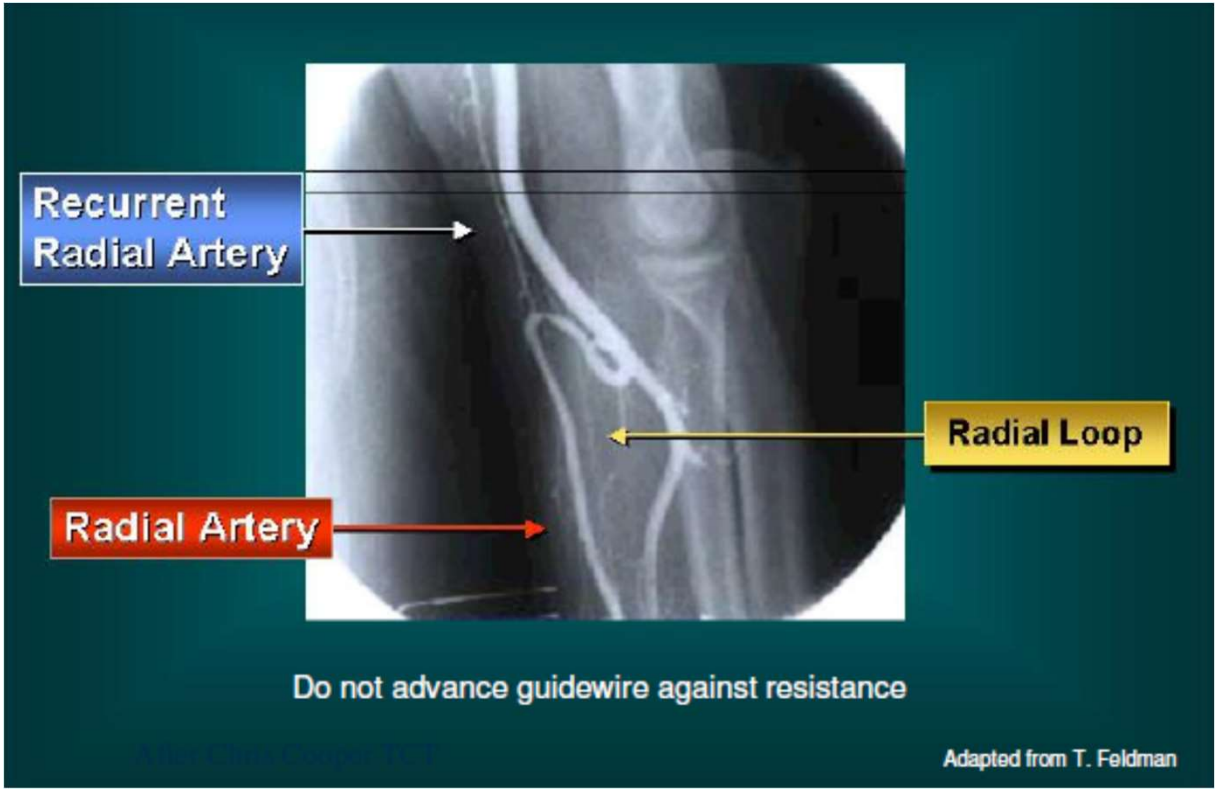
Case 4

- F/86
- ADLi
- Known HT, hyperlipidemia, IHD with PCI done, severe AS
- Plan for TAVI under Claret cerebral protection device through radial access

Claret cerebral protection device

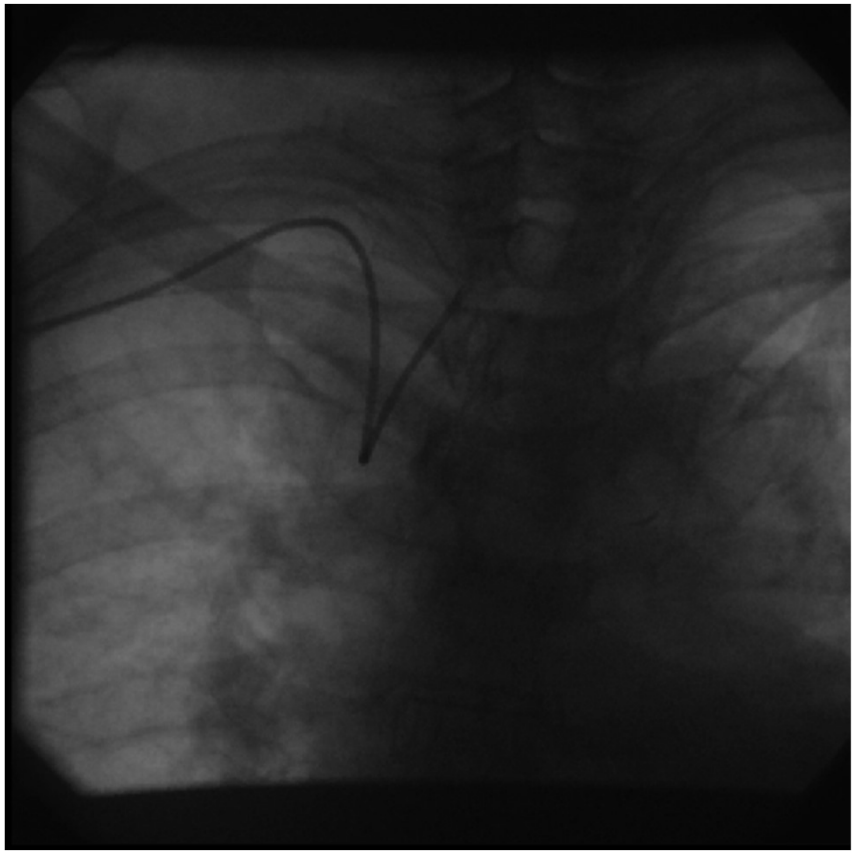


Recurrent radial artery



Tortuosity

Tortuosity



Poor guide support

Technique to enhance guide support

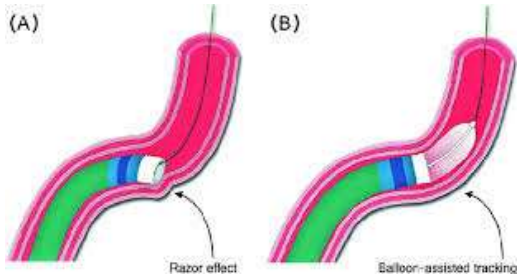
- Deep intubation
- Buddy wire
- Anchoring wire in another vessel
- Guide extenders

With practice, conversion simply for guide support will not be an issue!

Complications

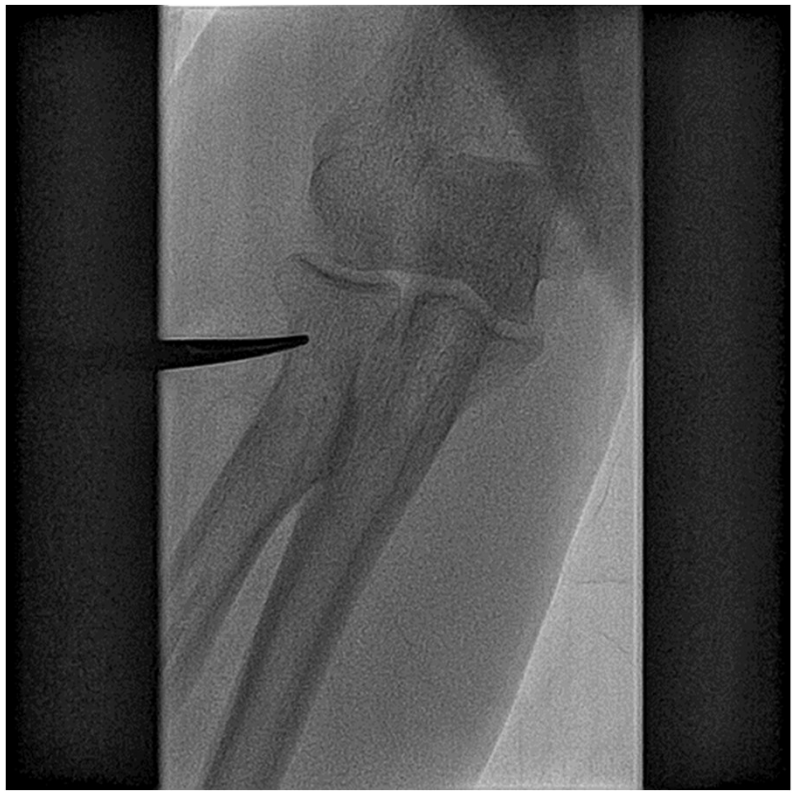
Radial artery perforation - prevention

- Never force against resistance, perform angiogram if you met any resistance
- Use hydrophilic wire or 0.014 coronary wire to traverse the complex anatomy
- Balloon assisted tracking prevent the razor effect from the edge of the guide

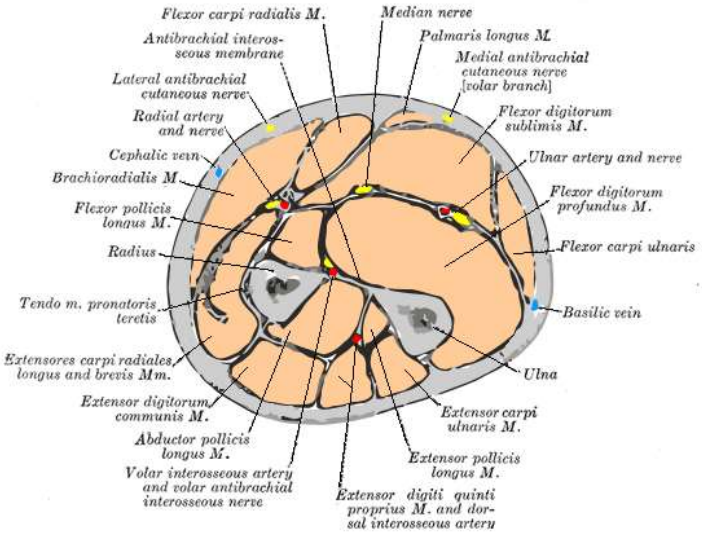


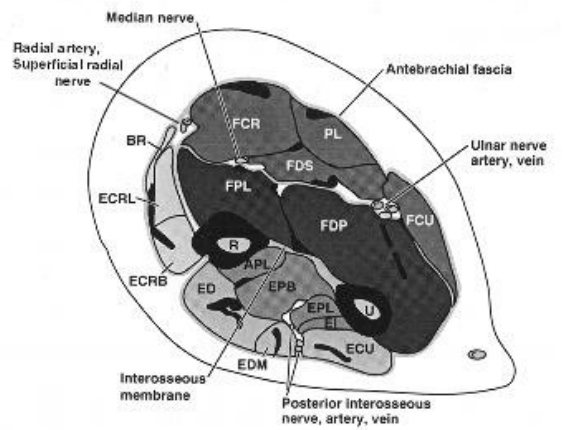
Management

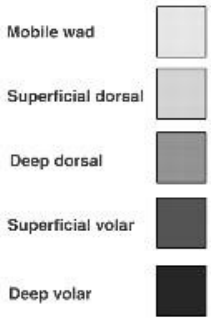
- Apply blood pressure cuff above the site of bleeding, inflate to about 10-20mmHg below the systolic blood pressure
- Reverse heparin if allowed
- Rarely, antegrade control using balloon tamponade or even cover stent



Compartment syndrome







Very rare, usually due to bleeding / hematoma

Figures: Wikipedia & Boles C A et al. AJR 2000;174:151-159

: Tadashi Araki et al. CCI 2010; 75: 362-365

Radial artery occlusion

RAO

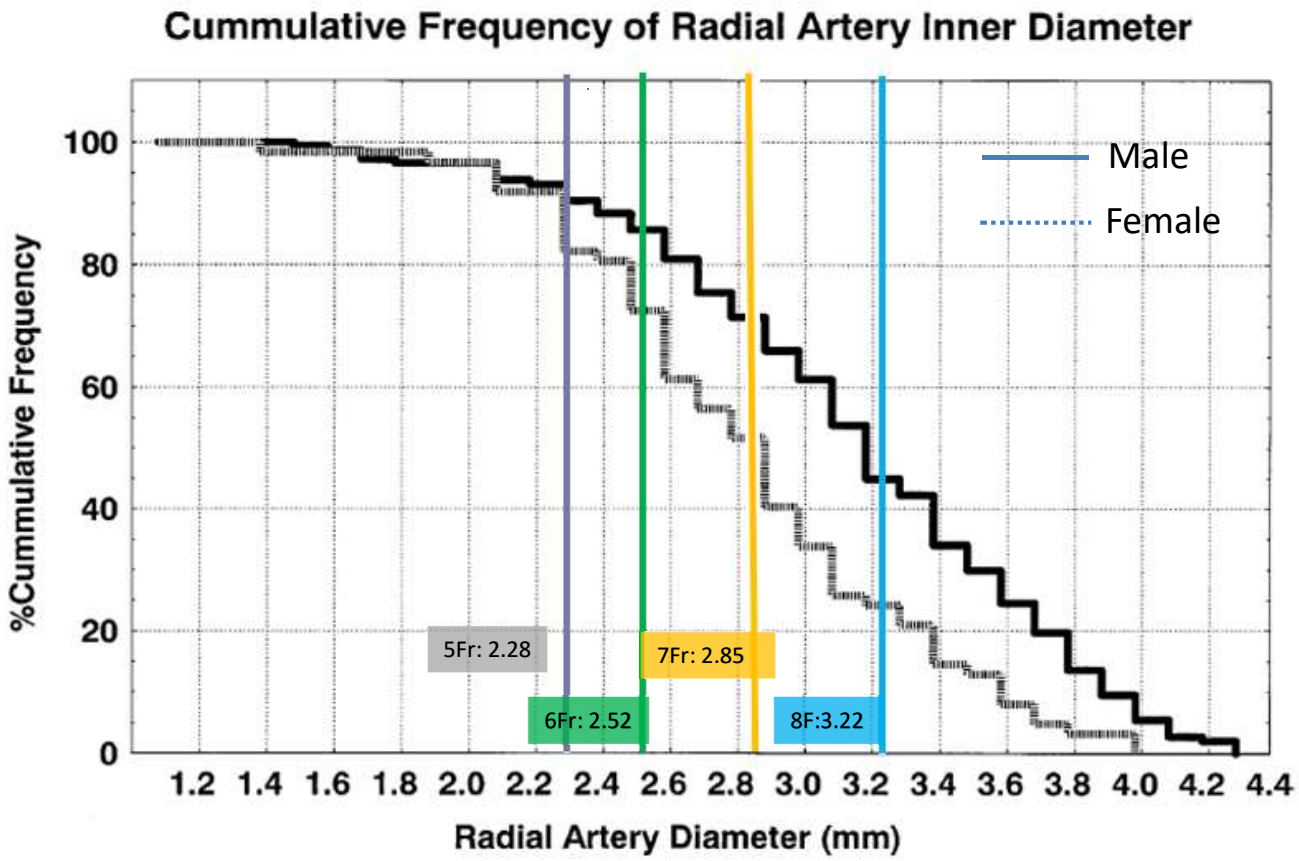
- Estimate 1-10% of cases[1-3]

- Painful forearm or thenar
- Loss of handgrip force
- Paresthesia

- Limited future access
- Limited the potential usage as a bypass graft

1: Stella PR et al. Cathet Cardiovasc Diagn. 1997; 40 :156-158
2: Sanmartin M et al. Catheter Cardiovasc Interv. 2007; 70: 185-189
3: Nagai S et al. Am J Cardiol. 1999; 83: 180-186

250 consecutive patients in Japan



Shigeru Saito et al. Cathet. Cardiovasc. Intervent. 1999; 46:173-178

Lower the ratio of ***RA inner diameter : shealth outer diameter***, high chance of severe flow reduction after TRI

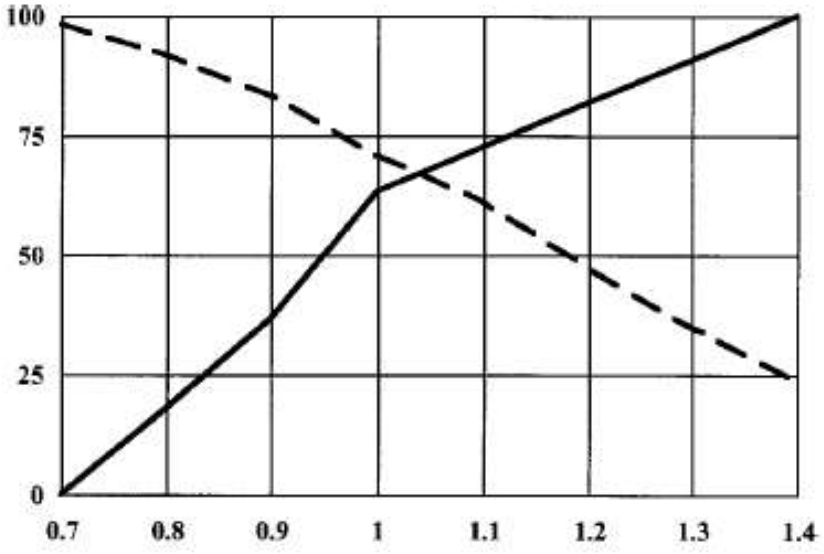
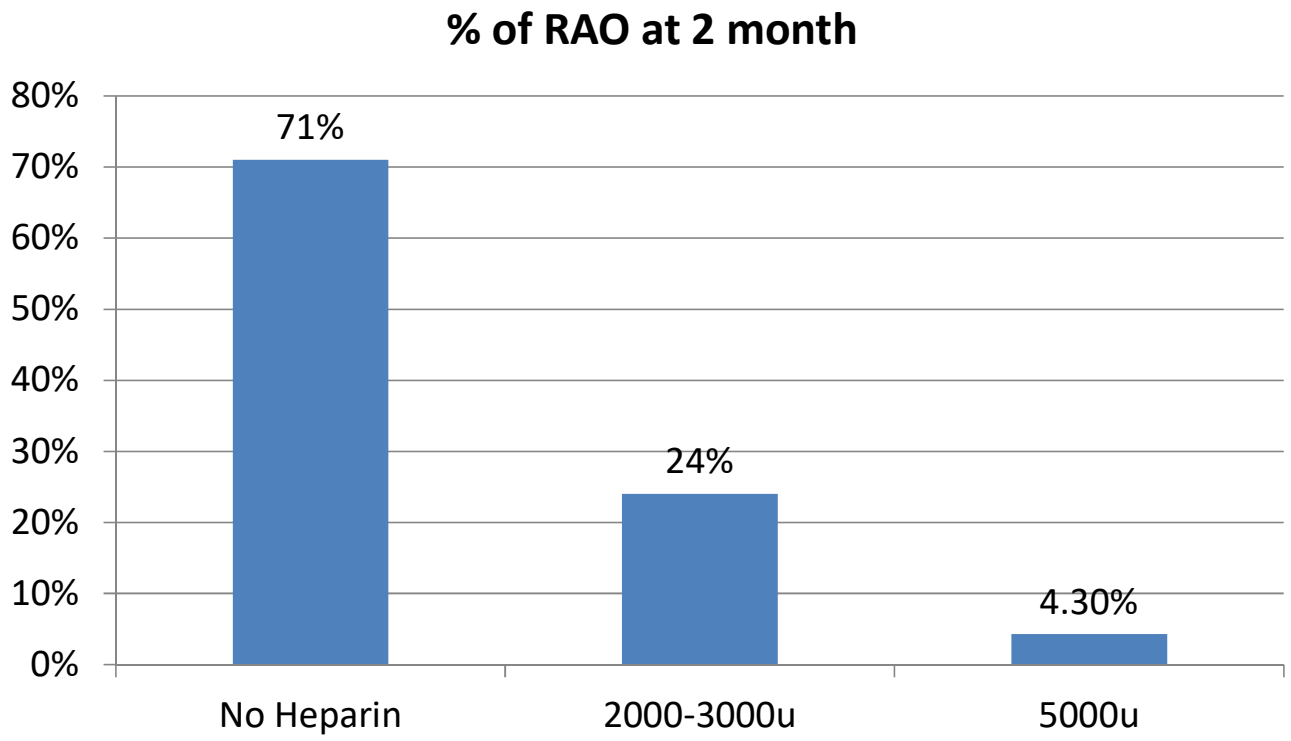


Fig. 5. The sensitivity and specificity curves to detect severe flow reduction of the radial artery vs. the ratio of radial artery inner diameter/cannulated sheath outer diameter. Vertical axis = sensitivity (dotted line) and specificity (solid line) value. Horizontal axis = the ratio of radial artery inner diameter/sheath outer diameter.

- USG measure radial inner diameter and flow before and 1-2 weeks after TR intervention
- All patients received 10000u heparin
- 2mg verapamil if spasm
- Severe flow reduction defined as absence of flow in RA (0%) or severely reduced antegrade flow (6.8%) in comparison to the contralateral side

Shigeru Saito et al. Cathet. Cardiovasc. Intervent. 1999; 46:173-178

Heparin prevent RAO (n=415)



Spaulding et al. Cathet Cardiovasc Diagn. 1996 Dec; 39(4):365-70

Heparin 5000u vs Weight adjusted Heparin (50i.u./Kg, Max: 5000i.u)

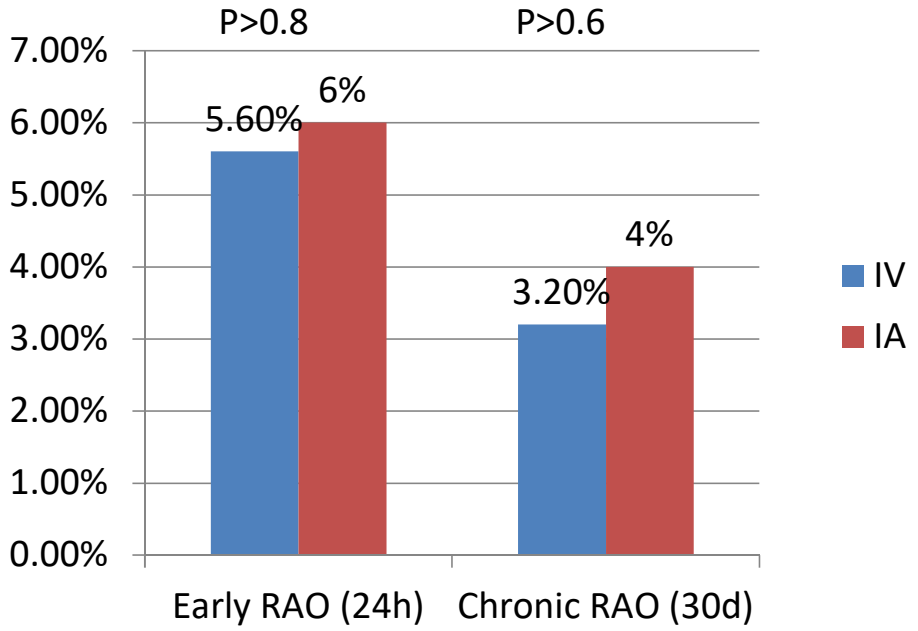
	5000 I.U Heparin (n=79)	Weight adjusted (n=83)	p value
Compression time (min)	235.5	204.5	<0.0001
Post-procedure ACT (sec)	265.6	231.4	<0.0001
Radial occlusion (n)	0	0	1.0

*RAO was diagnosed by doppler USG within 24 hour after procedure

Schiano et al. Eurointervention. 2010; 6:247-250

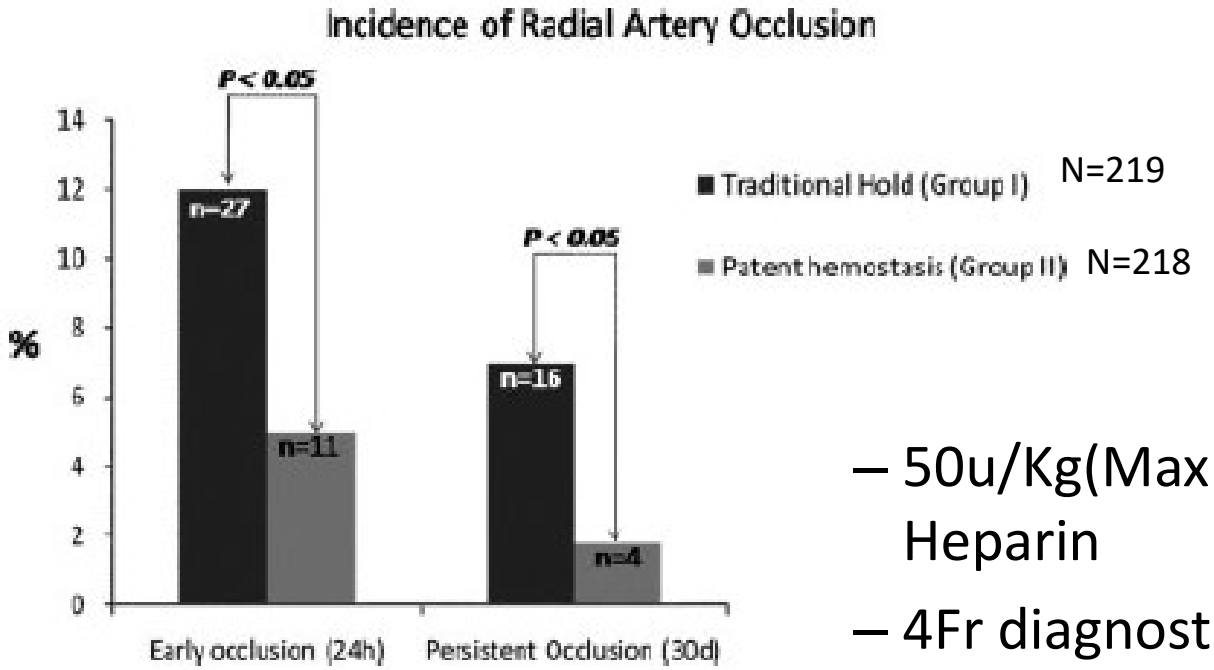
IA vs IV heparin

- Randomized study
- 250 patients in each arm
- Reverse Barbeau test



Samir B. Pancholy. Am J Cardiol 2009;104:1083-1085

Occlusive hold vs Patent Hemostasis



N=219

N=218

- 50u/Kg(Max:5000U) Heparin
- 4Fr diagnostic cath
- 100% FU rate in gp 1, 99.5% FU rate in gp2

Samir Pancholy et al. PROPHET Study. Catheterization and Cardiovascular Interventions 2008;72:335-340

Thank you for your kind attention