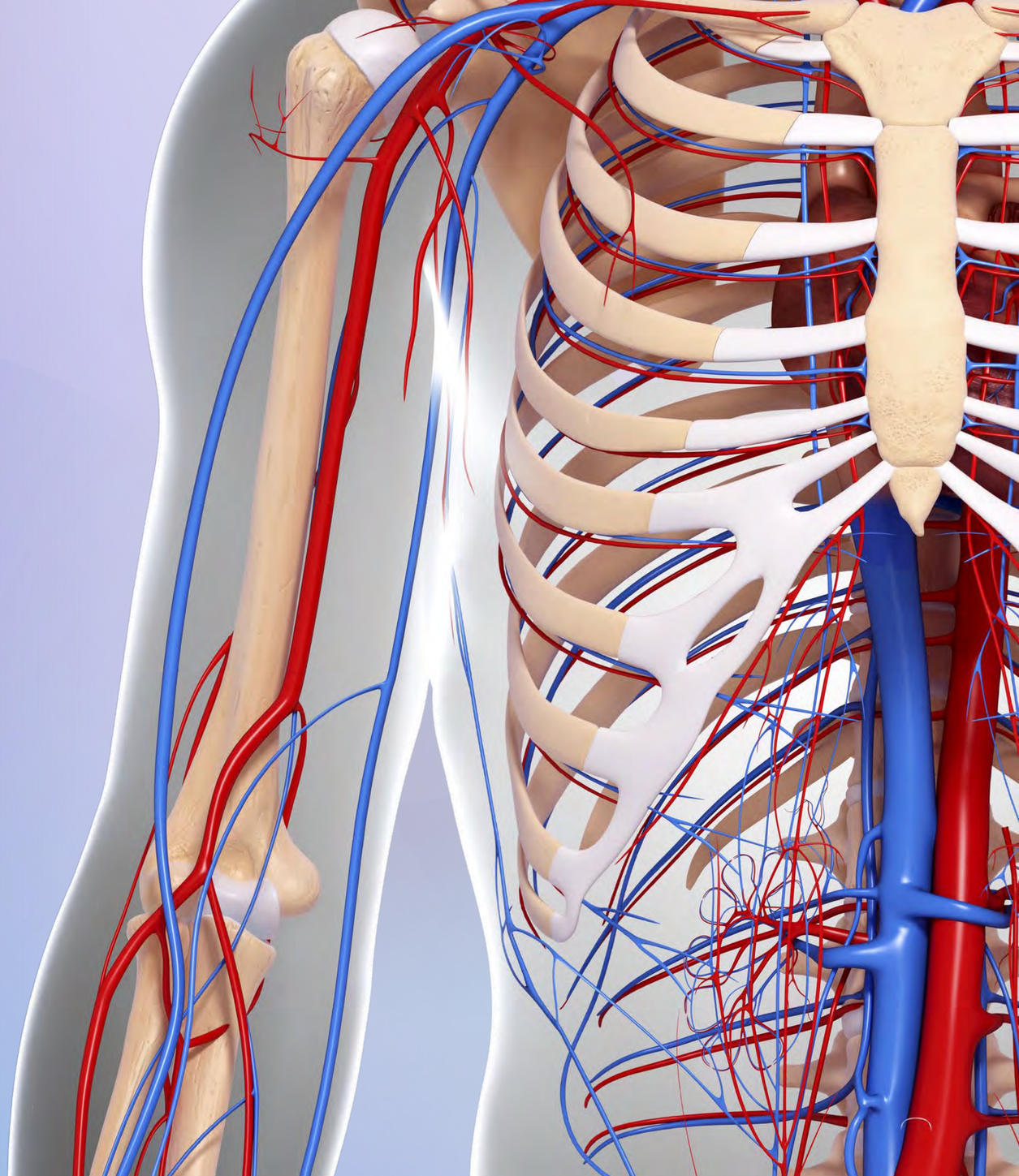
NEURI BICÊTRE

Radial Access for Neurointervention

New routes. Old challenges.

João B. Madureira
Jonathan Cortese, Jildaz Caroff, Cristian Mihalea, Léon Ikka, Vanessa Chalumeau, Sophie Gallas, Jacques Moret, Laurent Spelle

November 16, 2022



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Learning agenda

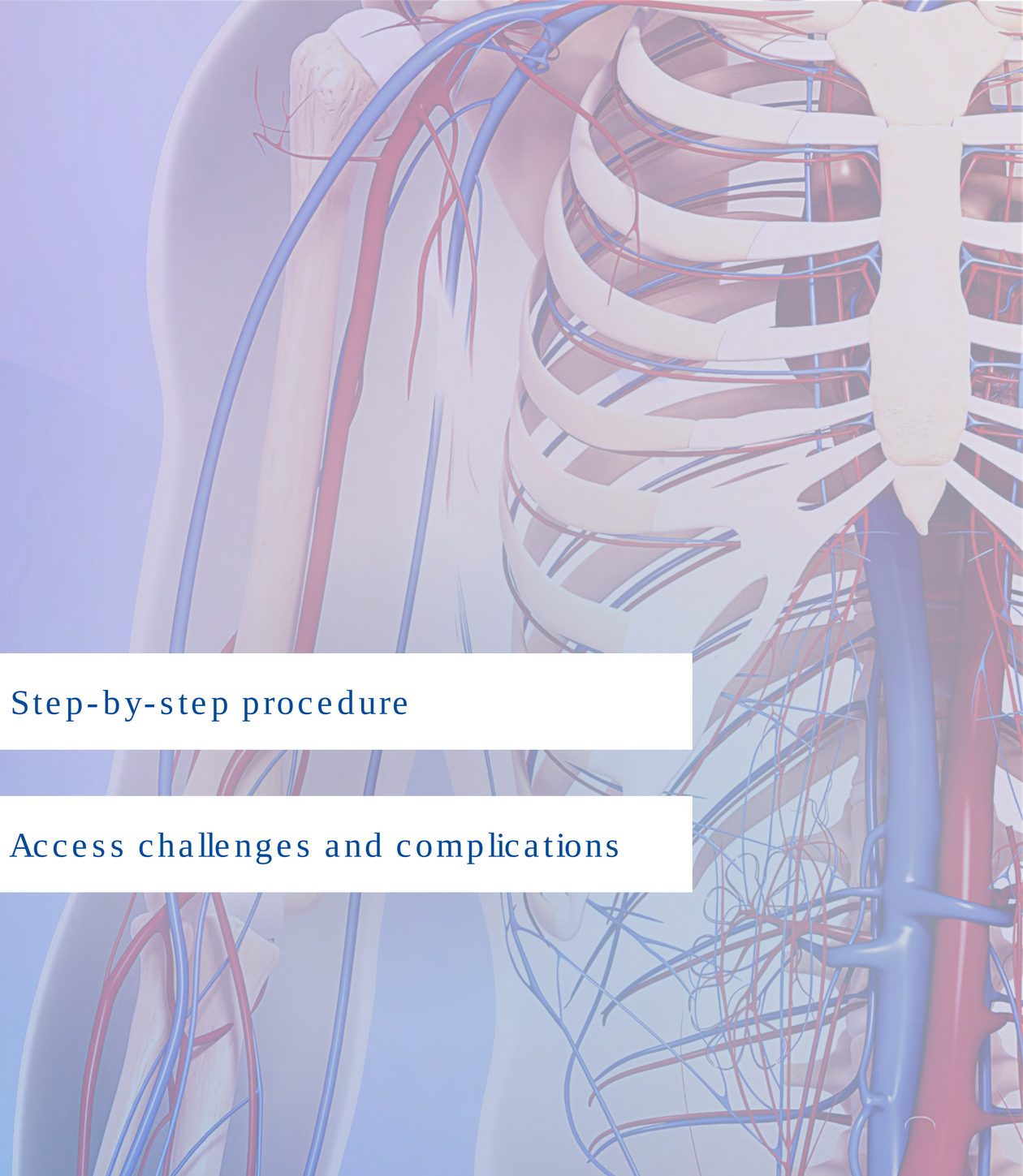
1 Brief historical remarks

2 Why go radial for neurointervention?

3 Anatomy review

4 Step-by-step procedure

5 Access challenges and complications



Brief historical remarks

Egas Moniz

1927

Performed the first brain angiography by surgical exposure and cannulation of the carotid artery.

Presentation at the French Neurological Society: "L'encéphalographie artérielle, son importance dans la localization des tumeurs cérébrales."

Stig Radner

1947

First radial access through surgical exposure.

It was developed in order to obtain angiograms of the thoracic aorta with better contrast resolution, compared with intravenous contrast injection.

Sven Seldiner

1952

Developed the technique for percutaneous access - Seldinger technique.

Catheterization was previously done by surgical exposure, cannulation with large bore tubes, followed by ligation or suture of the artery.

CONTRAST

RISK REDUCTION

ACCESS OPTIMIZATION

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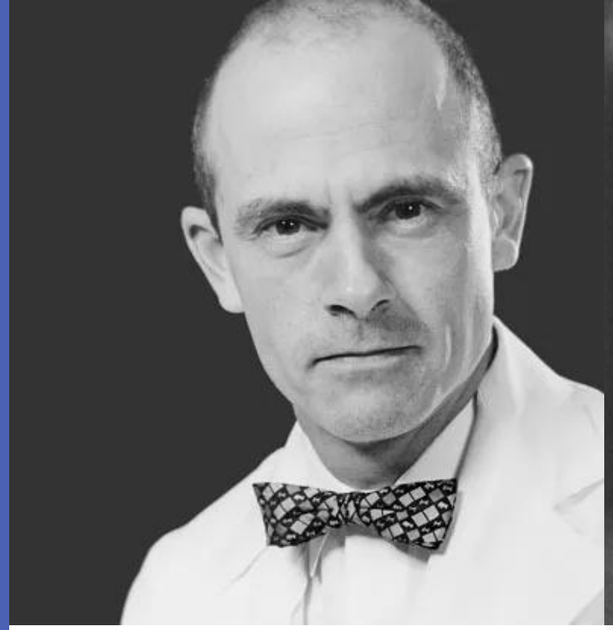
Brief historical remarks



Charles Dotter
1963

Father of interventional radiology by inadvertently catheterizing and recanalizing an occluded iliac artery.

ANATOMY CHANGE

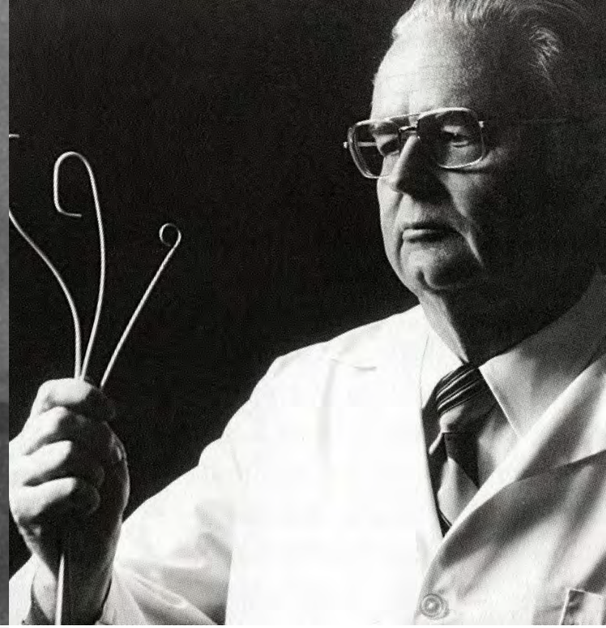
Per Amundsen
1967

First to routinely catheterize and examine all cerebral vessels, carotid as well as vertebral arteries, via the femoral route.

Used a single wall puncture techique to minimize the risk of groin hematoma.

SELECTIVE CATHETERISM

RISK REDUCTION



Melvin Judkins
1968

Was a pioneer in the development of pre-shaped catheters for transfemoral percutaneous selective angiography.

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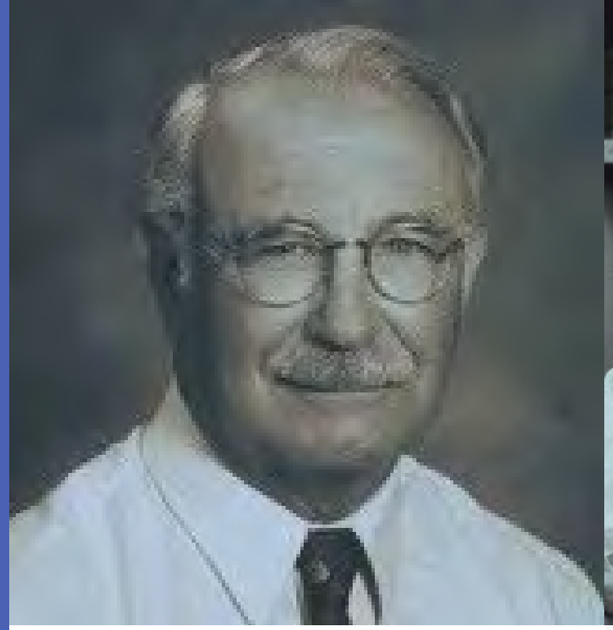
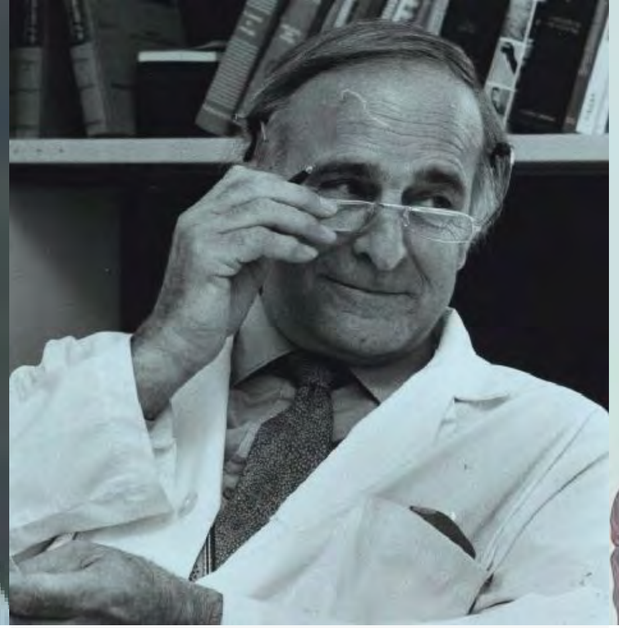
Brief historical remarks



William H. Barry
1979

Published on the technique of left heart coronary angiography through a femoral arterial sheath, with a reduced rate of complications.



Lucien Campeau
1989

Performed the first coronary angiogram with a transradial approach using 5F catheters, as a way to possibly cut the bleeding complication rate.

He performed his first radial access interventional coronary procedure in 1992.

Y. Matsumoto
2000

First report of selective diagnostic cerebral angiography through percutaneous radial approach.

PATIENT CONFORT

RESOURCE EFFICIENCY

RISK REDUCTION

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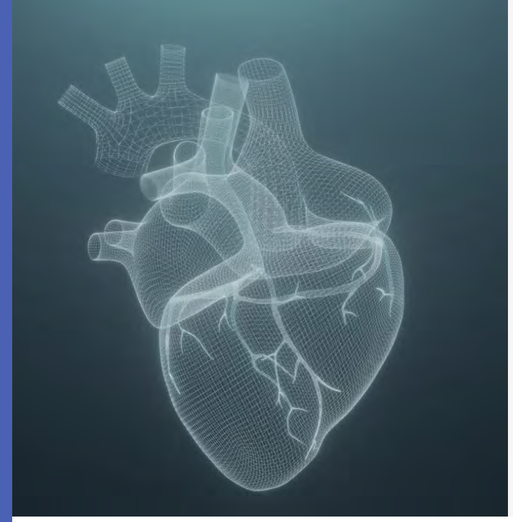
Brief historical remarks



ESC 2015
European Society of Cardiology

Recommended radial access as the first - line approach for coronary angiography and percutaneous coronary intervention.

However, proficiency in the femoral approach should be maintained, as this access is indispensable in a variety of scenarios.

THE LANCET MATRIX TRIAL 2015

Radial versus femoral access in patients with acute coronary syndromes undergoing invasive management: a randomised multicentre trial

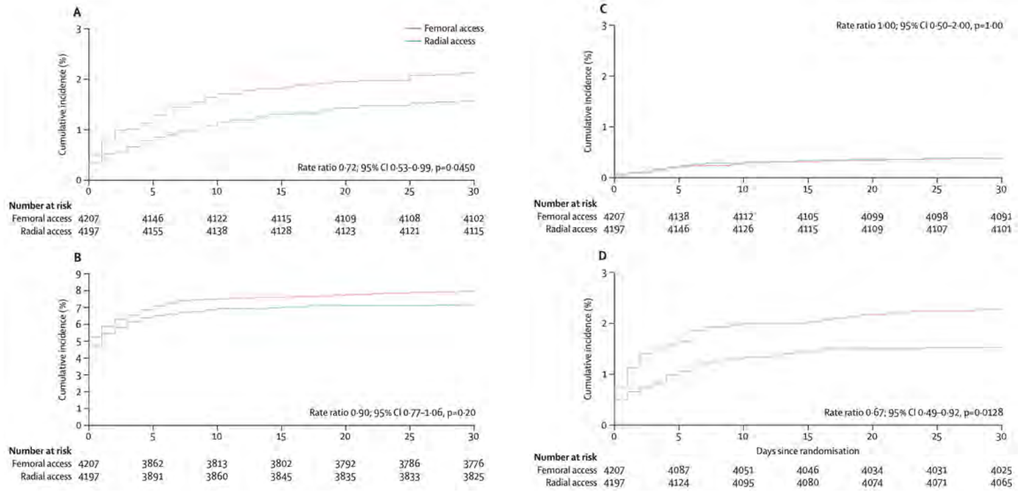


Figure 1: Components of coprimary composite at 30 days. (A) All - cause mortality, (B) myocardial infarction, (C) stroke, and (D) Bleeding .

Source : Valgimigli, M. et al. (2015) "Radial versus femoral access in patients with acute coronary syndromes undergoing invasive management : A randomised multicentre trial," The Lancet, 385 (9986), pp. 2465 –2476 . Available at:

Systematic Review and Meta-analysis of Major Cardiovascular Outcomes for Radial Versus Femoral Access in Patients with Acute Coronary Syndrome 2016

Ernesto Ruiz-Rodriguez, MD, Ahmed Asfour, MD, Georges Lolay, MD, Khaled M. Ziada, MD, and **Ahmed K. Abdel-Latif, MD, PhD**
Division of Cardiovascular Medicine, Gill Heart Institute, University of Kentucky and the Lexington VA Medical Center, Lexington, Kentucky

Abstract

Objectives—Radial artery access (RA) for left heart catheterization and percutaneous coronary interventions (PCIs) has been demonstrated to be safe and effective. Despite consistent data showing less bleeding complications compared with femoral artery access (FA), it continues to be underused in the United States, particularly in patients with acute coronary syndrome (ACS) in whom aggressive anticoagulation and platelet inhibition regimens are needed. This systematic review and meta-analysis aims to compare major cardiovascular outcomes and safety endpoints in patients with ACS managed with PCI using radial versus femoral access.

Methods—Randomized controlled trials and cohort studies comparing RA versus FA in patients with ACS were analyzed. Our primary outcomes were mortality, major adverse cardiac event, major bleeding, and access-related complications. A fixed-effects model was used for the primary analyses.

Results—Fifteen randomized controlled trials and 17 cohort studies involving 44,854 patients with ACS were identified. Compared with FA, RA was associated with a reduction in major bleeding (odds ratio [OR] 0.45, 95% confidence interval [CI] 0.33–0.61; $P < 0.001$), access-related complications (OR 0.27, 95% CI 0.18–0.39; $P < 0.001$), mortality (OR 0.64, 95% CI 0.54–0.75; $P < 0.001$), and major adverse cardiac event (OR 0.70, 95% CI 0.57–0.85; $P < 0.001$). These significant reductions were consistent across different study designs and clinical presentations.

Figure 2: Meta - analysis of major cardiovascular complications (RA vs FA). N = 44 854 patients. Favors RA regarding all outcomes: access - related complications, bleedings events, and major cardiovascular events.

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So why go radial for neurointervention?

To keep the history going.

Why go radial?

01

Better access profile

- LESS ACCESS COMPLICATIONS
- BETTER WHEN AORTO-ILIAC DISEASE
- BETTER WHEN HIGH HEMORRAGIC RISK
- BETTER FOR OBESE PATIENTS
- BETTER FOR SOME ADVERSE ARCHES
- DIRECT ACCESS TO THE VB ARTERIES

02

Patient preference

- LESS EMBARASSMENT
- FASTER RECOVERY TIME
- EARLIER MOBILIZATION / DISCHARGE
- LESS LOCAL COMPLICATIONS
- EASIER PROCEDURE PREPARATION
- LESS DISCONFORT POSTPROCEDURE
- LESS PAINFUL PROCEDURE

03

Higher cost efficiency

- FASTER HEMOSTASIS
- FASTER RECOVERY TIMES
- EARLIER DISCARGE
- LESS COMPLICATIONS

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Less access site complications

FEMORAL ACCESS

Groin or retroperitoneal hematoma

Arterial dissection and pseudoaneurysm

Arteriovenous fistula formation

Femoral nerve injury

Lower limb ischemia

RADIAL ACCESS

Radial artery spasm (RAS)

Radial artery occlusion (RAO)

Arteriovenous fistula formation

Arm hematoma

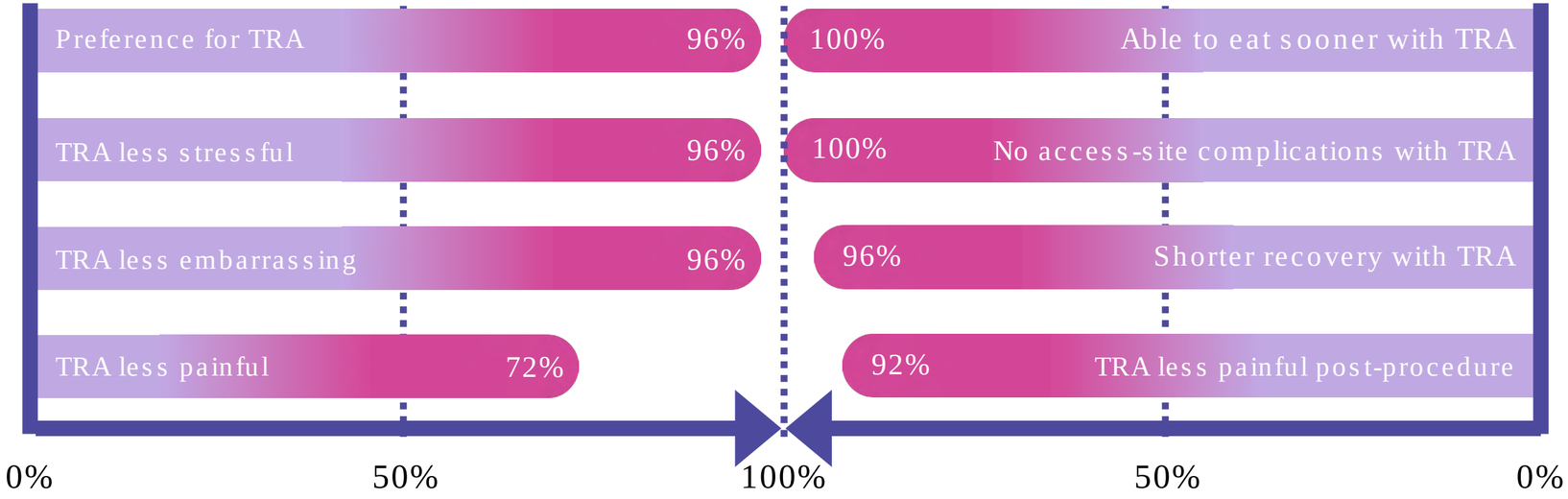
Hand ischemia

POTENTIAL ADVANTAGES

Shorter procedure duration (depending on anatomy)
Less discomfort post - procedure (fewer complications)
Less embarrassment (not exposing groin)
Earlier mobilization/discharge
Less stressful

JVIR
Journal of Vascular and Interventional Radiology
2019

Subjective patient preference: RA versus FA (N=25)



Source: Liu, L.B. et al. (2019) "Patient experience and preference in transradial versus transfemoral access during Transarterial radioembolization: A randomized single - center trial," Journal of Vascular and Interventional Radiology, 30(3), pp. 414–420.

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Benefits for patients

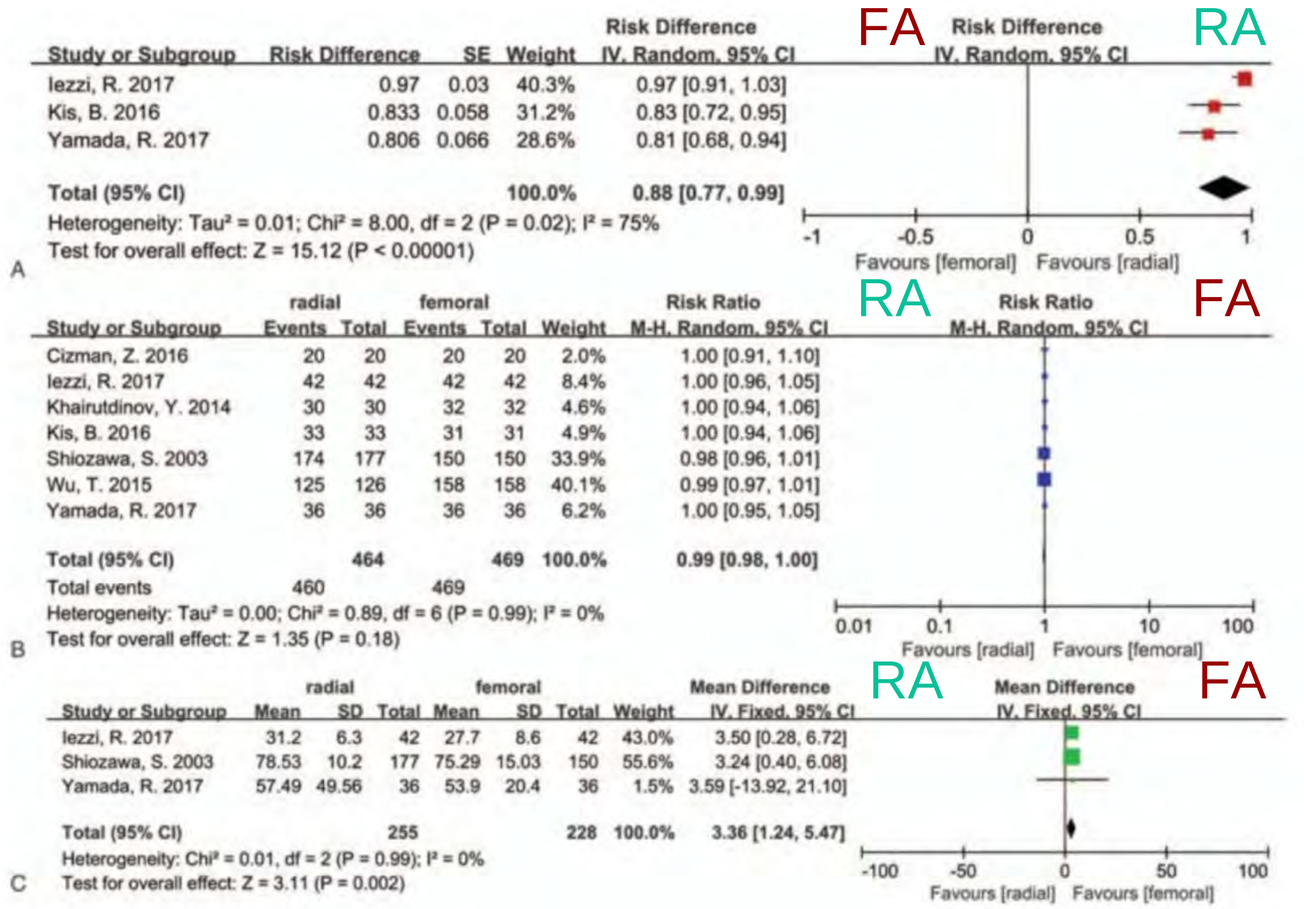
Forest plot: TRA versus TFA

JVIR Journal of Vascular and Interventional Radiology 2022

A: Patients' preference

B: Success rate

C: Procedure time



Source: Wan, Y. et al. (2022) "Transradial versus transfemoral access for patients with liver cancer undergoing hepatic arter ial infusion chemotherapy: Patient experience and procedural complications," Journal of Vascular and Interventional Radiology, 33 (8).

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Benefits for patients

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So, is there still any doubt?

Major concerns about the TRA

A learning -curve of

30-50 cases

has been described in cardiac and neurointervention series.

Longer procedures with higher radiation exposure;
Risk of vascular and neurological complications;
Risk of radial artery occlusion and spasm;
Adverse anatomy with vascular tortuosity;
Smaller caliber of the radial artery;
Absence of dedicated hardware for INR.

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THE LANCET RIVAL STUDY 2011

	Radial (n=3507)	Femoral (n=3514)	Hazard ratio (95% CI)	p value
Primary outcome				
Death, MI, stroke, or non-CABG bleeding at 30 days	128 (3·7%)	139 (4·0%)	0·92 (0·72–1·17)	0·50
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

Source : Jolly, S.S. et al. (2011) “Radial versus femoral access for coronary angiography and intervention in patients with acute coronary syndromes (rival) : A randomised, Parallel Group, Multicentre Trial,” The Lancet, 377(9775), pp. 1409–1420.

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	Radial (n=3507)	Femoral (n=3514)	HR (95% CI)	p value
Major vascular complications at 30 days				
Large haematoma	42 (1·2%)	106 (3·0%)	0·40 (0·28–0·57)	<0·0001
Pseudoaneurysm needing closure	7 (0·2%)	23 (0·6%)	0·30 (0·13–0·71)	0·006
Arteriovenous fistula	0 (0%)	5 (0·1%)	..	..
Ischaemic limb needing surgery	1 (0%)*	0 (0%)	..	..
PCI complications†				
Abrupt closure	12 (0·5%)	11 (0·5%)	1·11 (0·49–2·51)	0·81
No reflow	21 (0·9%)	31 (1·3%)	0·69 (0·40–1·20)	0·19
Dissection with reduced flow	30 (1·3%)	25 (1·1%)	1·22 (0·72–2·07)	0·46
Coronary perforation	5 (0·2%)	4 (0·2%)	1·27 (0·34–4·73)	0·72
Catheter thrombus	2 (0·1%)	2 (0·1%)	1·01 (0·14–7·21)	0·99
Stent thrombosis‡	16 (0·7%)	26 (1·2%)	0·63 (0·34–1·17)	0·14
Definite	8 (0·4%)	16 (0·7%)	0·51 (0·22–1·19)	0·12
Probable	8 (0·4%)	11 (0·5%)	0·74 (0·30–1·84)	0·52
PCI procedural time (min)	35 (22–50)	34 (22–50)	..	0·62
Fluoroscopy time (min)§	9·3 (5·8–15·0)	8·0 (4·5–13·0)	..	<0·0001
PCI contrast volume (mL)	181 (140–240)	180 (145–240)	..	0·87
Length of stay in hospital (days)	4 (3–7)	4 (3–7)	..	0·18
Persistent pain at access site for >2 weeks	87/3378 (2·6%)	104/3392 (3·1%)	0·84 (0·63–1·12)¶	0·22
Patient prefers radial next procedure	2962/3282 (90·2%)	1629/3210 (50·7%)	8·99 (7·86–10·28)¶	<0·0001

Data are number (%) or median (IQR), unless otherwise stated. HR=hazard ratio. PCI=percutaneous coronary intervention. *Related to iliac artery thrombosis secondary to intra-aortic balloon pump inserted via femoral site. †As a proportion of patients having PCI: n=2311 in the radial group and n=2349 in the femoral group. ‡As a proportion of individuals receiving a stent: n=2197 in the radial group and n=2243 in the femoral group. §Fluoroscopy times added to case report forms and available for 2850 patients in the radial group and 2890 patients in the femoral group. ¶Odds ratio (95% CI).

Table 4: Procedural complications and outcomes and patient preference

Source : Jolly, S.S. et al. (2011) “Radial versus femoral access for coronary angiography and intervention in patients with acute coronary syndromes (rival) : A randomised, Parallel Group, Multicentre Trial,” The Lancet, 377(9775), pp. 1409–1420. Available at: https ://doi .org/ 10.1016/s0140 - 6736 (11)60404 - 2.

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Archives of Cardiovascular Diseases

RAY'ACT-1 STUDY 2019

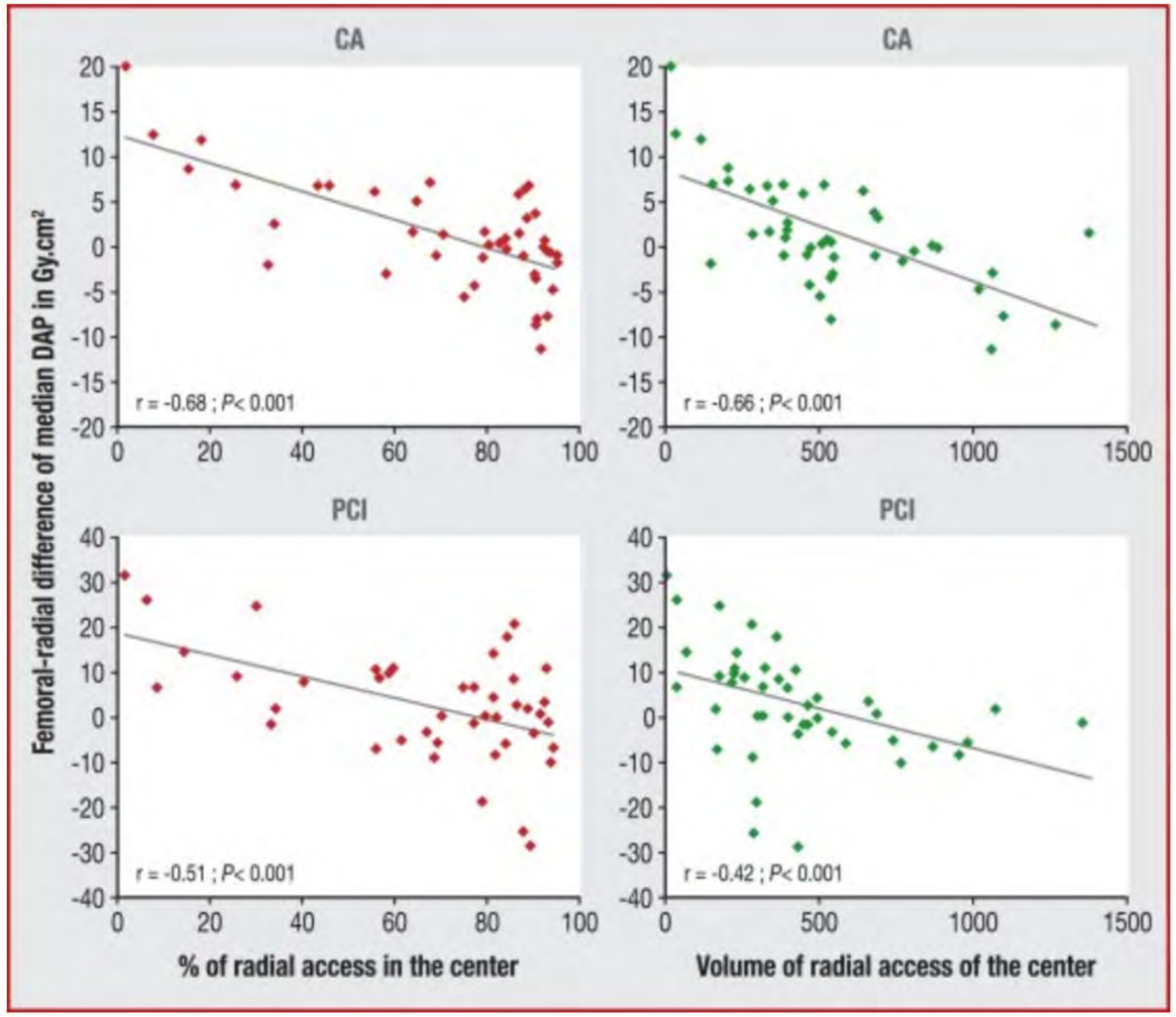

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Table 1 Characteristics of patients undergoing angiographic procedures by access site*

Characteristic	Radial† (n=206)	Femoral‡ (n=844)	P value
Sex			
Female	127 (62)	498 (59)	0.53
Mean age, years	56±17	59±17	0.07
Procedure			<0.001
Diagnostic/vasospasm	148 (72)	522 (62)	
Primary coil embolization of aneurysm	19 (9)	83 (10)	
Flow-diverter device, stent for aneurysm	16 (8)	57 (7)	
Thrombectomy, thrombolysis, carotid artery stent, stent for atherosclerosis/stroke	9 (4)	138 (16)	
Embolization other than for aneurysm	12 (6)	42 (5)	
Other treatment	2 (1)	2 (0.2)	
Pathology			<0.001
Normal	41 (20)	112 (14)	
Arteriovenous malformation/dural arteriovenous fistula	36 (18)	144 (17)	
Aneurysm	86 (42)	306 (36)	
Acute stroke	2 (1)	86 (10)	
Atherosclerosis/chronic occlusion	20 (10)	113 (13)	
Tumor	3 (1.4)	31 (4)	
Vasospasm	8 (4)	24 (3)	
Other	10 (5)	28 (3)	
Sheath size, F			0.004
5	139 (67)	512 (61)	
6	62 (30)	194 (23)	
7	4 (2)	28 (3)	
8	1 (0.5)	110 (13)	
Catheter size, F			0.29
5	145 (70)	565 (67)	
6	59 (29)	229 (27)	
7	1 (0.5)	19 (2)	
8	1 (0.5)	31 (4)	

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Variable	Radial (n=206)	Femoral (n=844)	P value
Fluoroscopy time (min)	23±17	20±17	0.09
Total contrast (mL)	121±64	113±71	0.18
Treatment fluoroscopy time (min)†	40±20	30±19	**0.001**
Treatment total contrast (mL)	159±69	131±57	**0.002**
Diagnostic/vasospasm fluoroscopy time (min)	15±8	14±13	0.30
Diagnostic/vasospasm total contrast (mL)	106±55	102±76	0.61
Total complications	4 (2)	60 (7)	**0.003**
Total minor complications‡	3 (2)	47 (6)	**0.01**
Total major complications§	1 (0.5)	13 (2)	0.33
Life-threatening complications	0 (0)	5 (0.5)	0.50
Treatment complications	3 (5) (n=58)	30 (9) (n=321)	0.45
Diagnostic/vasospasm complications	1 (1) (n=148)	30 (6) (n=522)¶	**0.007**
Access site crossover	3 (1.5)	11 (1.3)	0.89

Source : Catapano, J.S. et al. (2019) “Complications of femoral versus radial access in neuroendovascular procedures with propensity adjustment,” Journal of NeuroInterventional Surgery, 12(6), pp. 611–615.

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Life-threatening complications	0 (0)	5 (0.5)	0.50
Treatment complications	3 (5) (n=58)	30 (9) (n=321)	0.45
Diagnostic/vasospasm complications	1 (1) (n=148)	30 (6) (n=522)¶	**0.007**
Access site crossover	3 (1.5)	11 (1.3)	0.89

Source : Catapano, J.S. et al. (2019) “Complications of femoral versus radial access in neuroendovascular procedures with propensity adjustment,” Journal of NeuroInterventional Surgery, 12(6), pp. 611–615.

NEURI BICÊTRE

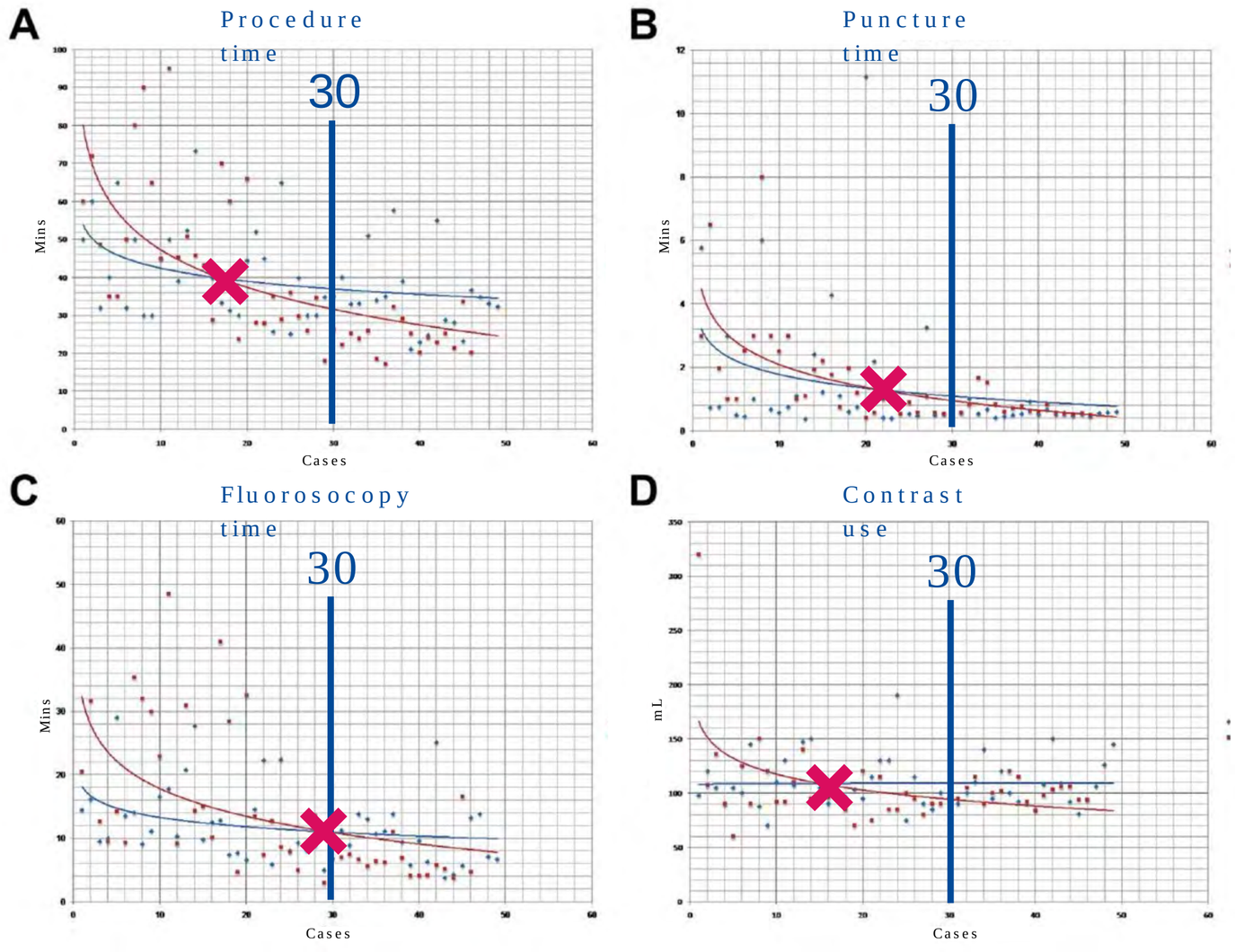
Experience matters

A learning-curve of

30-50 cases

has been described in cardiac and neurointervention series.

JOURNAL OF ENDOVASCULAR THERAPY 2022



Source: Wan, Y. et al. (2022) Liu, Y. et al. (2019) "A single-center, randomized, controlled comparison of the transradial vs transfemoral approach for cerebral angiography : A learning curve analysis," Journal of Endovascular Therapy, 26(5), pp. 717–724.

NEURI BICÊTRE

Why go radial?

NEURI BICÊTRE

01

Better access profile

- LESS ACCESS COMPLICATIONS
- BETTER WHEN AORTO-ILIAC DISEASE
- BETTER WHEN HIGH HEMORRAGIC RISK
- BETTER FOR OBESE PATIENTS
- BETTER FOR SOME ADVERSE ARCHES
- DIRECT ACCESS TO THE VB ARTERIES

02

More comfortable for patients

- LESS EMBARASSMENT
- FASTER RECOVERY TIME
- EARLIER MOBILIZATION / DISCHARGE
- LESS LOCAL COMPLICATIONS
- EASIER PROCEDURE PREPARATION
- LESS DISCONFORT POSTPROCEDURE
- LESS PAINFUL PROCEDURE

03

Higher cost efficiency

- FASTER HEMOSTASIS
- FASTER RECOVERY TIMES
- EARLIER DISCARGE
- LESS COMPLICATIONS

... with experience!

NEURI BICÊTRE

It all goes back to the anatomy

Anatomy considerations

Originates 1 cm distal to the flexor crease.

MAIN BRANCHES

1st segment

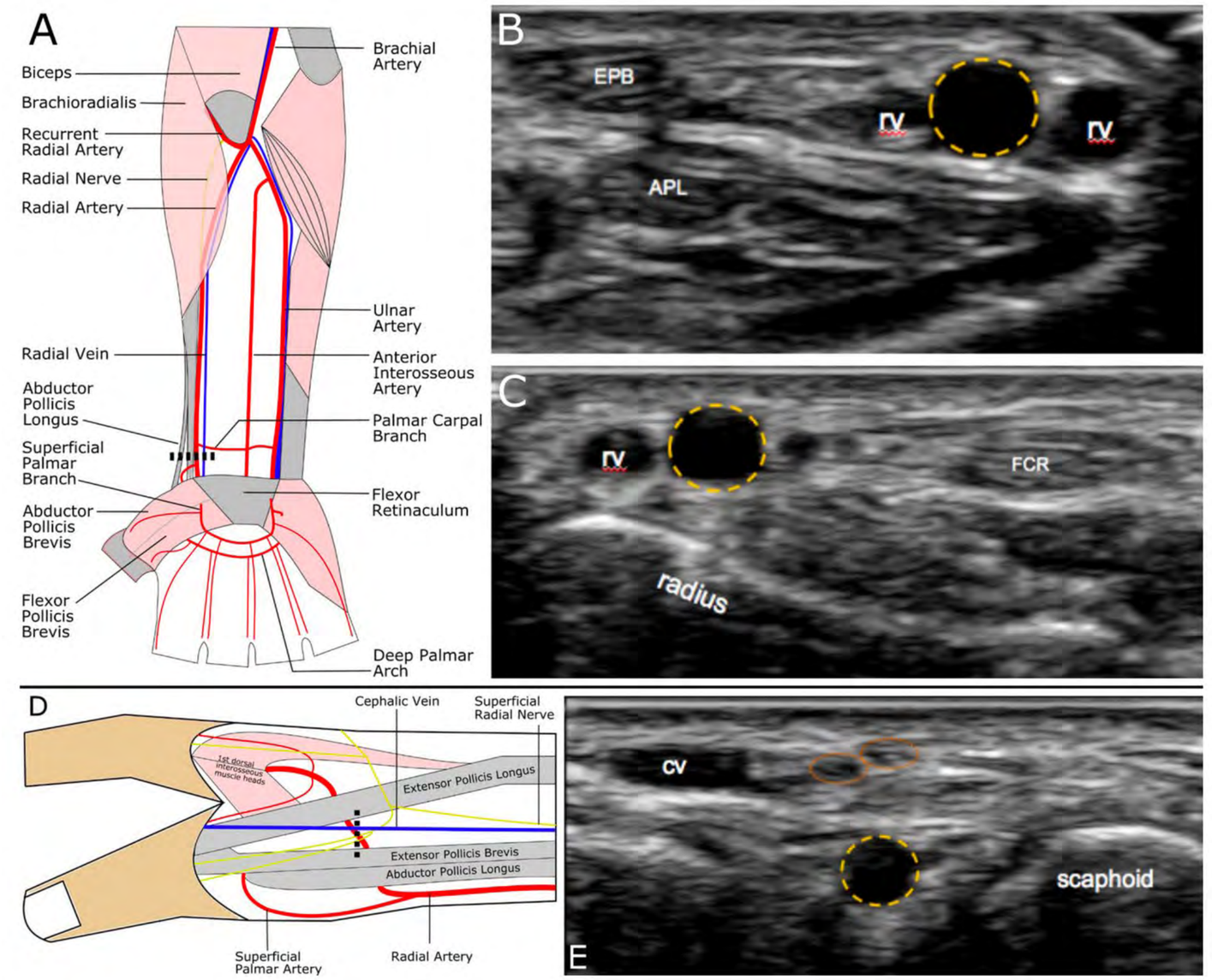
Recurrent radial artery
Palmar carpal branch

2nd segment

Superficial palmar branch
Dorsal carpal branch
Deep palmar branch

3rd segment

Arteria princeps pollicis
Arteria radialis indicis



Source : Narsinh, K.H. et al. (2021) “Radial artery access anatomy : Considerations for neuroendovascular procedures,” Journal of NeuroInterventional Surgery, 13(12), pp. 1139–1144.

NEURI BICÊTRE

Anatomy considerations

Brachial artery

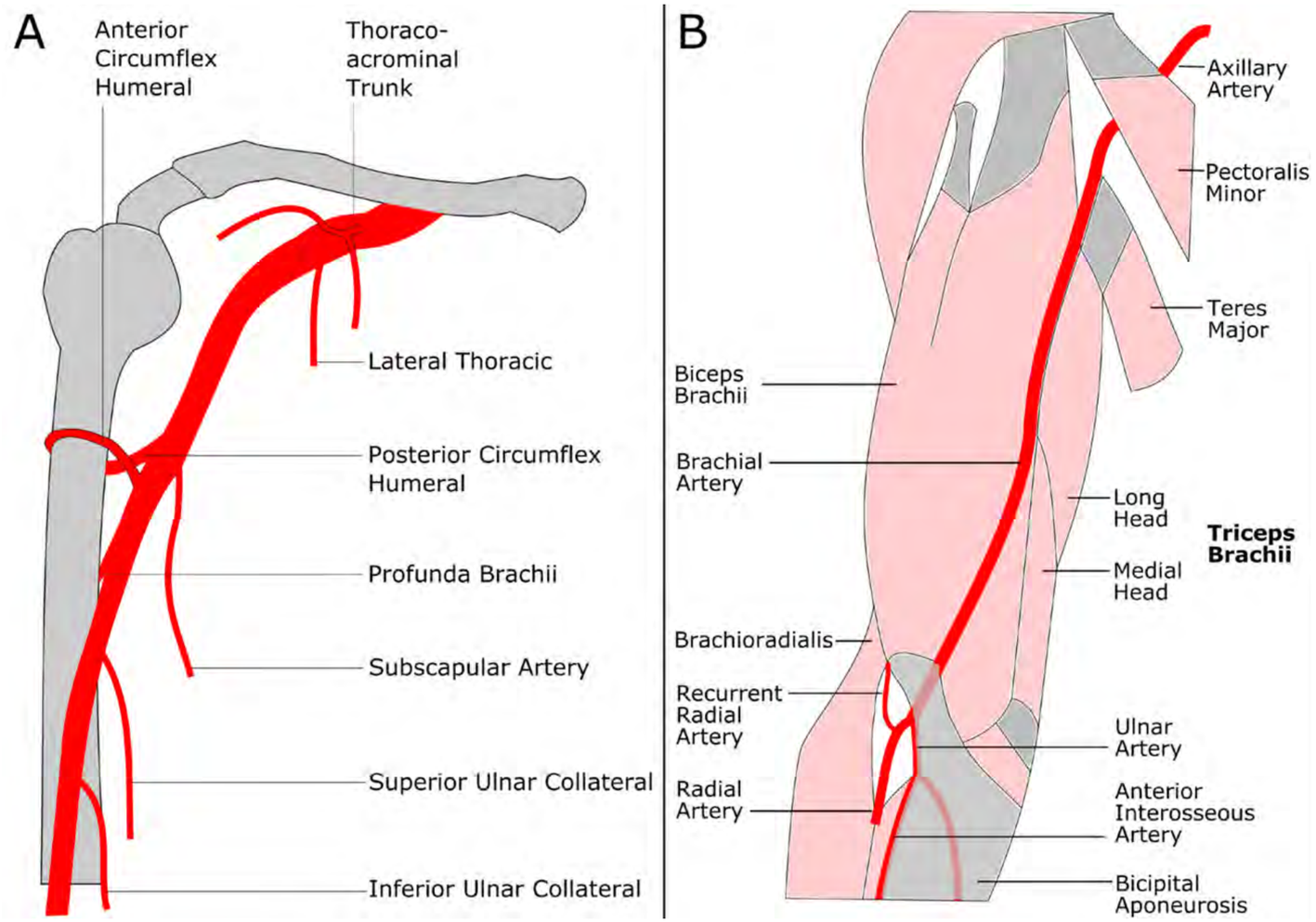
Distal: Cubital fossa
Proximal: Lower border of teres major

Axillary artery

Distal: Lower border of teres major
Proximal: Lateral border of the 1st rib

Subclavian artery

Distal: Lateral border of the 1st rib
Proximal: Brachiocephalic trunk/aortic arch



Source : Narsinh, K.H. et al. (2021) "Radial artery access anatomy : Considerations for neuroendovascular procedures," Journal of NeuroInterventional Surgery, 13(12), pp. 1139–1144.

NEURI BICÊTRE

Anatomic considerations

Navigation through the radial and brachial arteries is usually straightforward, but variants can complicate the navigation.

ANATOMIC VARIANT	INCIDENCE	IMPORTANCE
Bovine aortic arch	13.6% (n=23 882)	Eases catheterization of left CCA from right TRA, may increase the difficulty of left CCA from TFA.
High origin of the RA/'brachioradial artery'	9.2% (n=120)	Increases risk of spasm, can risk dissection when exchanging from a hydrophilic to stiff guidewire.
Tortuous right brachiocephalic artery	1% (n=997)	Can cause artery avulsion if straightened; increases conversion from TRA to TFA.
Radial artery loop	1% (n=997)	Can cause artery avulsion if straightened; increases conversion from TRA to TFA.
Aberrant right subclavian artery	0.47% (n=6833)	Difficulty entering the ascending aorta when using a TRA.

Source: Narsinh, K.H. et al. (2021) "Radial artery access anatomy: Considerations for neuroendovascular procedures," Journal of NeuroInterventional Surgery, 13(12), pp. 1139–1144.

NEURI BICÊTRE

High origin of the RA/'brachioradial artery'

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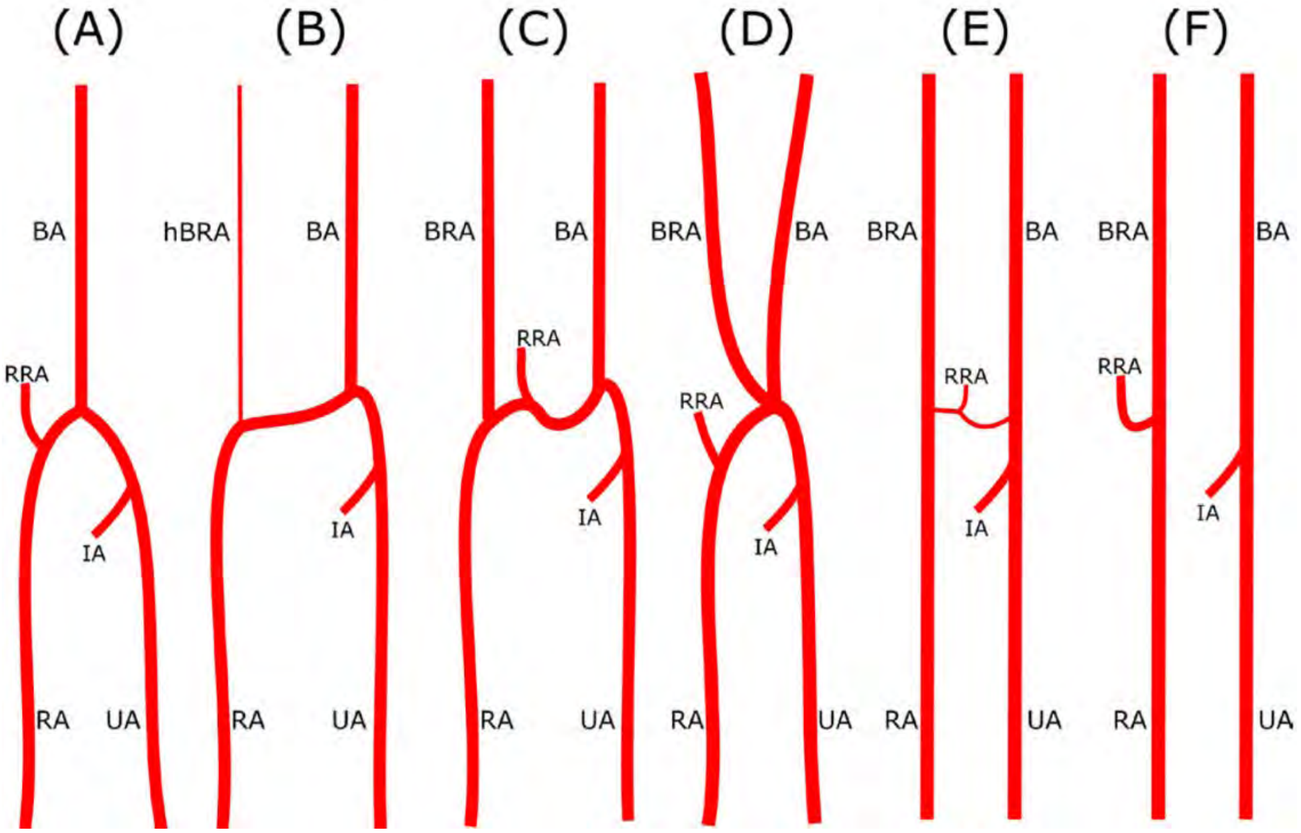

NEURI BICÊTRE

Anatomic considerations

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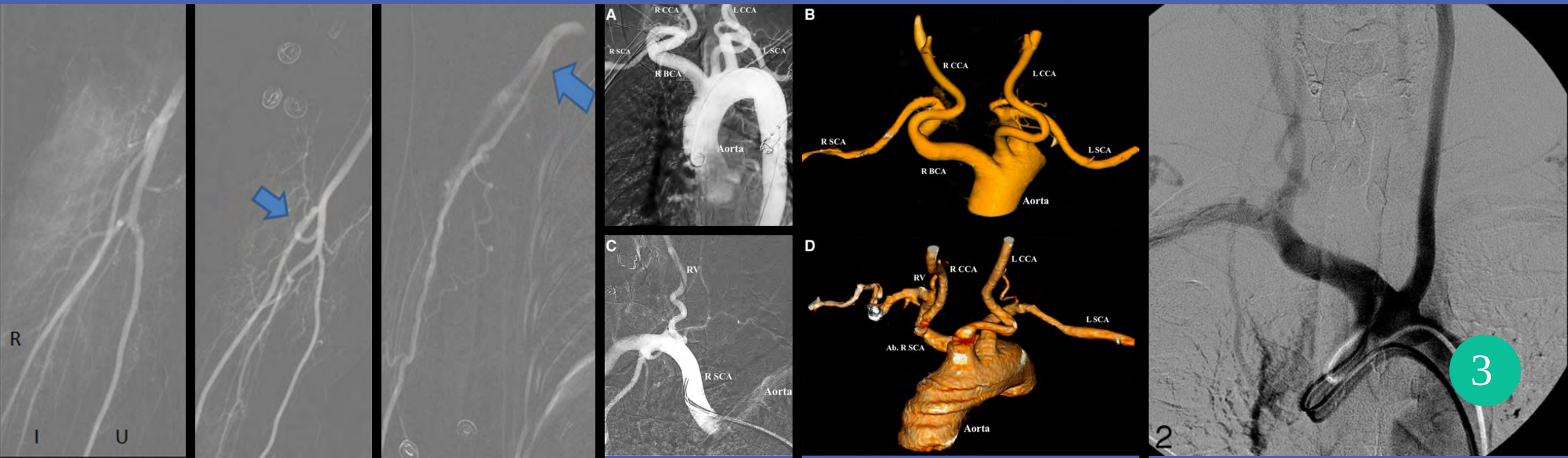


NEURI BICÊTRE

Step-by-step

Literature review and Bîcetre experience

Patient selection

RADIAL FIRST, PARTICULARLY IF:

Obese patient;

Bovine or type II/III aortic arches;

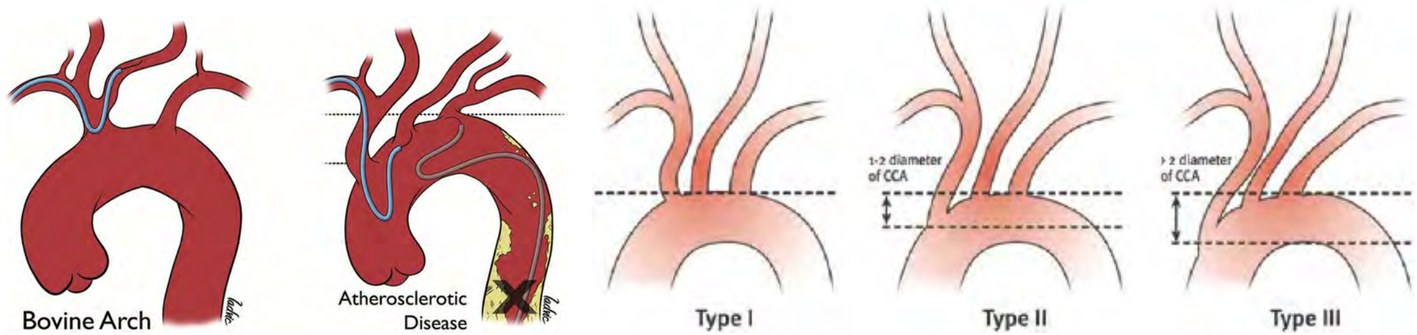
Previous iliac stenting/bypass, or femoral occlusion;

Extensive aortoiliac disease;

Antiplatelet agents or anticoagulation;

Pregnant patients;

Only a need for posterior circulation access.



Careful assessment of both radial and femoral pulses is recommended before entering the angiosuit.

Source:
Zalocar, L.A., Doroszuk, G. and Goland, J. (2020) “Transradial approach and its variations for neurointerventional procedures : Literature review,” Surgical Neurology International, 11, p. 248.
Kotelis, D. et al. (2012) “Morphological risk factors of stroke during thoracic endovascular aortic repair,” Langenbeck's Archives of Surgery, 397(8), pp. 1267 –1273.

NEURI BICÊTRE

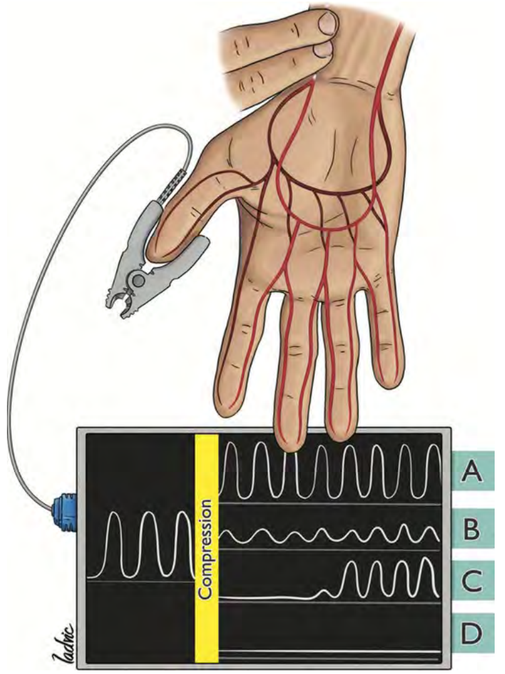
Patient selection

RELATIVE CONTRAINDICATIONS:

Radial artery size < 2mm;
Need for access > 7F;
Cardiogenic shock without palpable radial pulse;
Potential need for future arteriovenous fistula;
Need a radial artery donor site for coronary bypass graft surgery;
Known distal arterial occlusive disease or of Raynaud's syndrome .

Hand collateral circulation assessment through Allen/Barbeau tests has failed to predict hand-ischemia outcomes after TRA.

American Heart Association.



Source: Zalocar, L.A., Doroszuk, G. and Goland, J. (2020) "Transradial approach and its variations for neurointerventional procedures: Literature review," Surgical Neurology International, 11, p. 248.

NEURI BICÊTRE

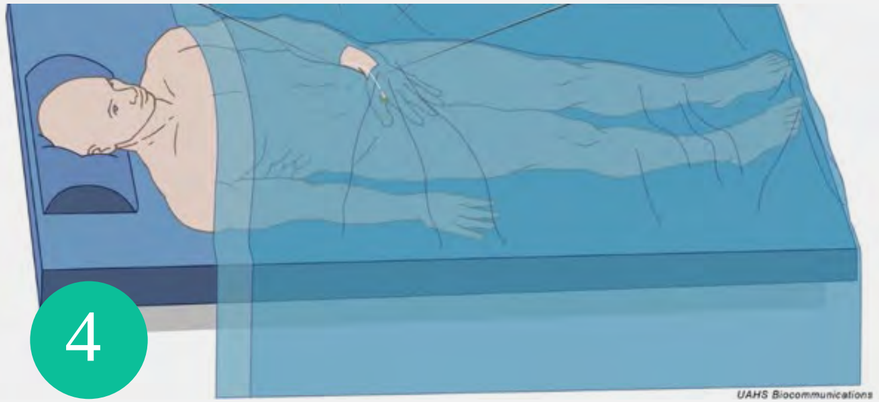
Room setup and patient preparation

Right side TRA is most frequently chosen as it is more convenient and favorable to the operator.

RIGHT APPROACH

Hand supine and extended on an arm - board.

Hand rotation if distal TRA.

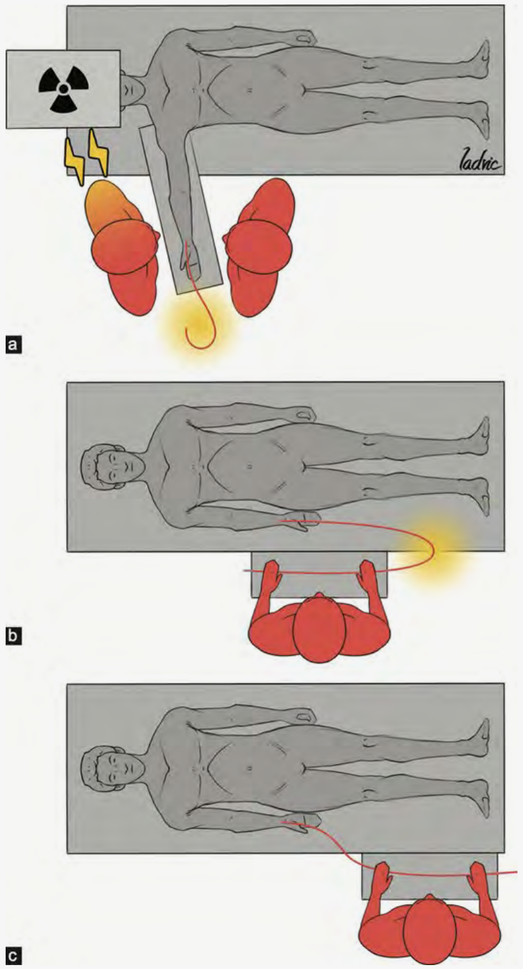


http://indieonlydesign.com/portfolio/surgical - procedure/

LEFT APPROACH

Catheterize from the left.

Work with left extended or bent arm, “Napoleonic” pose.



Source: Zalocar, L.A., Doroszuk, G. and Goland, J. (2020) “Transradial approach and its variations for neurointerventional procedures: Literature review,” Surgical Neurology International, 11, p. 248.

Room setup and patient preparation

Right side TRA is most frequently chosen as it is more convenient and favorable to the operator.

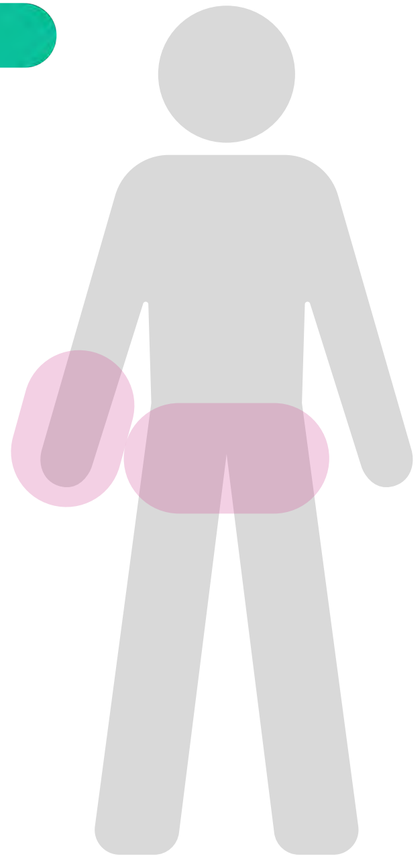
Room setup and patient preparation

Patient comfort is key to success.

STERILIZING PRACTICES

Wrist area from the flexor crease to the mid-forearm .

Groins should also be scrubbed .



PAIN AND SPASM PREVENTION

Topical lidocaine and nitroglycerin cream at least 30 minutes prior to puncture .

PRE-DILATE study

Manual heating of the radial artery prior to puncture .

Conscious sedation with opioids and/or benzodiazepines .

Radial puncture

RADIAL PUNCTURE SITE

Traditionally, TRA is obtained ~1 –3 cm proximal to the palmar wrist crease.

ARTERY SIZE

Proximal TRA:

2.69±0.40 mm (men); 2.43±0.38 mm (women)

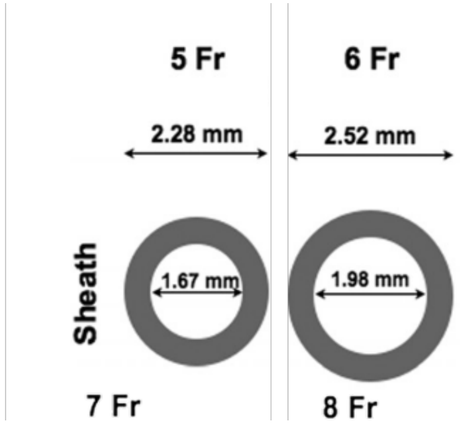
Range 1.15–3.95 mm.

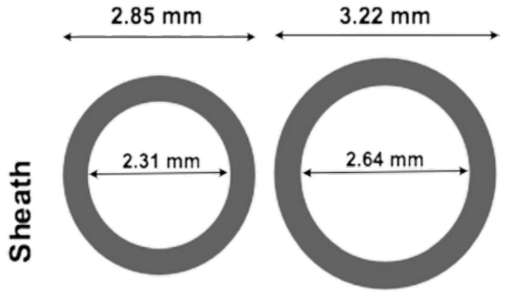
Distal TRA:

Smaller in size, but the difference is not significant .

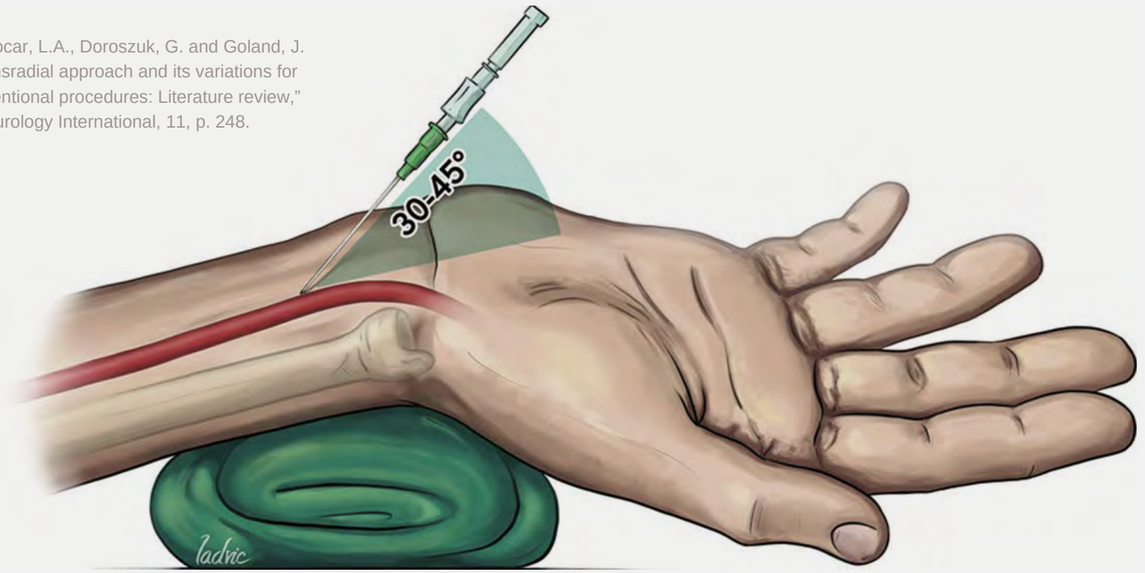
Ulnar artery :

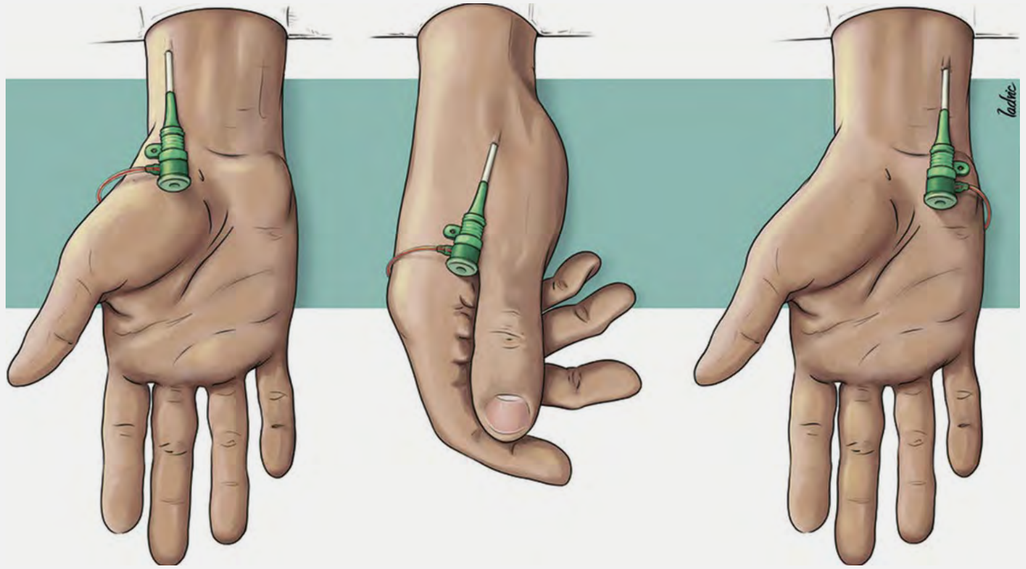
Larger than RA, but deeper .





Source: Zalocar, L.A., Doroszuk, G. and Goland, J. (2020) “Transradial approach and its variations for neurointerventional procedures: Literature review,” Surgical Neurology International, 11, p. 248.





Radial puncture

RADIAL PUNCTURE SITE

Distal transradial access (dTRA) has a lower rate of complications.

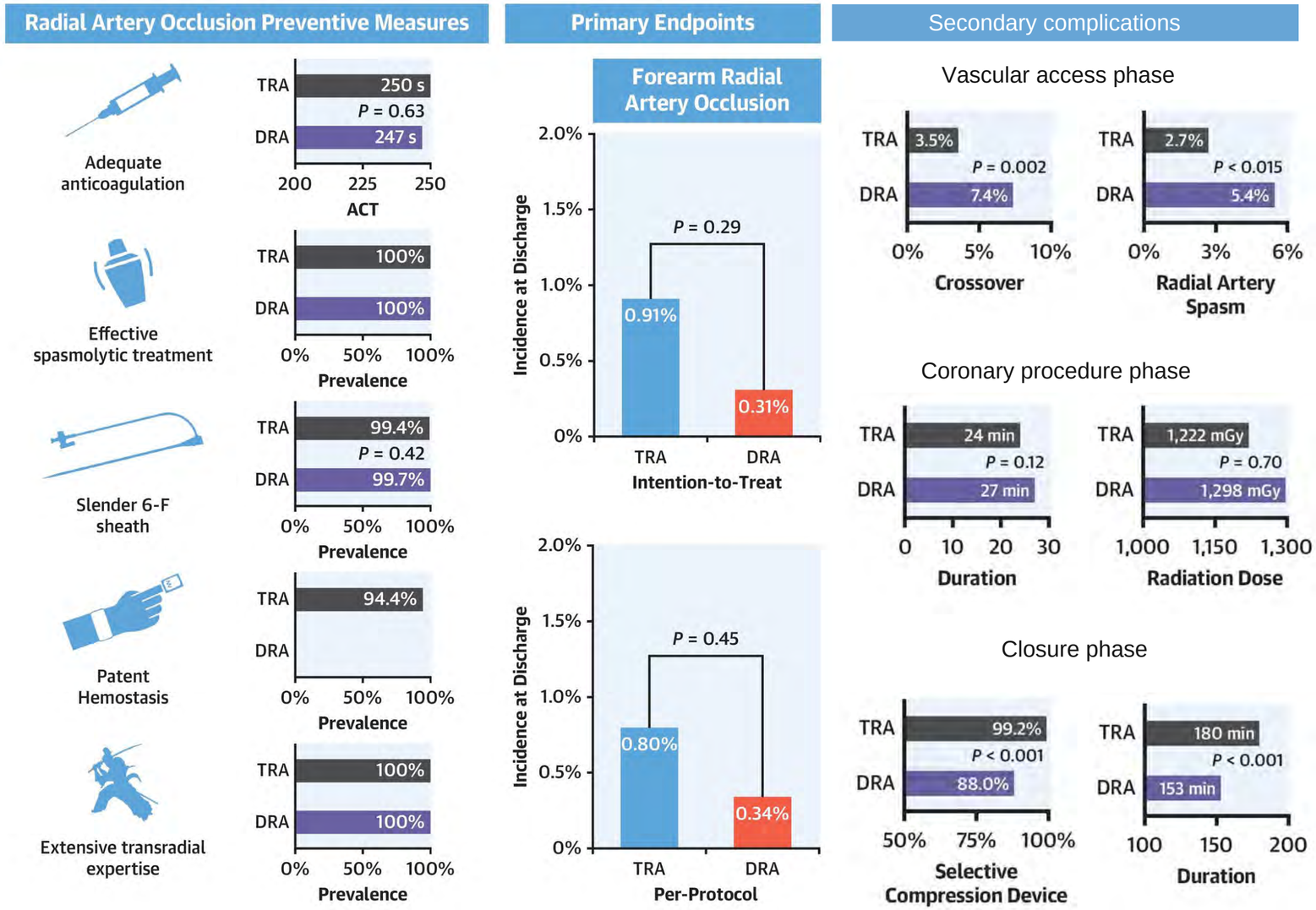
There is a lower risk of radial artery occlusion and sparing of the superficial palmar branch origin and conventional TRA access site.

NEURI BICÊTRE

Archives of Cardiovascular Diseases

DISCO RADIAL TRIAL

2017



Source: Georges, J. -L. et al. (2017) “Radial versus femoral access for coronary angiography and intervention is associated with lower patient radiation exposure in high -radial -volume centres: Insights from the ray’act -1 study,” Archives of Cardiovascular Diseases, 110(3), pp. 179 –187.

Radial puncture

RADIAL PUNCTURE SITE

To avoid excess spasm caused by multiple punctures, it is ideal if radial artery access is achieved on the first attempt.

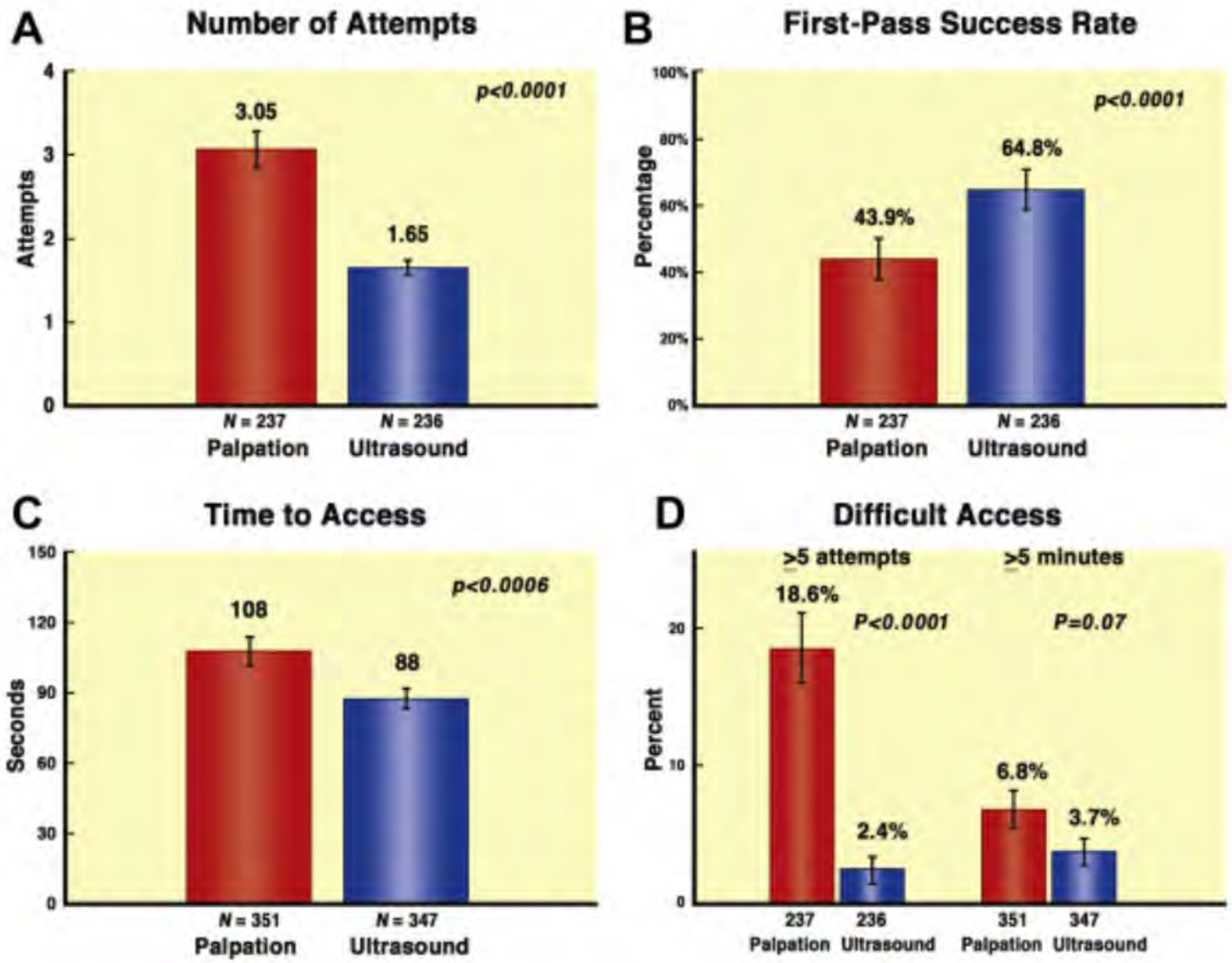
Micro-puncture radial set with a 21G needle, 0.018″ micro-guidewire, and sheath (either 4, 5, or 6F) is preferred.

Use the smallest sheath size.

NEURI BICÊTRE

JACC cardiovascular Interventions RAUST STUDY 2015

USE ECOCUIDANCE FOR OPTIMAL ACCESS



Source: Seto, A.H. et al. (2015) "Real-time ultrasound guidance facilitates transradial access," JACC: Cardiovascular Interventions, 8(2), pp. 283–291.

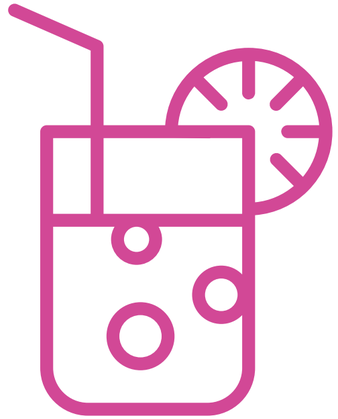
Radial cocktails

VASOSPASM PREVENTION

To prevent radial artery spasm or thrombosis, the use of anticoagulants and antispasmodic drugs is recommended.

If radial spasm is encountered during the procedure, antispasmodic drugs can be repeated.

THROMBOSIS



HEPARIN

Unfractionated heparin
50–70 U/kg or 5000 U

RADIAL SPASM

CCB

Verapamil
2.5 - 5 mg

Diltiazem
2 mg

Nicardipine
1 mg

Nimodipine
1 mg

NITRATES

Nitroglycerin
100 - 200 µg

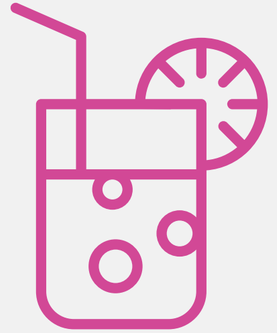
NEURI BICÊTRE

Radial cocktails

VASOSPASM PREVENTION

At Bîcetre we use a combination of unfractionated heparin (5000 U) and verapamil (2.5 mg).

Since the PATENS trial (2022) we stopped using intra-arterial nitrates.

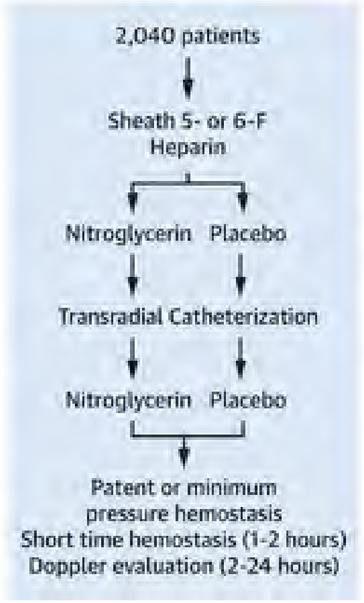


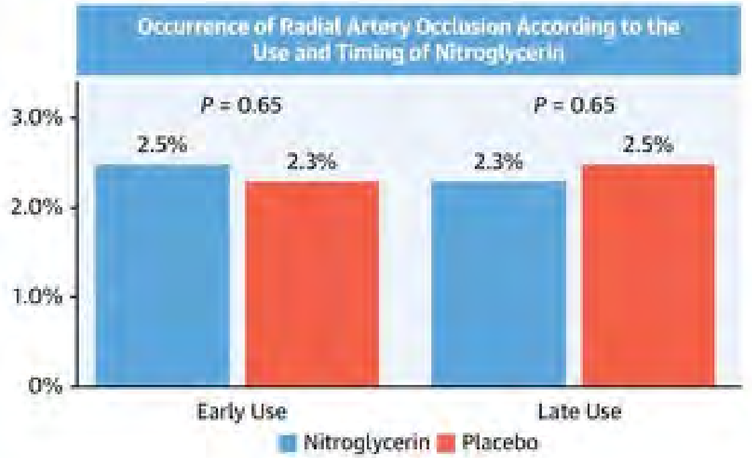
HEPARIN

Unfractionated heparin
5000 U

CCB

Verapamil
2.5 mg





Source : da Silva, R. L., de Andrade, P. B., Dangas, G., Joaquim, R. M., da Silva, T. R. W., Vieira, R. G., Pereira, V. C., Sousa, A. G. M., Feres, F., & Costa, J. R. (2022). Randomized clinical trial on prevention of radial occlusion after Transradial access using nitroglycerin . JACC: Cardiovascular Interventions, 15(10),

NEURI BICÊTRE

Radial puncture

RADIAL PUNCTURE SITE

1. Perform surgical field cleaning and disinfection.

2. Prepare the echograph probe with adequate parameters.

3. Assess the radial artery location with palpation followed by echography.

4. Inject subcutaneous lidocaine with or without nitroglycerin (400 -500 µg). Needle 23G.

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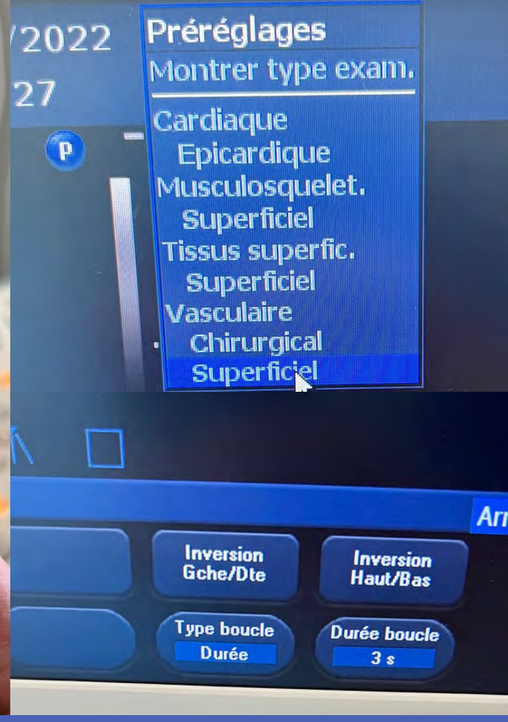
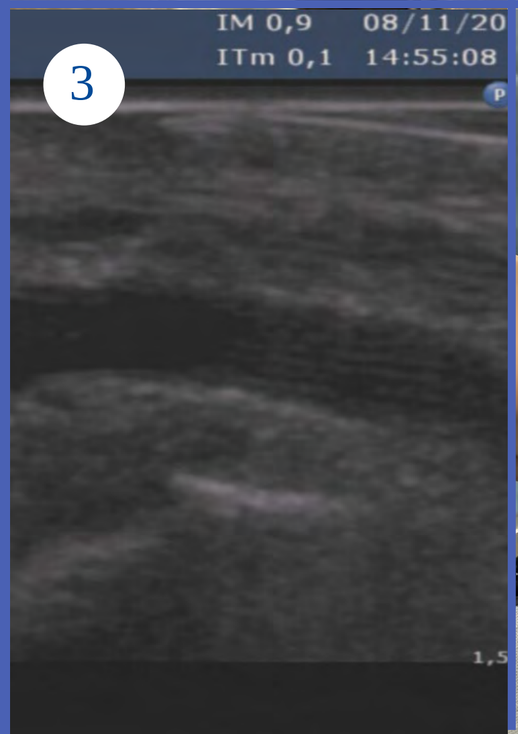
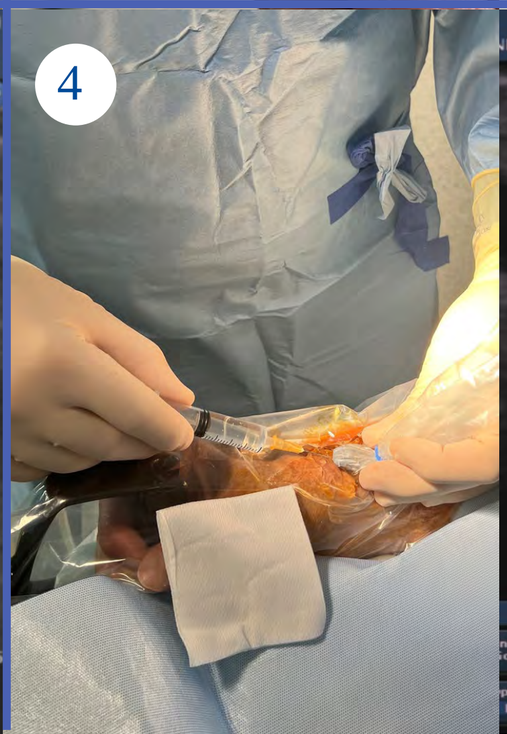
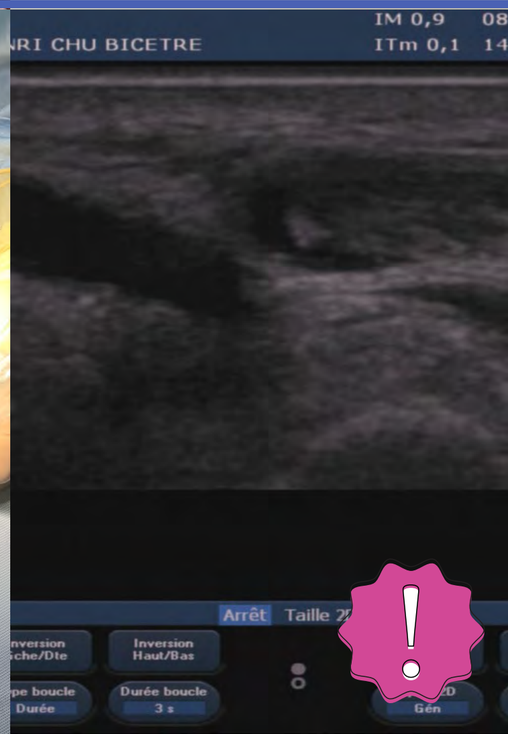








Radial puncture

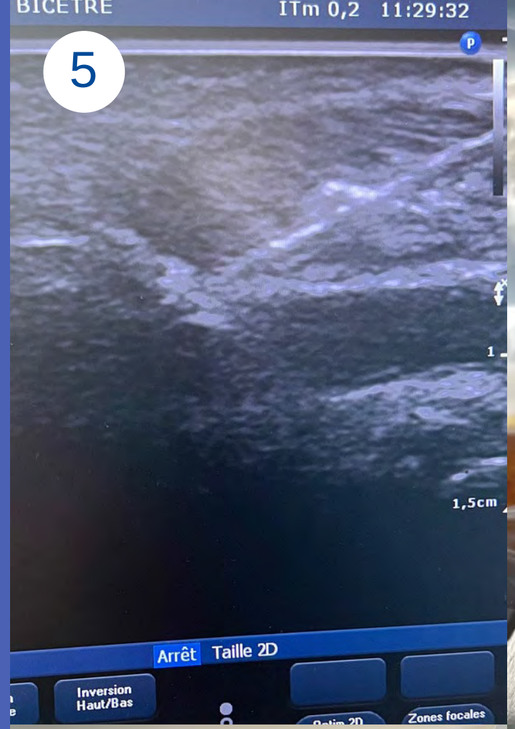
RADIAL PUNCTURE SITE

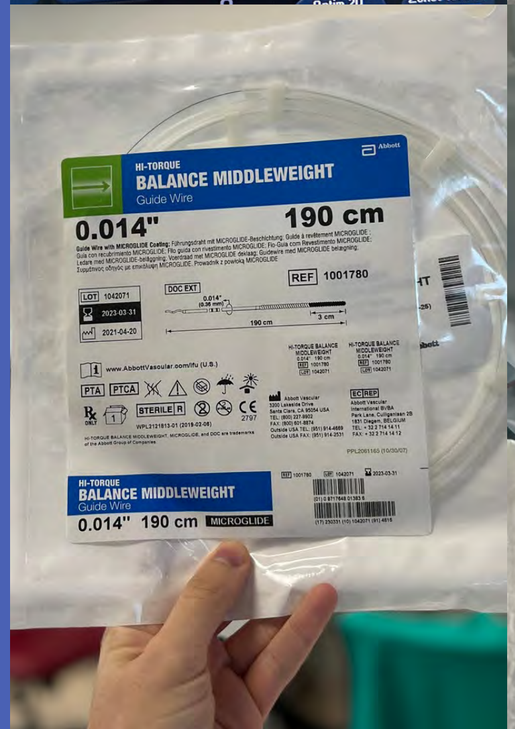
5. Puncture under echoguidance. In Bîcetre we favor the single -wall puncture.

6. Advance the guide -wire. If resistance is felt, take it back and try again.

7. Place the sheath over the guide -wire.

8. Slowly administer the radial cocktail diluted in the patient blood (20 mL) through the sheath 3 -way stop cock. Fixate the sheath.



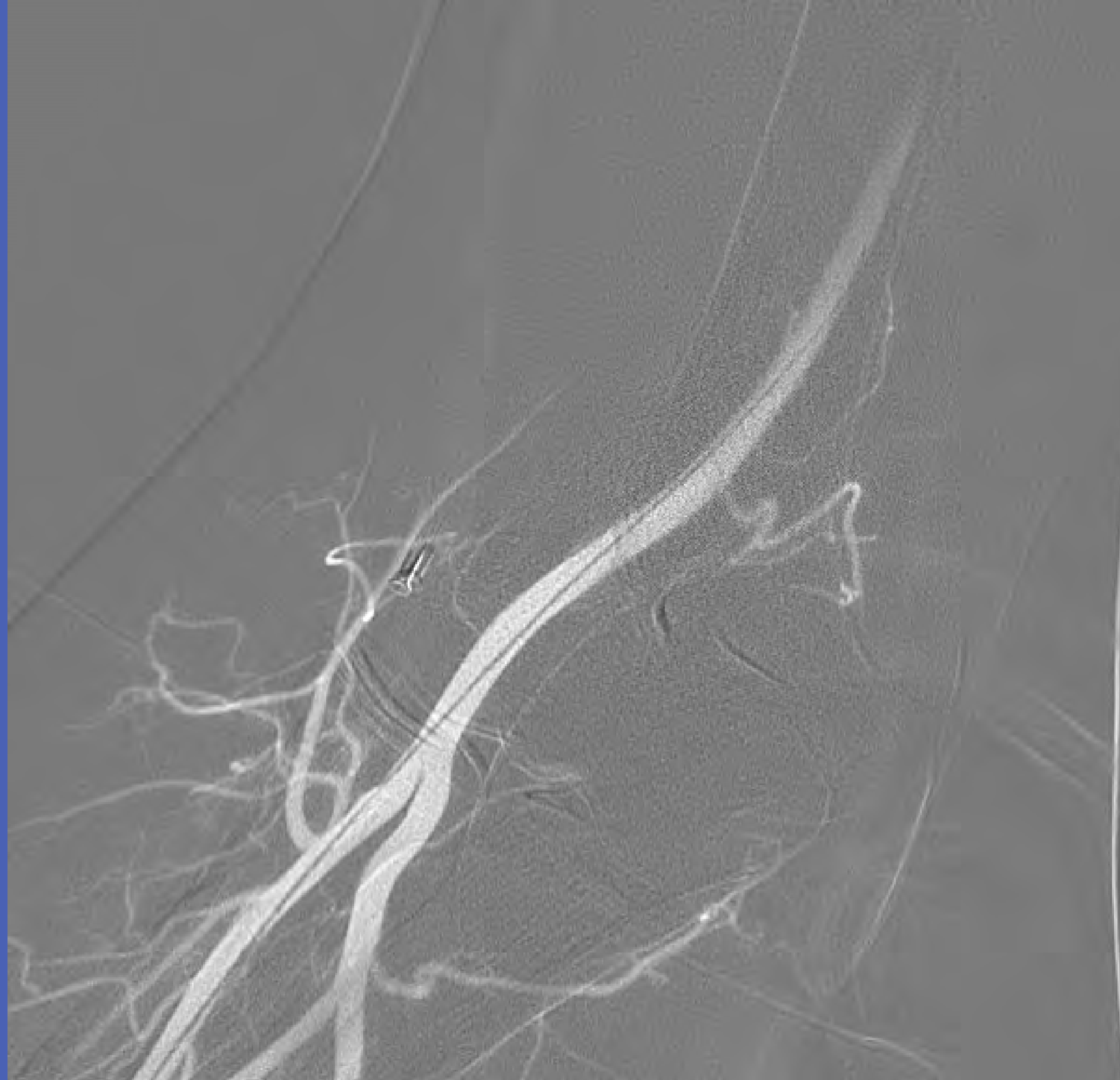


NEURI BICÊTRE

Navigation

ARM NAVIGATION

A radial artery angiogram should be performed through the sheath to include a view of the brachial bifurcation.



NEURI BICÊTRE

Navigation

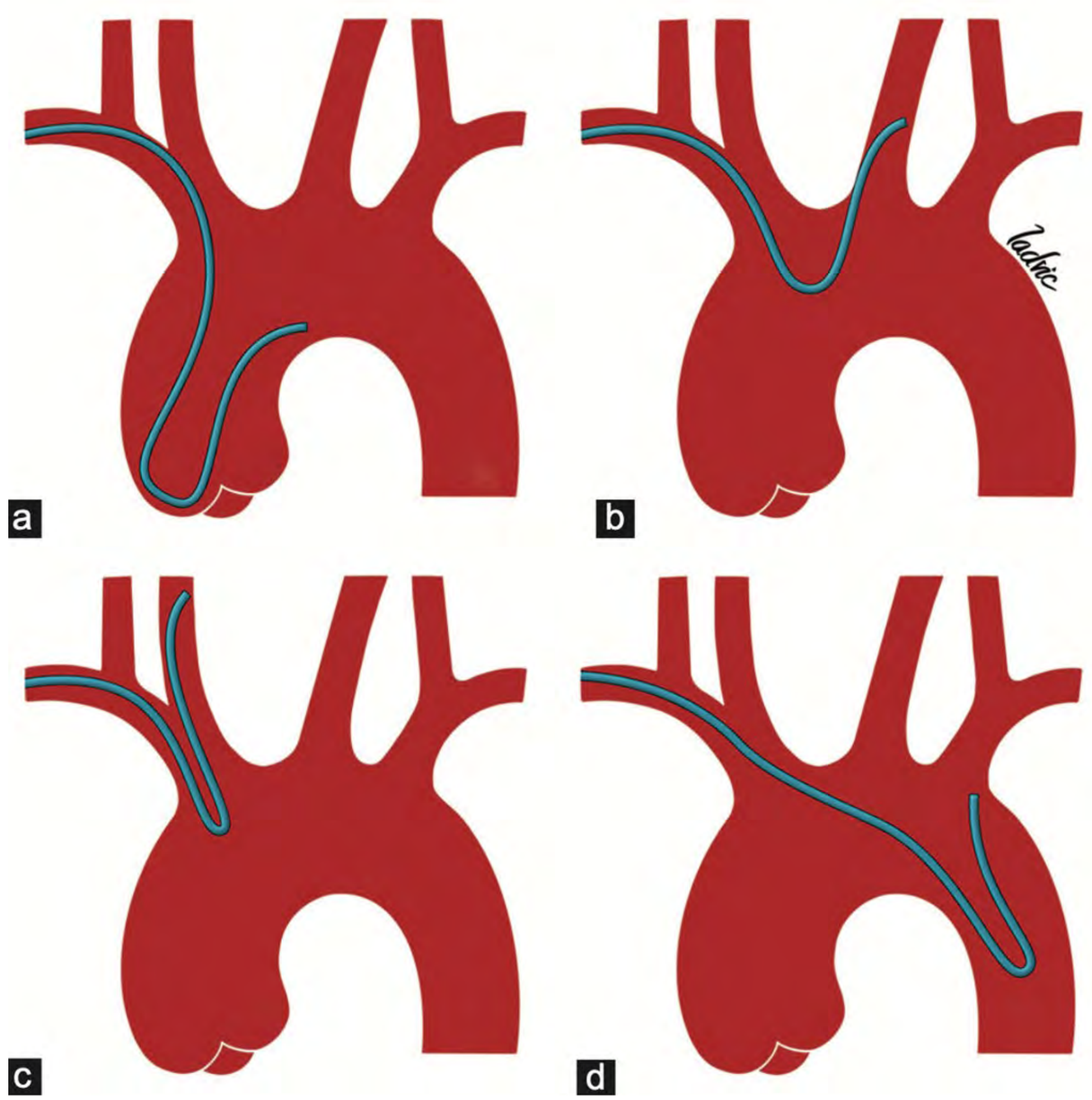
CATHETER CURVE FORMATION

Navigation can be usually performed using a Simmons 2 catheter and 150 cm 45-shaped 0.035" wire.

Glide: > navigability, < support
Non-glide: < navigability, > support.

Once the Simmons catheter is reconstituted, selective four-vessel catheterization is performed identically as in TFA.

NEURI BICÊTRE



Source : Zalocar, L.A., Doroszuk, G. and Goland, J. (2020) “Transradial approach and its variations for neurointerventional procedures : Literature review,” Surgical Neurology International, 11, p. 248.

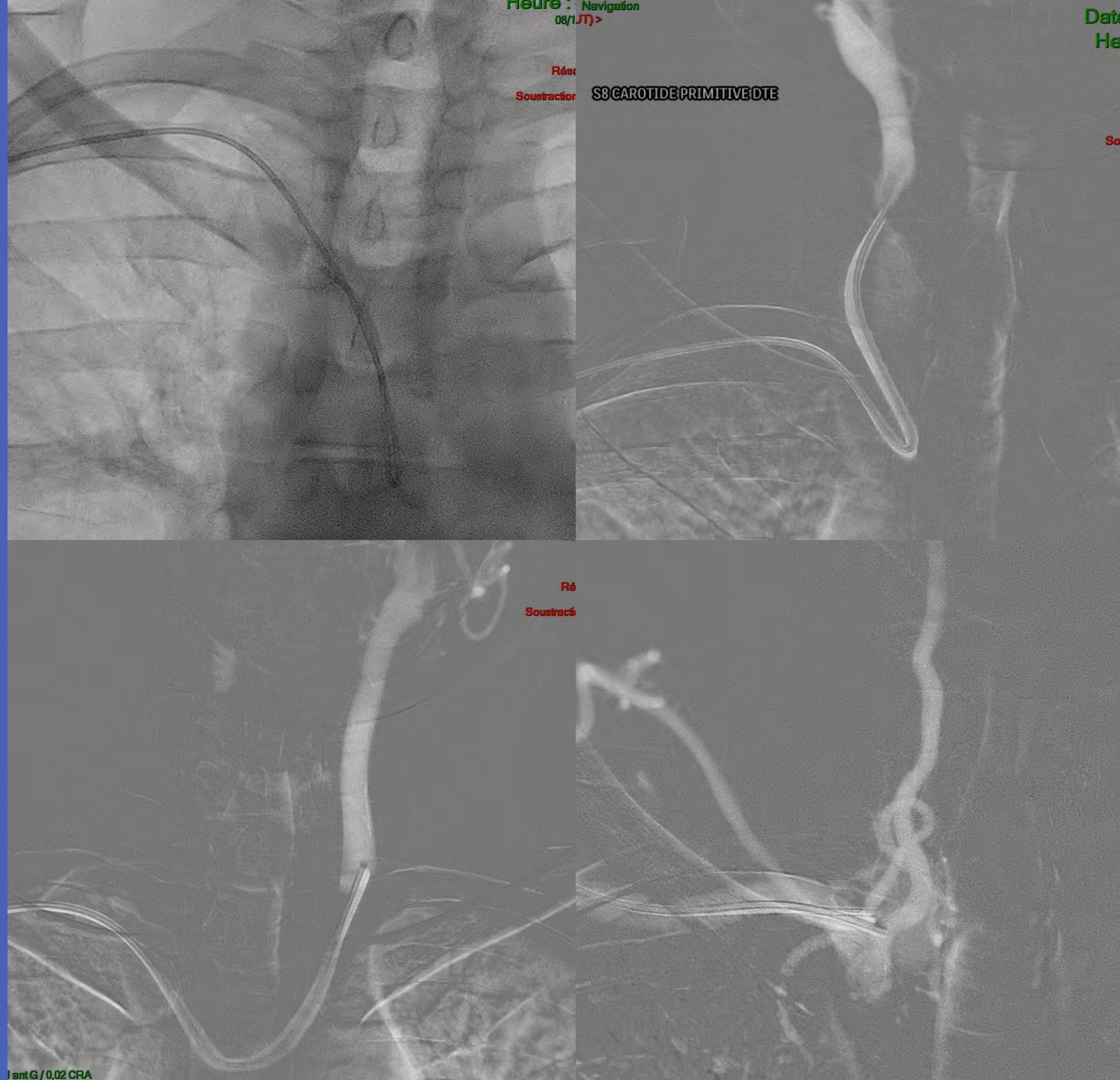
Navigation

CATHETER CURVE FORMATION

Navigation can be usually performed using a Simmons 2 catheter and 175 cm J-shaped 0.035" wire.

Glide: > navigability, < support
Non-glide: < navigability, > support.

Once the Simmons catheter is reconstituted, selective four-vessel catheterization is performed identically as in TFA.



NEURI BICÊTRE

Navigation

ENDOVASCULAR TREATMENT

When angiography is followed by endovascular treatment, the Simmons catheter usually is exchanged for another type of catheter over an exchange guide.

Several support catheters have been described in the literature for endovascular treatment procedures:

	OD F / inch / mm	ID inch / mm	Working length cm
BALLAST .088	8 / 0.106 / 2.70	0.088 / 2.24	80, 90,100, 105
RIST .079	7 / 0.092 / 2.36	0.079 / 2.01	95, 100, 105
BENCHMARK .071	6 / 0.079 / 2.03	0.071 / 1.80	95, 105, 115

NEURI BICÊTRE

Navigation

POOLED-ANALYSIS FROM:

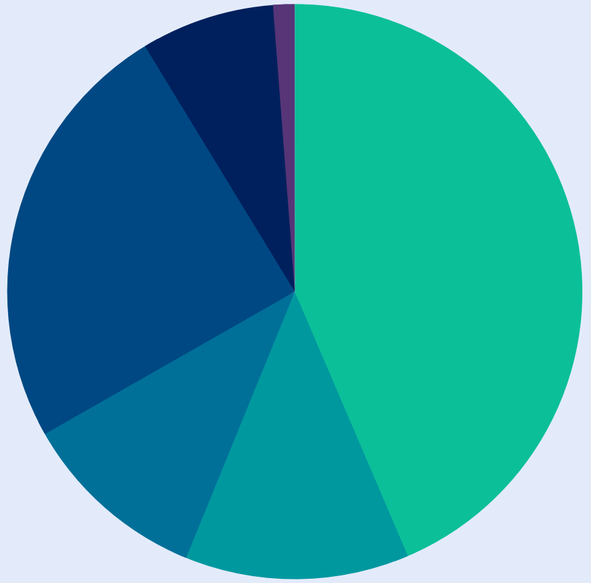
Catapano, J.S. et al. (2019)
Journal of NeuroInterventional Surgery
N=206 / Multiple procedures / Multiple devices

Abecassis, I.J. et al. (2021)
Journal of NeuroInterventional Surgery
N = 152 / Multiple procedures / RIST (7F)

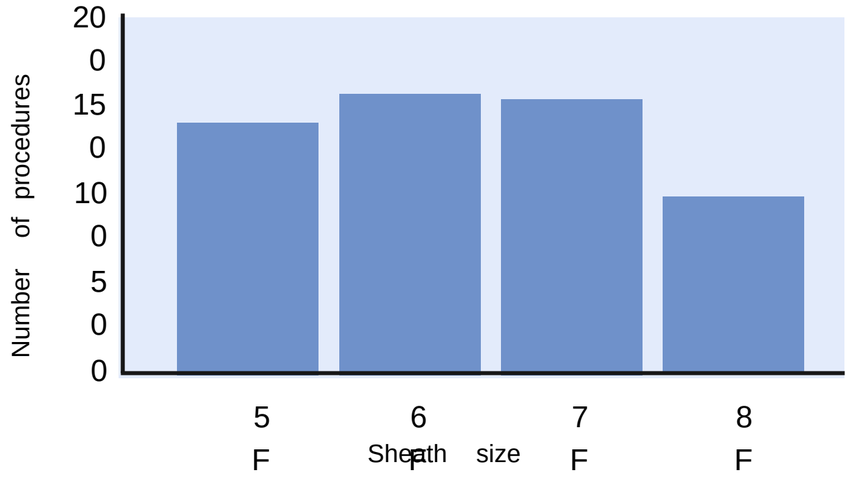
Weinberg, J.H. et al. (2021)
Clinical Neurology and Neurosurgery
N = 91 / Multiple procedures / BALLAST (8F)

Siddiqui, A.H. et al. (2021)
Journal of NeuroInterventional Surgery
N = 93 / Stroke / Multiple devices

ENDOVASCULAR PROCEDURES VIA TRA



- DIAGNOSTIC / VASOSPASM (N= 325 / 43 .6 %)
- ANEURYSM COILING (N= 94 / 12 .6 %)
- MECHANICAL THROMBECTOMY AND STENTING (N= 183 / 24 .5 %)
- FLOW DIVERSION, STENT OR INTRASACULAR (N= 79 / 10 .6 %)
- EMBOLIZATION OTHER THAN ANEURYSM (N= 56 / 7.5 %)
- OTHER TREATMENTS (N= 9 / 1.2 %)



Crossover to TFA: N=8

Access - site hematomas: N=4

Thromboembolic events: N=1

Vessel dissection/perforation : N=2

Weakness or paresthesia: N=2

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Closure

TECHNIQUE

Several techniques have been proposed for radial artery hemostasis.

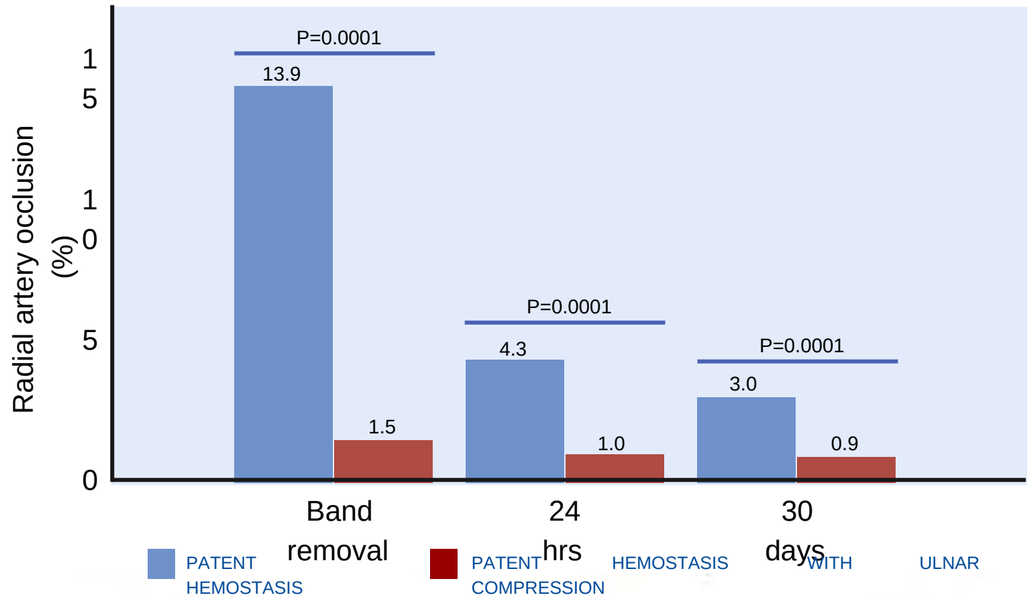
The objective is to promote hemostasis, while preventing radial artery occlusion.

Lower compression times, patent hemostasis technique and distal access have been show to improve patency rates.

NEURI BICÊTRE

JACC cardiovascular Interventions PROPHET-II TRIAL 2016

CONFLICTING EVIDENCE REGARDING ULNAR COMPRESSION



Source: Pancholy, S.B. et al. (2016) "Prevention of radial artery occlusion after Transradial catheterization," JACC: Cardiovascular Interventions, 9(19), pp. 1992–1999.

Closure

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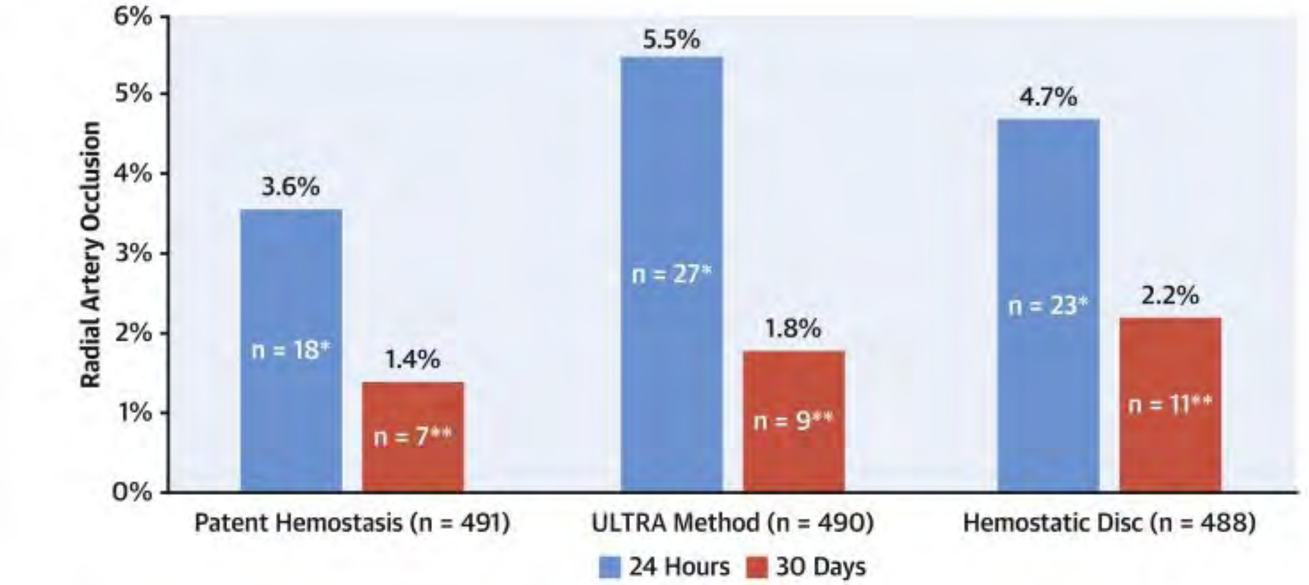
JACC cardiovascular Interventions 2022

CONFLICTING EVIDENCE REGARDING ULNAR COMPRESSION



Source: Eid-Lidt, G. et al. (2022) "Prevention of radial artery occlusion of 3 hemostatic methods in transradial intervention for coronary angiography," JACC: Cardiovascular Interventions, 15(10), pp. 1022–1029.

Closure

TECHNIQUE

Several techniques have been proposed for radial artery hemostasis.

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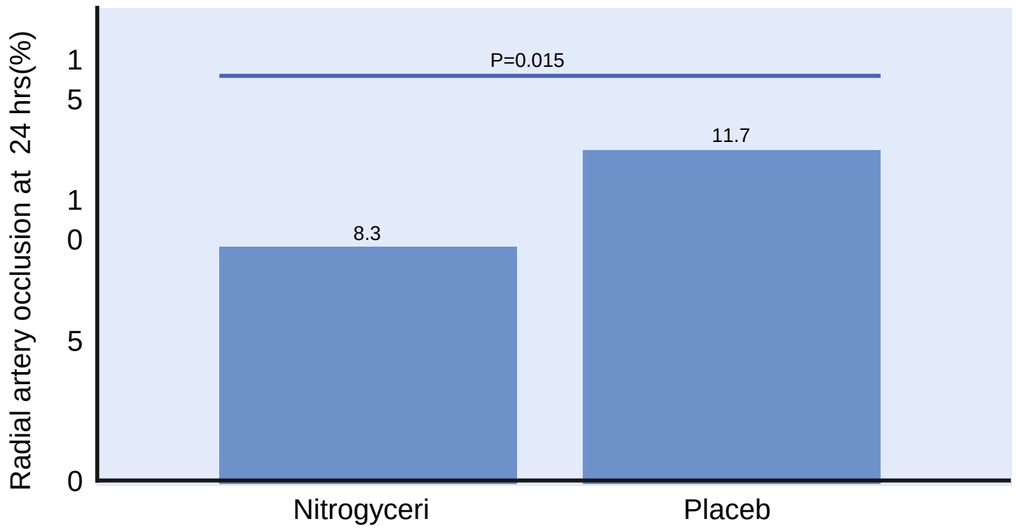
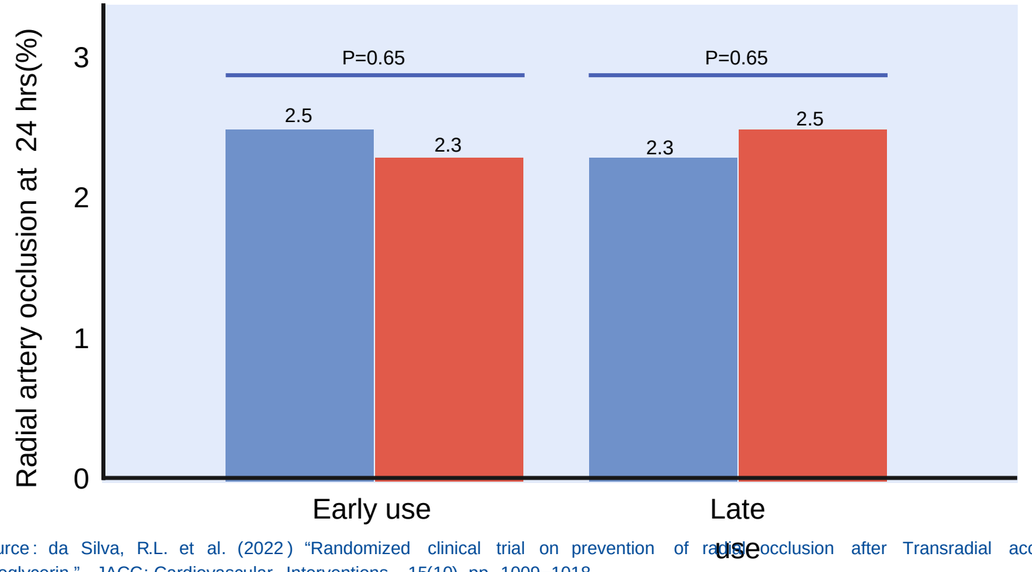
CONFLICTING EVIDENCE REGARDING NITROGLYCERIN



CCI Catheterization & Cardiovascular Interventions

2014

Source: Dharma, S. et al. (2014) "A novel approach to reduce radial artery occlusion after transradial catheterization : Postprocedural/prehemostasis intra-arterial nitroglycerin," Catheterization and Cardiovascular Interventions, 85(5), pp. 818–825



JACC Cardiovascular Interventions

PATENS TRIAL

2022

Source: da Silva, R.L. et al. (2022) "Randomized clinical trial on prevention of radial occlusion after Transradial access using nitroglycerin," JACC: Cardiovascular Interventions, 15(10), pp. 1009–1018.

Closure

TECHNIQUE

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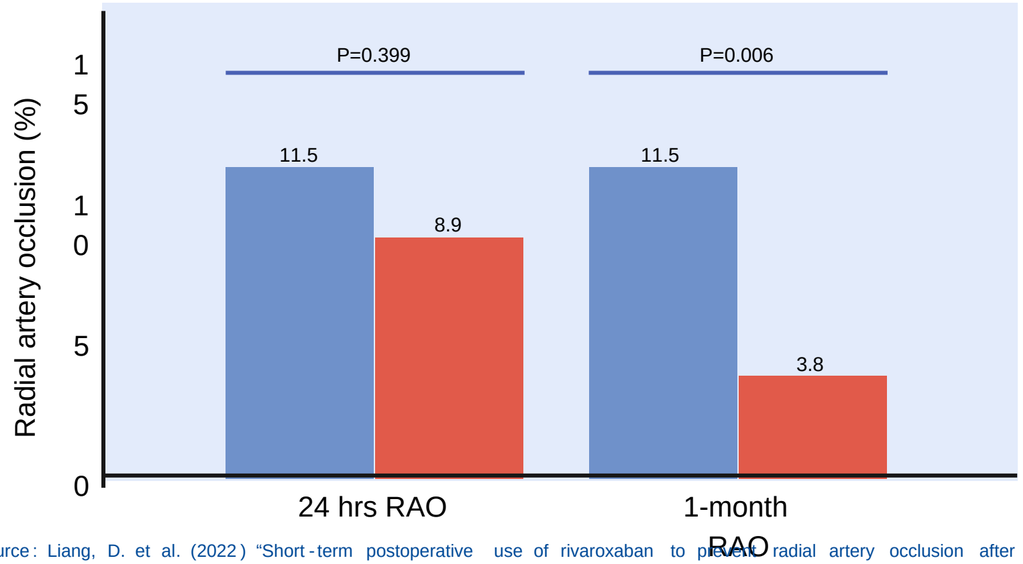
Circulation:
Cardiovascular Interventions RESTORE TRIAL 2022

RESTORE TRIAL: 7 DAYS RIVAROXABAN TO PREVENT RAO



Source : Liang, D. et al. (2022) “Short-term postoperative use of rivaroxaban to prevent radial artery occlusion after Transradial coronary procedure : The Restore Randomized Trial,” Circulation : Cardiovascular Interventions, 15(4).

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Closure

TECHNIQUE

At Bîcetre we use a radial band insuflated 1-2 cc above the bleeding pressure.

Full compression is maintained for 45min-1 hour, with a gradual release of pressure in the following hours.

Compression device can be removed when hemostasis is visually confirmed.

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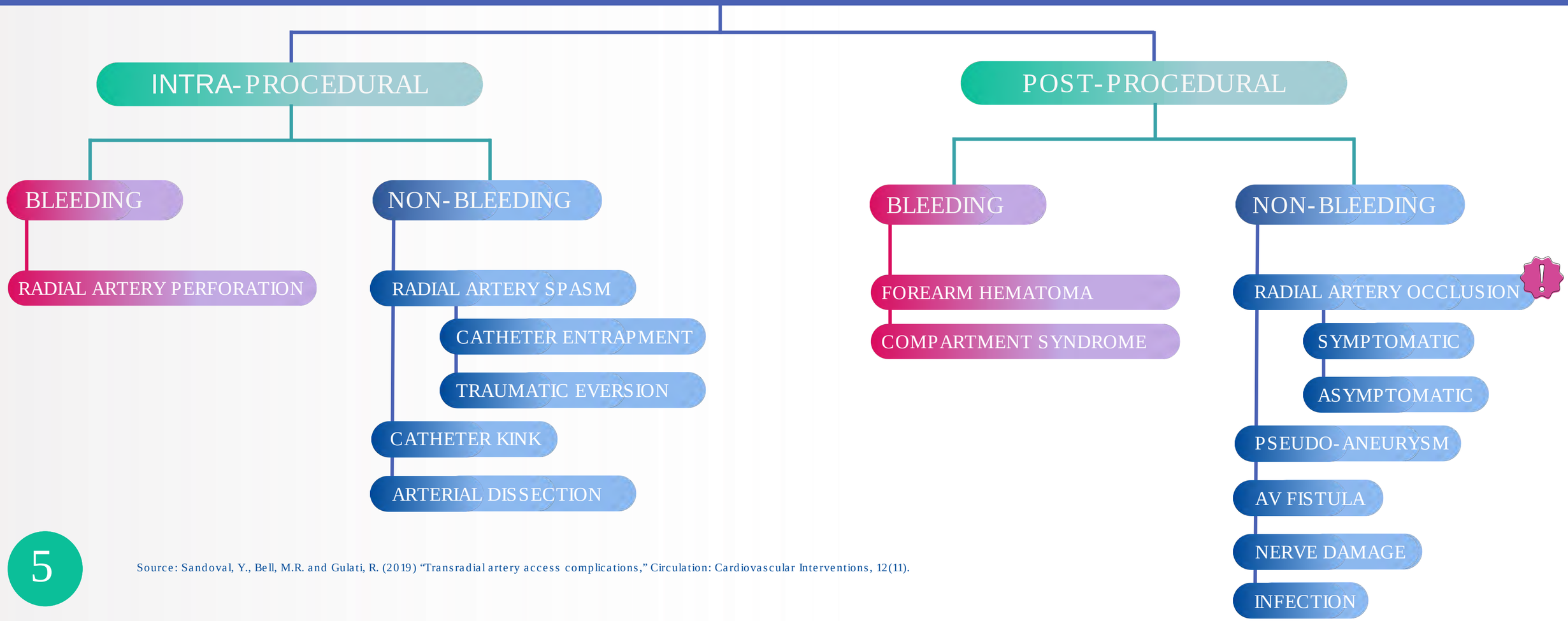
Access challenges and complications

A quick-guide for problem solving

TRA complications

Although TRA is associated with a lower likelihood of vascular complications compared with TFA, minor and major access site - related complications can occur following TRA.



Source: Sandoval, Y., Bell, M.R. and Gulati, R. (2019) “Transradial artery access complications,” Circulation: Cardiovascular Interventions, 12(11).

Radial artery spasm

It remains one of the most common causes of transradial procedure failure.

Source: Garg, N., Sahoo, D. and Goel, P.K. (2016) "Pigtail assisted tracking of guide catheter for navigating the difficult radial: Overcoming the 'Razor effect,'" Indian Heart Journal, 68(3), pp. 355–360.

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5

CHUGH'S GRADING OF RADIAL ARTERY SPASM

GRADE 4 — Severe pain and spasm disallowing any catheter movement necessitating crossover.

GRADE 3 — Moderate pain and spasm restricting catheter movement & necessitating a pause in procedure and > 2 doses of additional intra-arterial Diltiazem or Verapamil> 5mg and or > 1 mg of intravenous Midazolam.

GRADE 2 — Mild pain and spasm not restricting catheter movement; no pause in procedure but > dose of (additional) intra-arterial Diltiazem (or Verapamil) of Smg and / or 0.5 mg of intravenous Midazolam.

GRADE 1 — Mild pain and spasm not restricting catheter movement; no pause in procedure and only 1 dose of either or both intra arterial Diltiazem (or Verapamil) of 5mg and/or > 0.5 mg of intravenous Midazolam.

Source: Chugh, S.K., Chugh, Y. and Chugh, S. (2015) "How to tackle complications in radial procedures : Tip and tricks," Indian Heart Journal, 67(3), pp. 275–281.

HIGHER RISK OF RAS IN:

- Female sex, short stature and low BMI;
- Small wrist circumference;
- Small radial diameter;
- Radial artery tortuosity/variant;
- Higher sheath size;
- Number of puncture attempts;
- Number of catheters used;
- Moderate-to-severe pain during radial artery cannulation

Radial artery spasm

If RAS is suspected, repeat an angiogram with diluted contrast for diagnosis. Do not force.

Source : Garg, N., Sahoo, D. and Goel, P.K. (2016) "Pigtail assisted tracking of guide catheter for navigating the difficult radial: Overcoming the 'Razor effect,'" Indian Heart Journal, 68(3), pp. 355–360.

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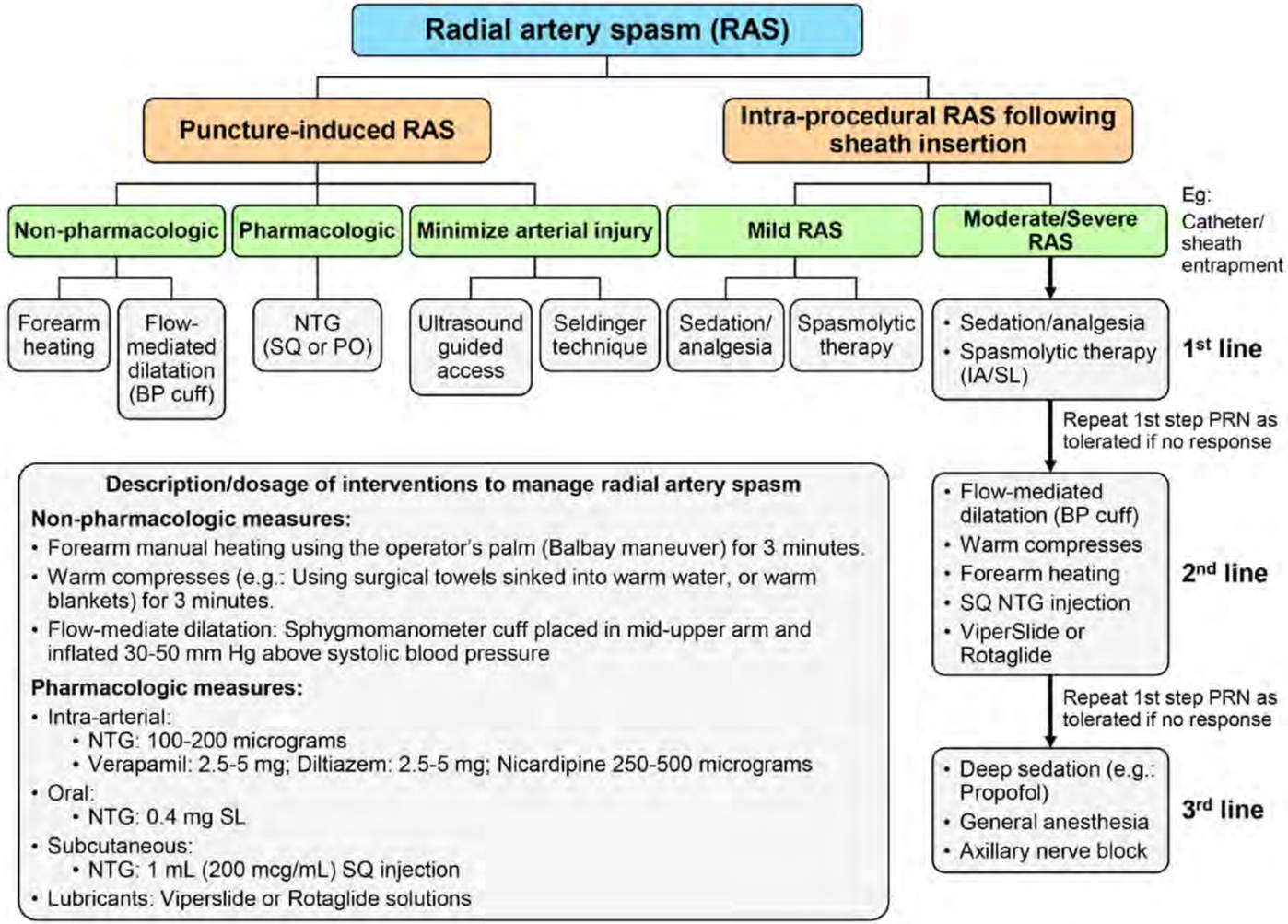

Description/dosage of interventions to manage radial artery spasm

Non-pharmacologic measures:

- Forearm manual heating using the operator's palm (Balbay maneuver) for 3 minutes.
- Warm compresses (e.g.: Using surgical towels sinked into warm water, or warm blankets) for 3 minutes.
- Flow-mediate dilatation: Sphygmomanometer cuff placed in mid-upper arm and inflated 30-50 mm Hg above systolic blood pressure

Pharmacologic measures:

- Intra-arterial:
  - NTG: 100-200 micrograms
  - Verapamil: 2.5-5 mg; Diltiazem: 2.5-5 mg; Nicardipine 250-500 micrograms
- Oral:
  - NTG: 0.4 mg SL
- Subcutaneous:
  - NTG: 1 mL (200 mcg/mL) SQ injection
- Lubricants: Viperslide or Rotaglide solutions

Source : Sandoval, Y., Bell, M.R. and Gulati, R. (2019) "Transradial artery access complications," Circulation : Cardiovascular Interventions, 12(11).

If eversion of the radial artery , gently reintroduce the material and reinforce vasospasm reduction.

Vascular tortuosity and radial loops

Catheter 5F Simons 1
less prone to kinking

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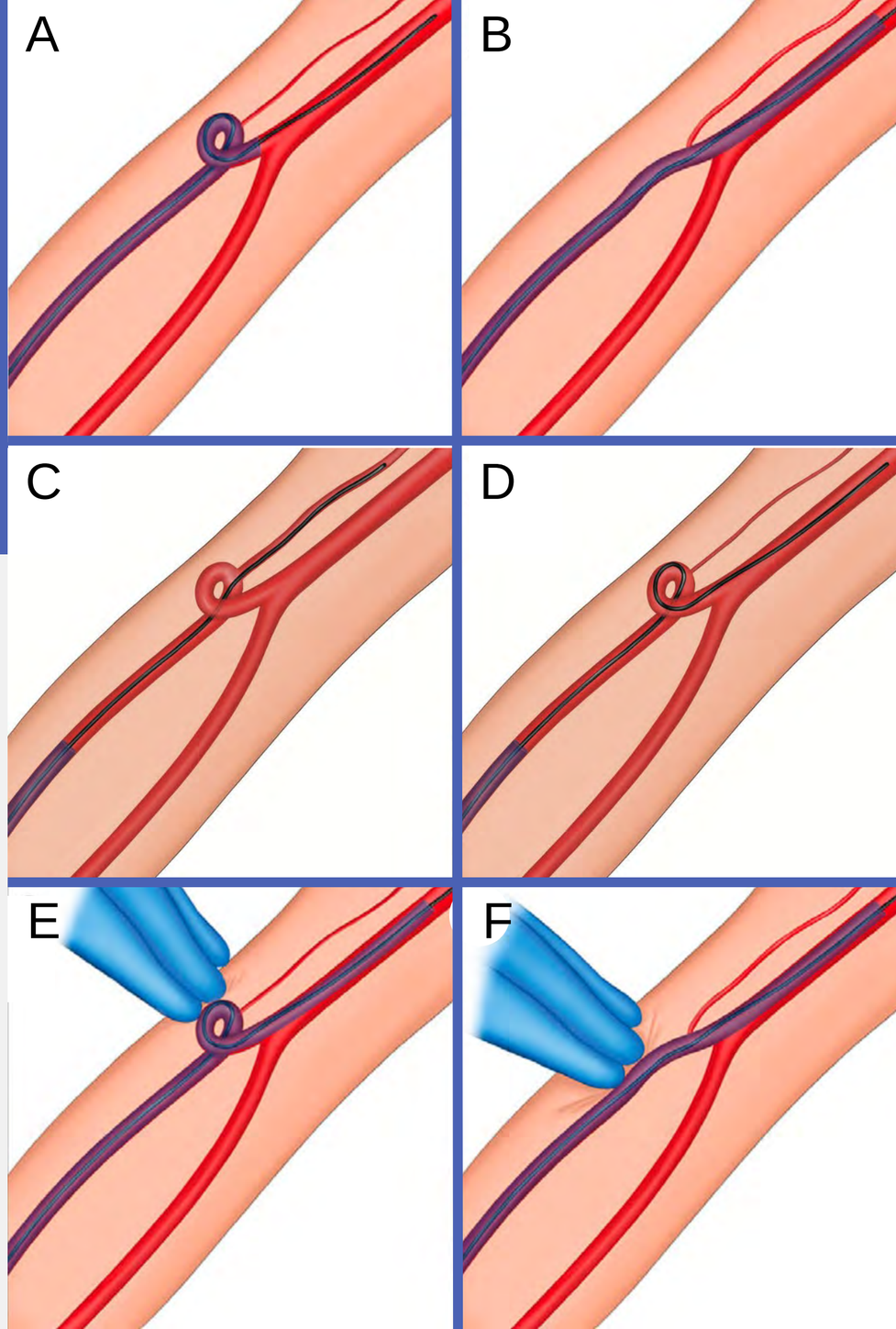
TECHNIQUES FOR CATHETER REMOVAL

- Repeat angiogram and control RAS according to severity.
- Advance the 0.035" with/out a parallel 0.014" guidewire.
- Balloon-assisted tracking.
- Telescoping a 0.027 -inch microcatheter with a 0.018" guidewire.
- External compression.

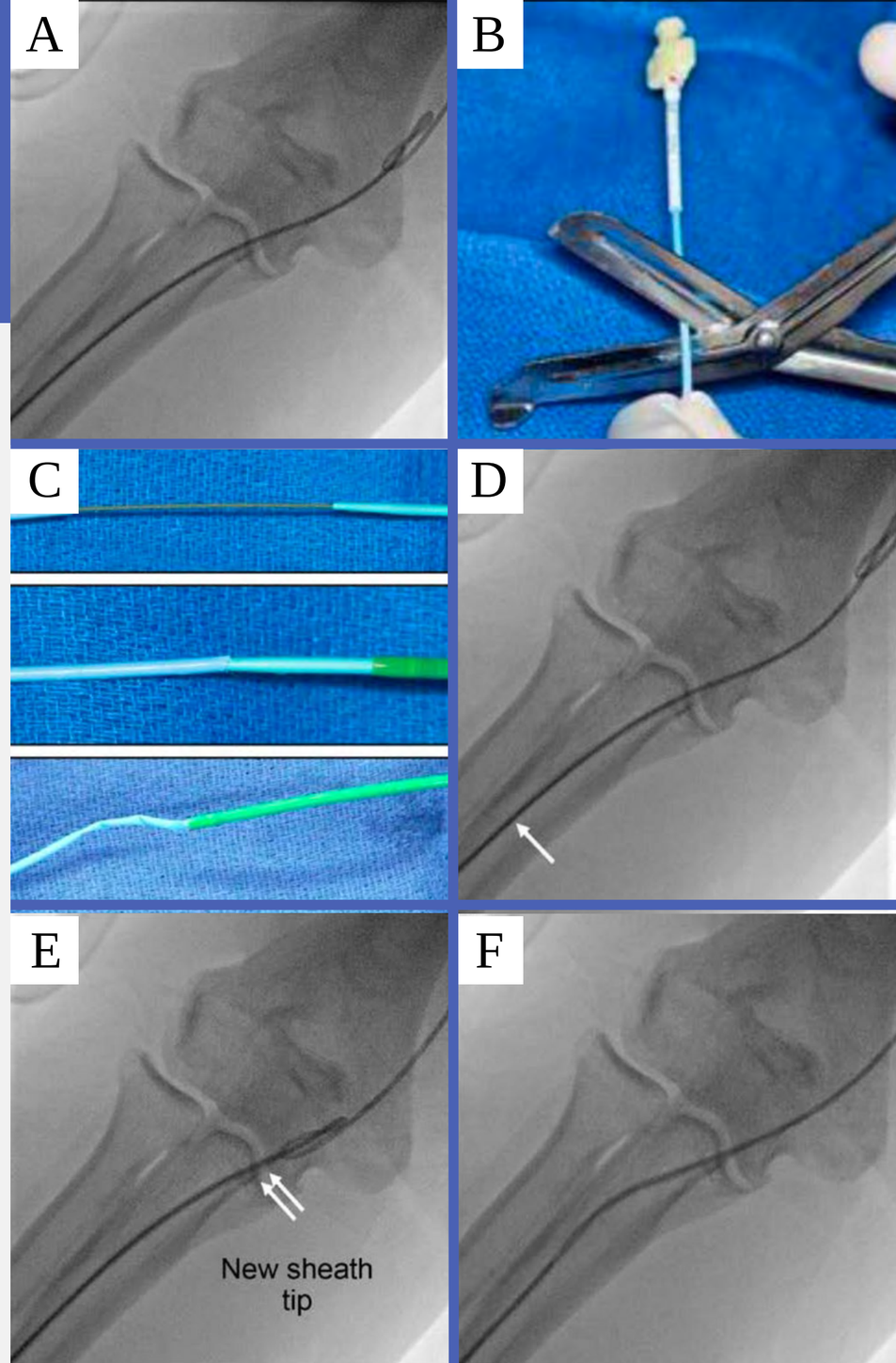


Source: Luther, E. et al. (2020) “Navigating radial artery loops in neurointerventions,” Journal of NeuroInterventional Surgery, 13(11), pp. 1027–1031.

Catheter kinks and knots

TECHNIQUES FOR CATHETER REMOVAL

- Repeat angiogram and control RAS according to severity.
- Untwist the knot in the opposite direction while gently advancing the 0.035" or stiffer guidewires in anterograde fashion.
- Apply external pressure with a sphygmomanometer or manual compression and rotate the entrapped catheter.
- Apply external pressure with retrogade ballon inflation.
- Encase with a larger sheath (mother and child technique).
- Use a snare device via femoral access.



NEURI BICÊTRE

Source: Sandoval, Y., Bell, M.R. and Gulati, R. (2019) "Transradial artery access complications," Circulation: Cardiovascular Interventions, 12(11).

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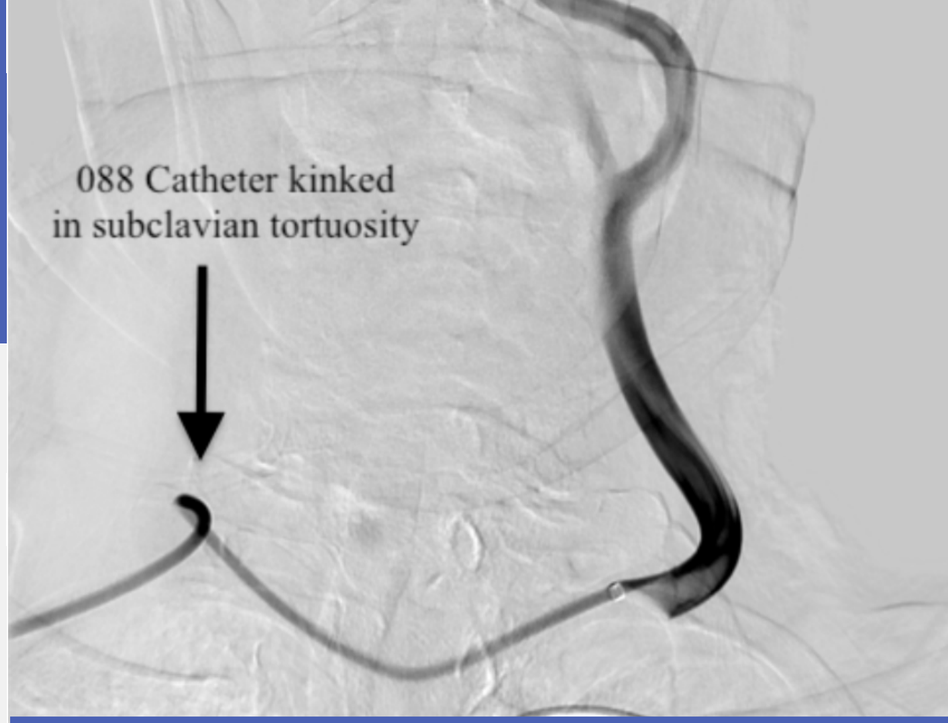

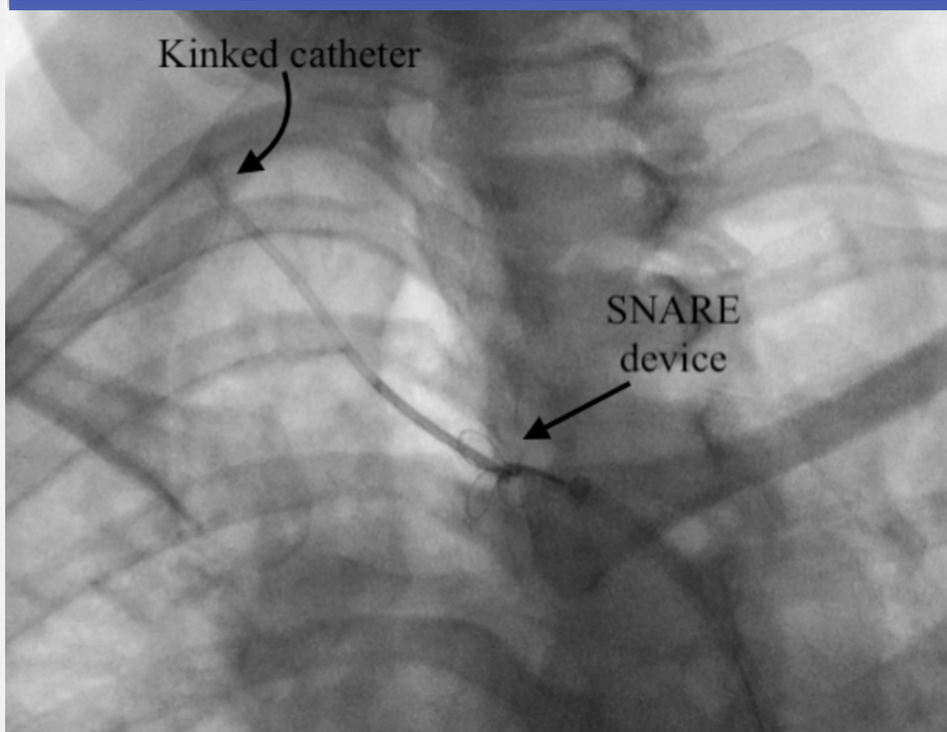

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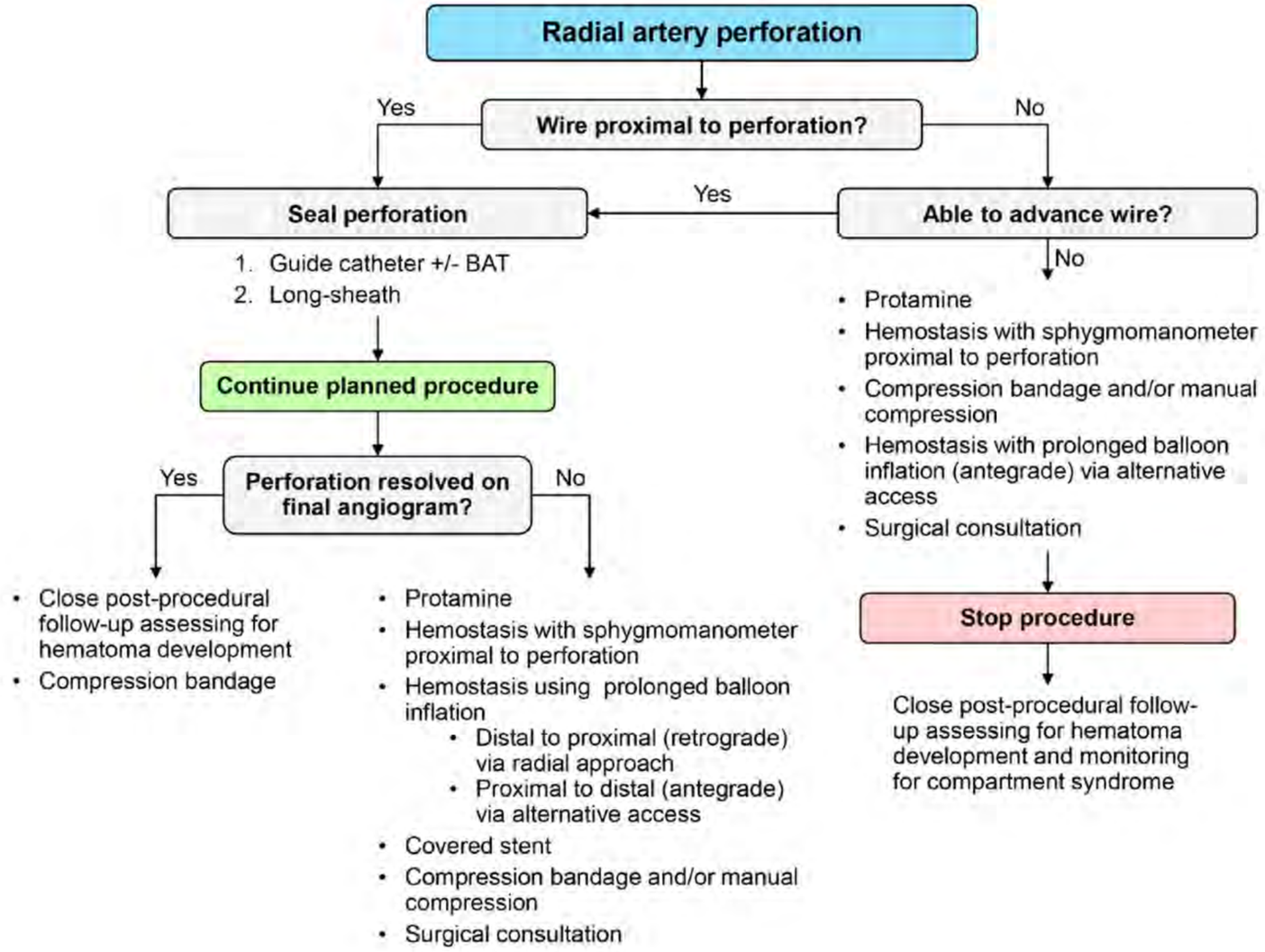
Radial artery perforation

There should be a low threshold to perform angiography of the upper extremity if perforation is suspected.



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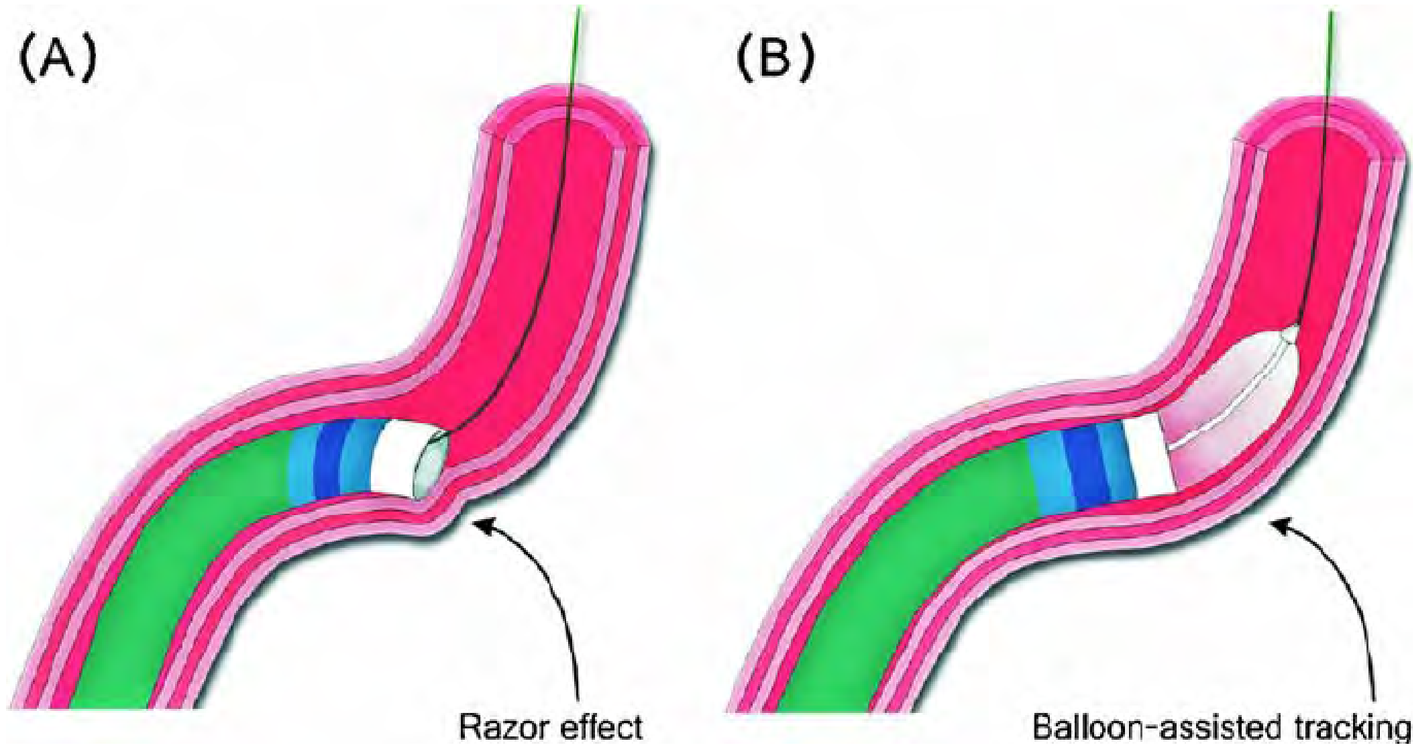


Source: Patel, T., Shah, S. and Pancholy, S. (2012) “Balloon - assisted tracking of a guide catheter through Difficult Radial Anat omy: A Technical Report,” Catheterization and Cardiovascular Interventions, 81(5).

IN CASE OF PERFORATION:

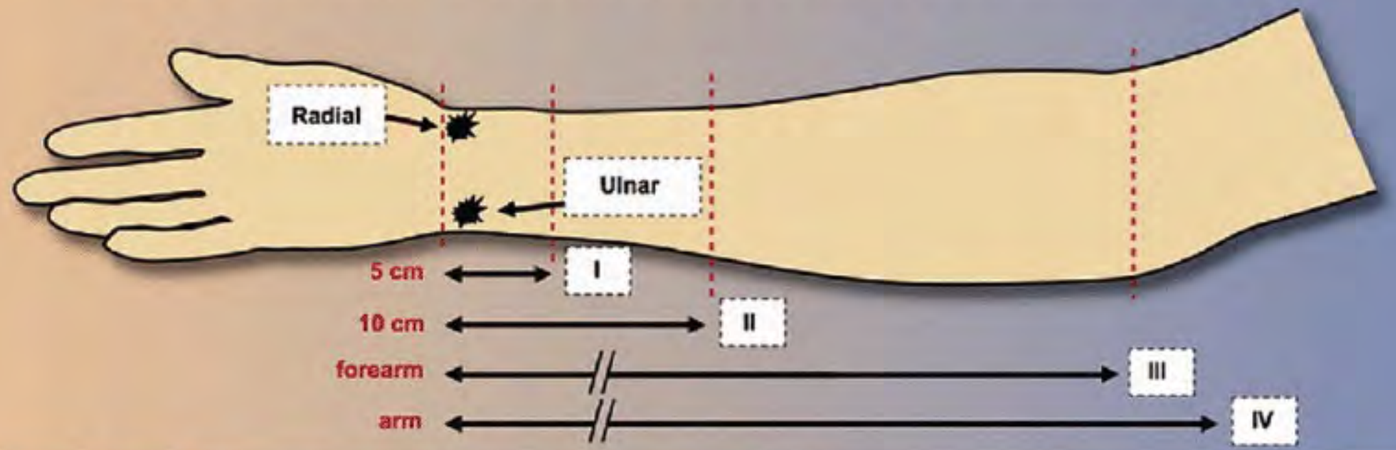
- Advancement of a catheter (diagnostic or guide sheath) across the perforation ;
- Alternatively temporary balloon inflation can be employed for tamponade ;
- If impossible to cross the perforation, external compression can reduce the risk of hematoma formation .

Hematomas

FOREARM HEMATOMAS

The key for management is early detection. Education of the staff involved in postprocedural care is essential for its timely diagnosis and treatment.

EASY Hematoma Classification after Transradial/Ulnar PCI



GRADE	I	II	III	IV	V
INCIDENCE	≤ 5%	< 3%	< 2%	≤ 0.1%	< 0.01%
DEFINITION	Local hematoma, superficial	Hematoma with moderate muscular infiltration	Forearm hematoma and muscular infiltration, below the elbow	Hematoma and muscular infiltration extending above the elbow	Ischemic threat (compartment syndrome)
TREATMENT	Analgesia Additional bracelet Local ice	Analgesia Additional bracelet Local ice	Analgesia Additional bracelet Local ice Inflated BP cuff	Analgesia Additional bracelet, Local ice Inflated BP cuff	Consider surgery
NOTES		Inform physician	Inform physician	Inform physician	STAT call to physician
REMARKS	- Control blood pressure (BP) (importance of pain management) - Consider interruption of any anticoagulation and/or antiplatelet infusion - Follow forearm and arm diameters to evaluate requirement for additional bracelet and/or BP cuff inflation - Additional bracelet(s) can be placed alongside artery anatomy - Ice cubes in a plastic bag or washcloth are placed on the hematoma - Finger O_2 saturation can be monitored during inflated blood pressure cuff - To inflate blood pressure cuff, select a pressure of 20 mmHg < systolic pressure and deflate every 15 minutes - After bracelet removal, use "Velpeau bandage" around forearm/arm for a few hours to maintain mild positive pressure				

Bertrand et al. Circulation 2006;114(24):2646-53

Other issues

PSEUDOANEURYSM

Management options include compression, thrombin injection, surgical repair or distal placement of a sheath.

AV FISTULA

Management options include conservative management, prolonged compression using a hemostatic band, percutaneous treatment using covered stents, and surgery.

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Thank you for your attention

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Radial Access for Neurointervention

New routes. Old challenges

João B. Madureira
Jonathan Cortese, Jildaz Caroff, Cristian Mihalea, Léon Ikka, Vanessa Chalumeau, Sophie Gallas, Jacques Moret, Laurent Spelle

November 16, 2022