

Hemodialysis angioaccesses

Pierre Bourquelot. Paris

DUTER 2019/03/22

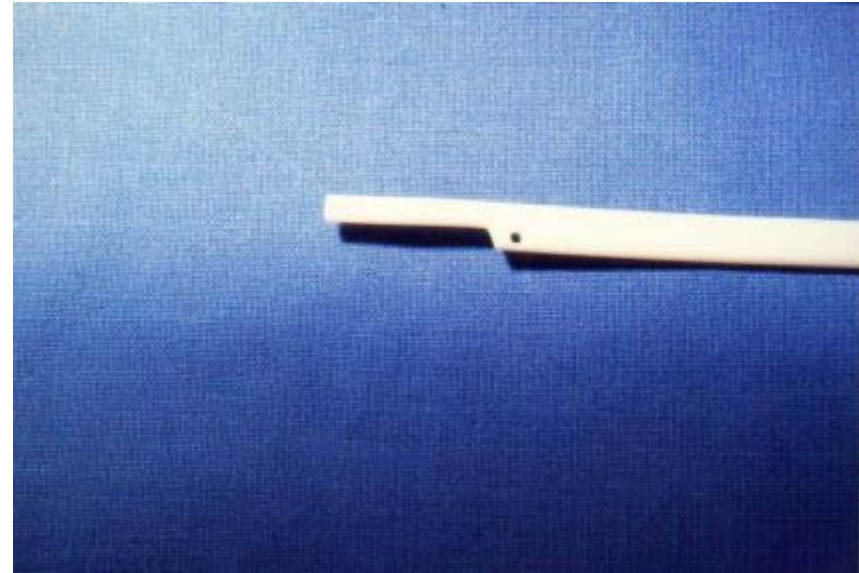
Strasbourg



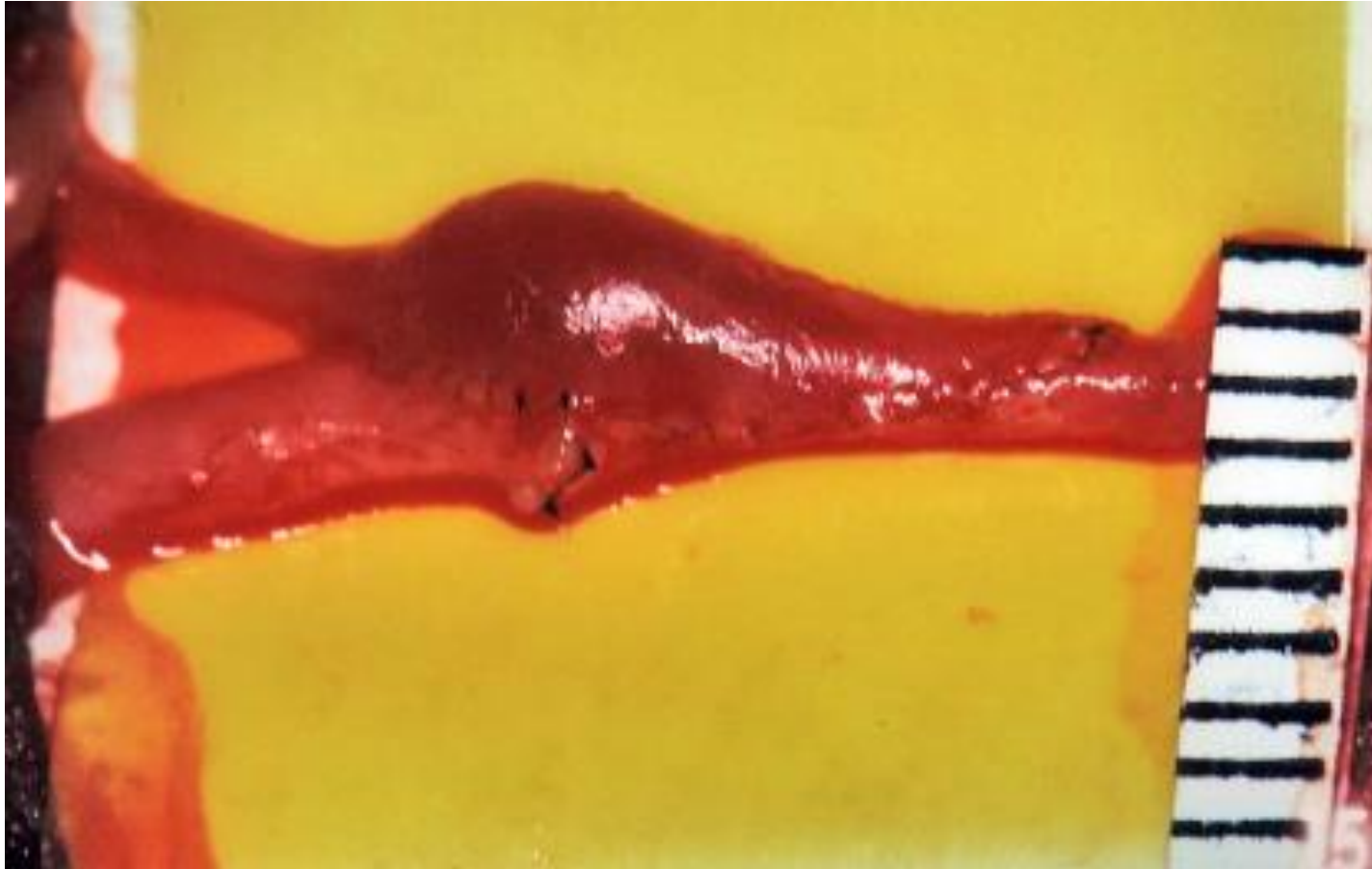
1960 : Shunt de Scribner



Permcath



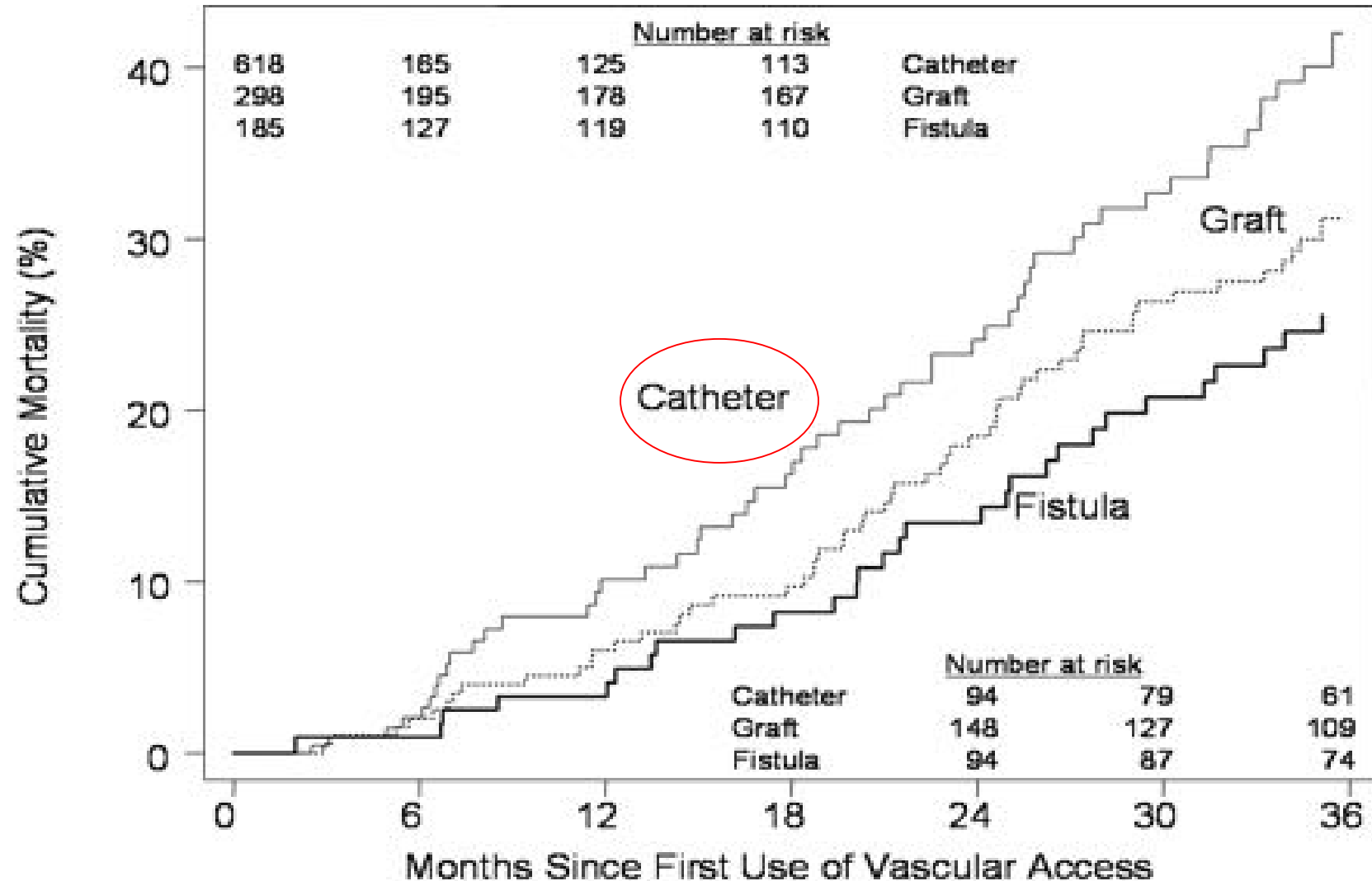
FAV – Brescia Cimino 1966

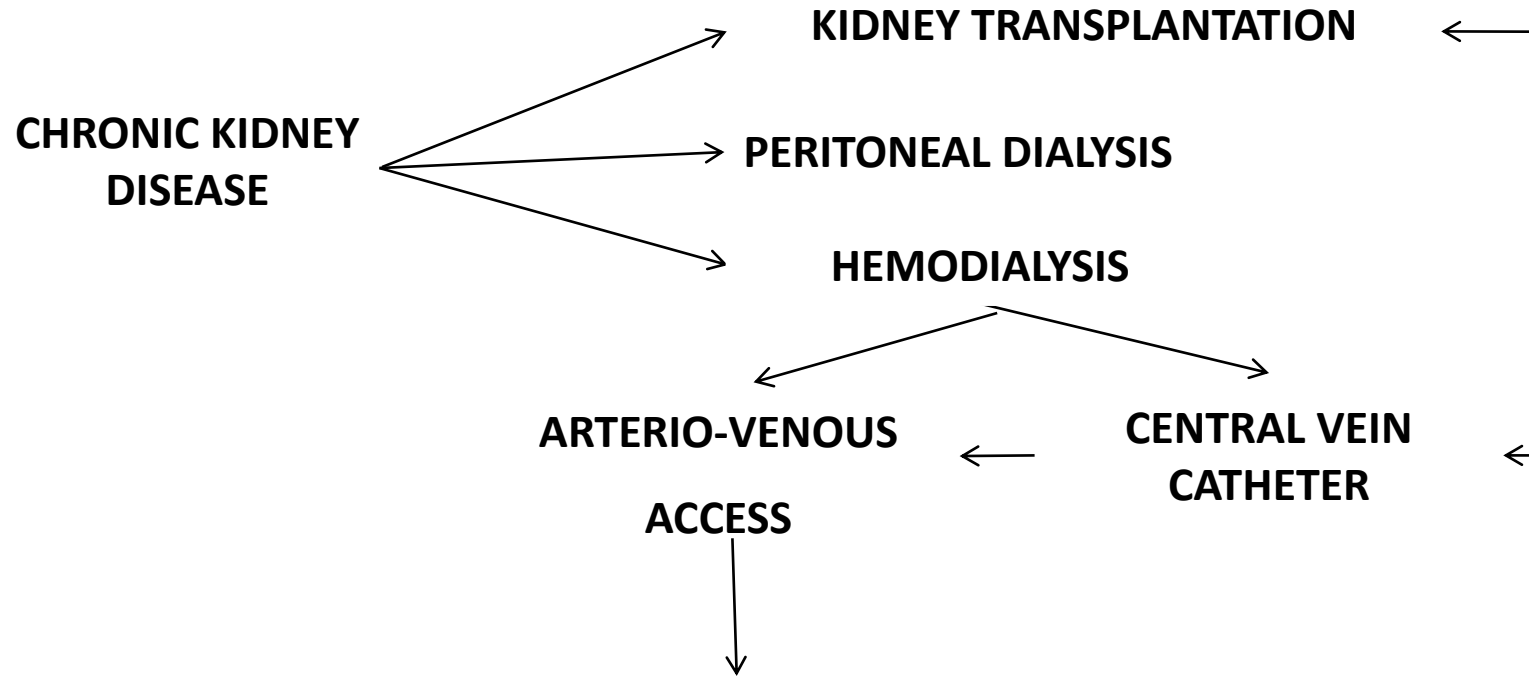


PTFE



Mortalité selon l'abord vasculaire



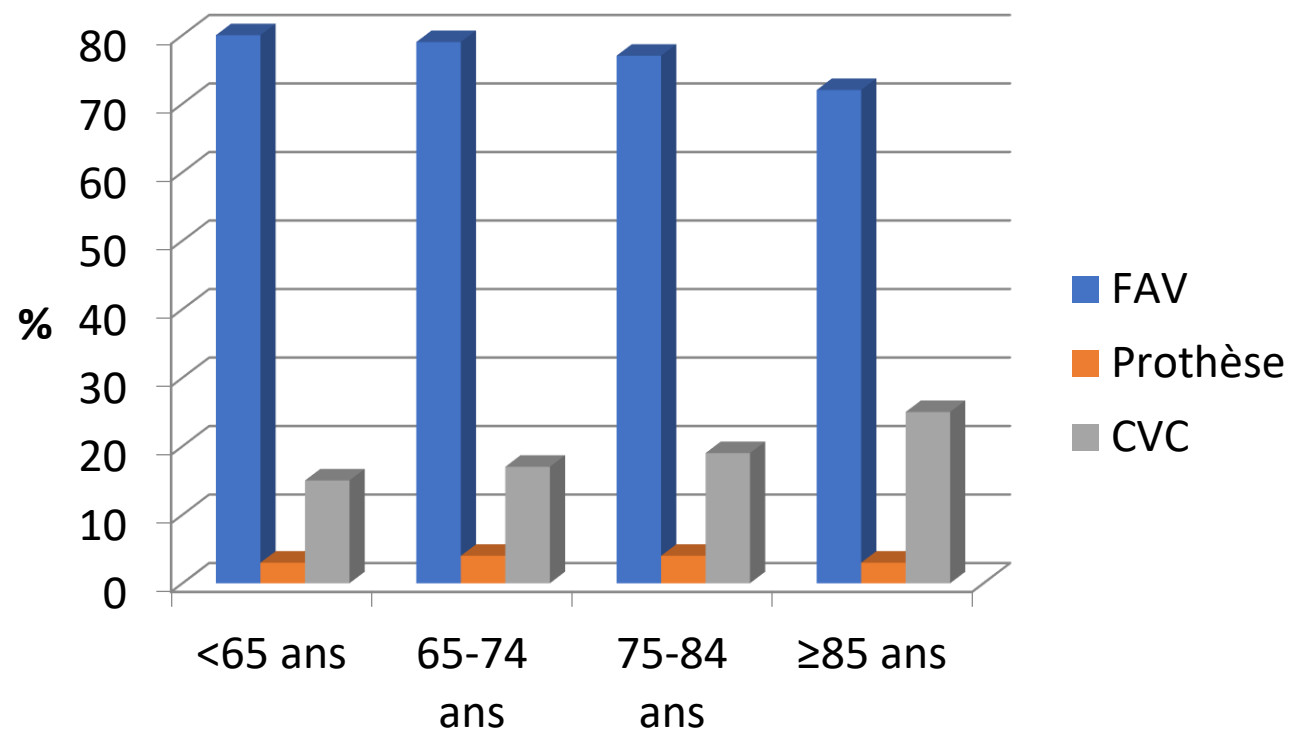


1. RADIAL-CEPHALIC AVF
2. ULNO-BASILIC AVF
3. BRACHIO-CEPHALIC AVF
4. BRACHIO-BASILIC AVF
5. BRACHIO-BRACHIAL AVF
6. FEMORO-FEMORAL AVF

Réseau R.E.I.N. 2016

- Au 31 décembre 2016, **85.000 patients en France vivaient**
 - grâce à la dialyse (55 %)
 - ou à la greffe (45 %).
- Durant l'année 2016, **11.000 personnes ont commencé un traitement de remplacement rénal,**
 - par greffe préemptive (seulement 439, soit 4%)
 - ou dialyse (l'immense majorité, soit 10 600, 96%).

France 2011 (Patients prévalents)



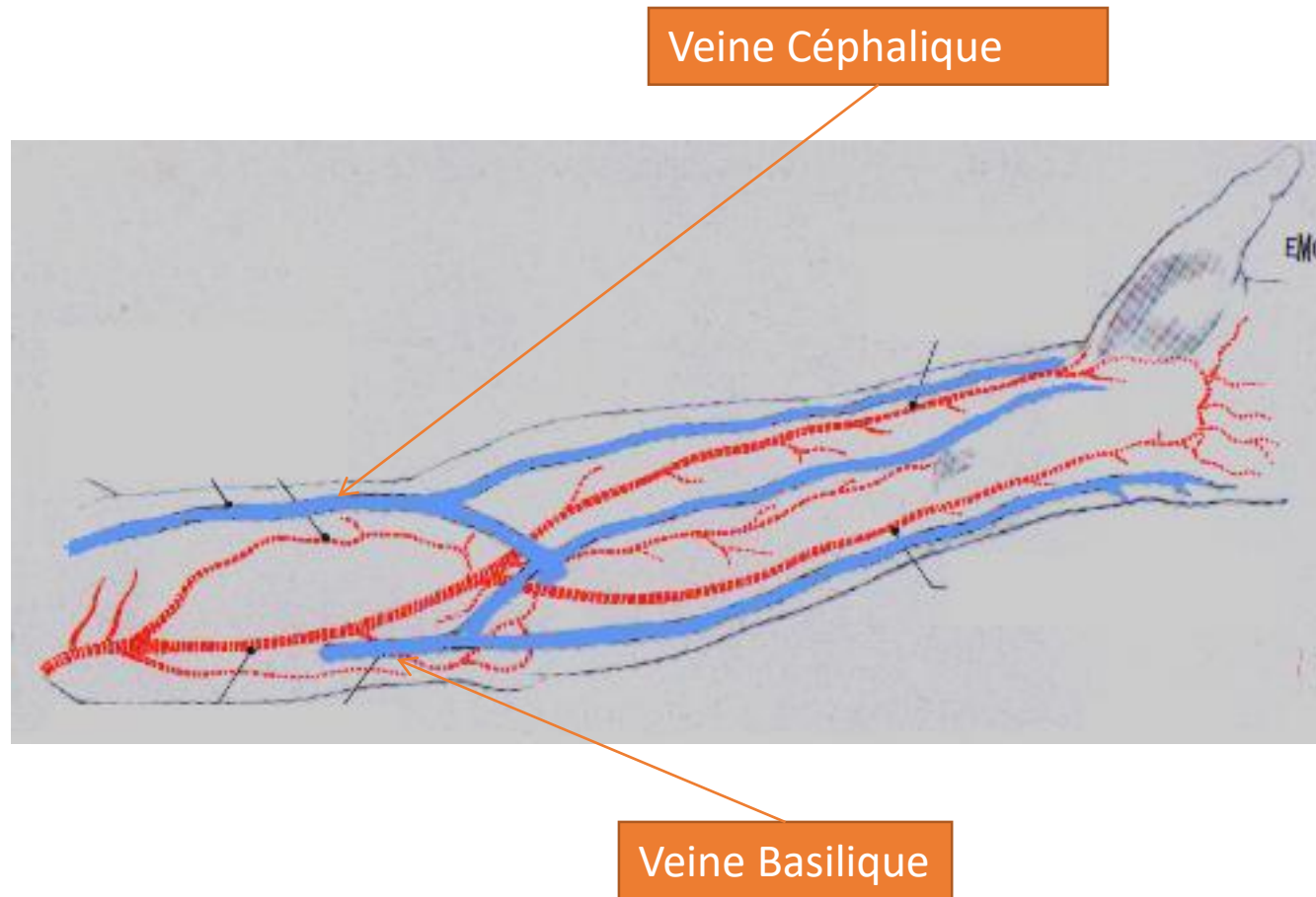
Préservation Capital Veineux



J. Pengloan

Bilan pré-op

Anatomie



Pre-operative Examination...



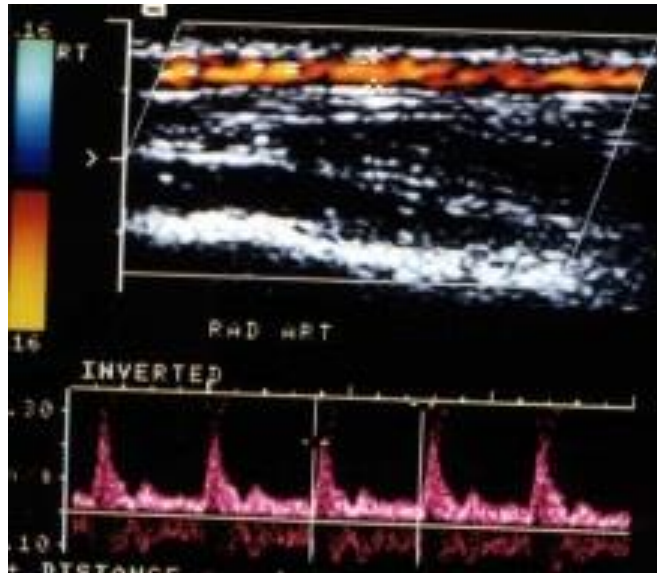
Basilic vein



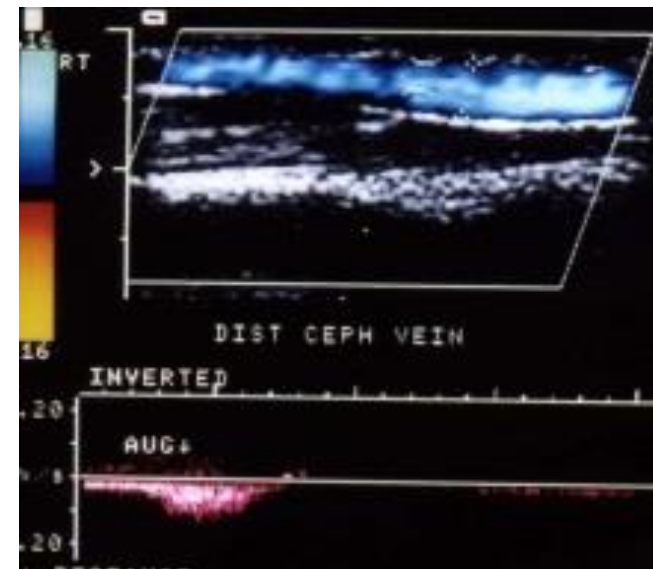
50-year old woman, after a 32 years successful kidney transplantation

Doppler

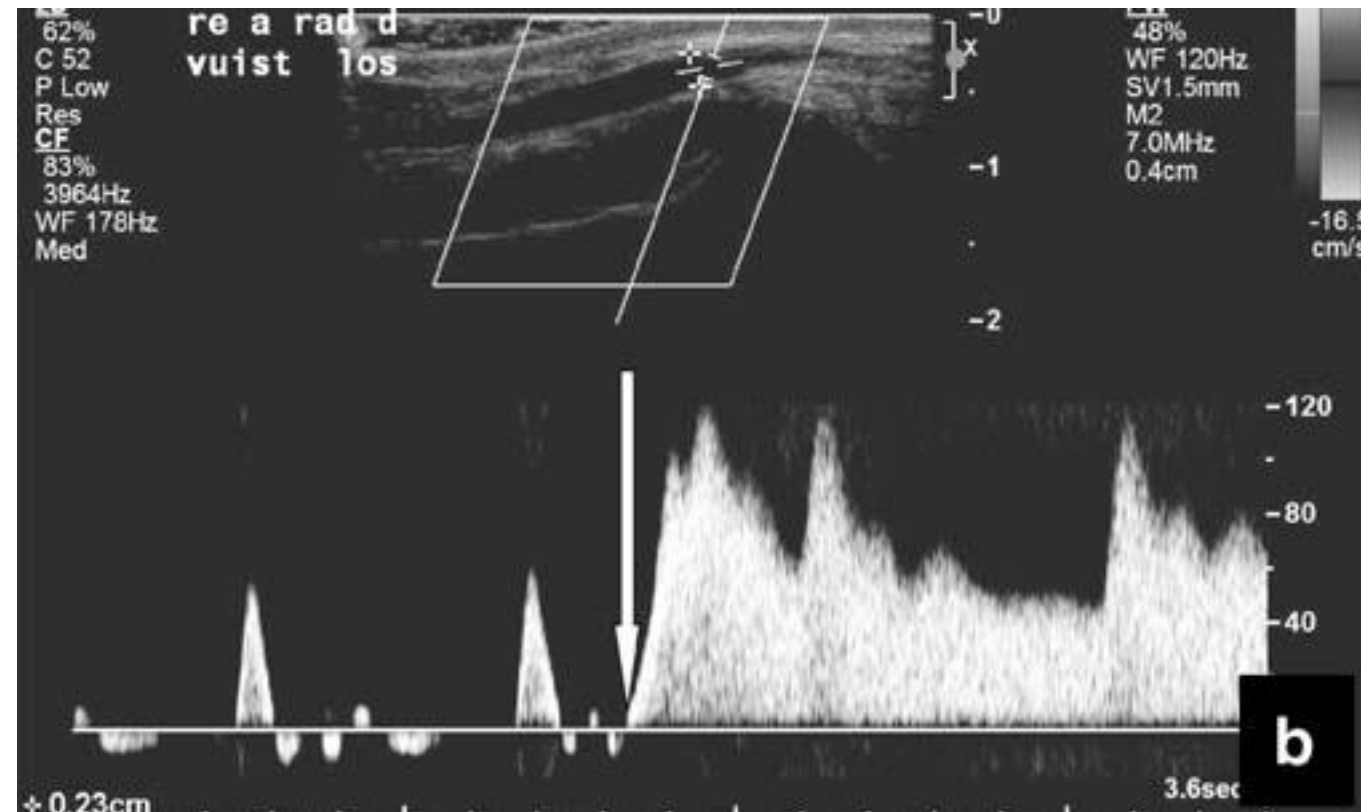
Radial artery



Wrist cephalic vein

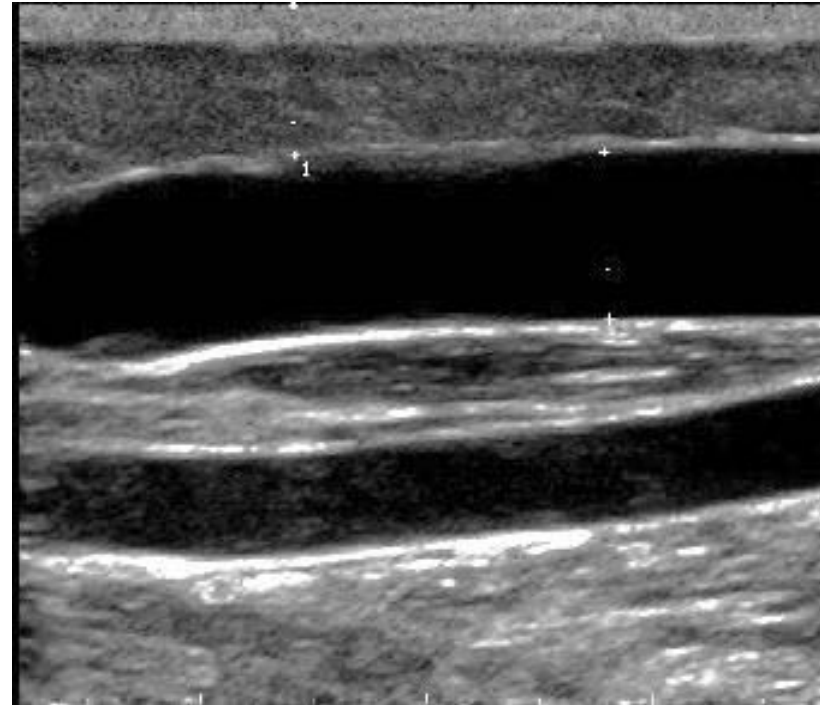
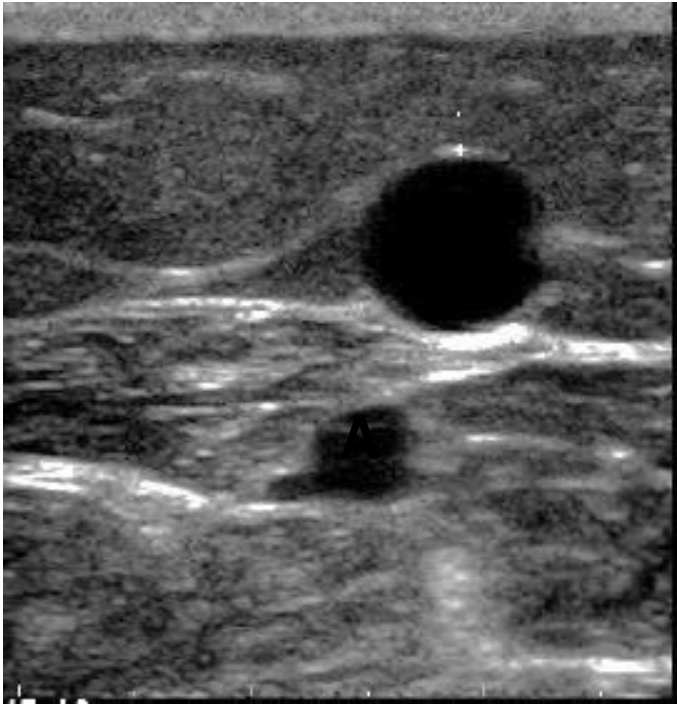


Doppler:

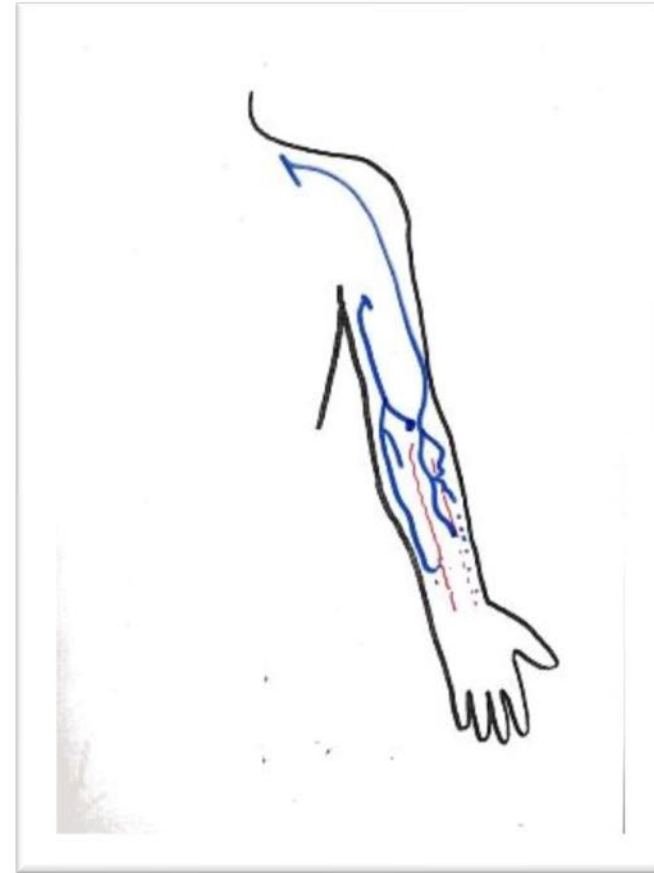
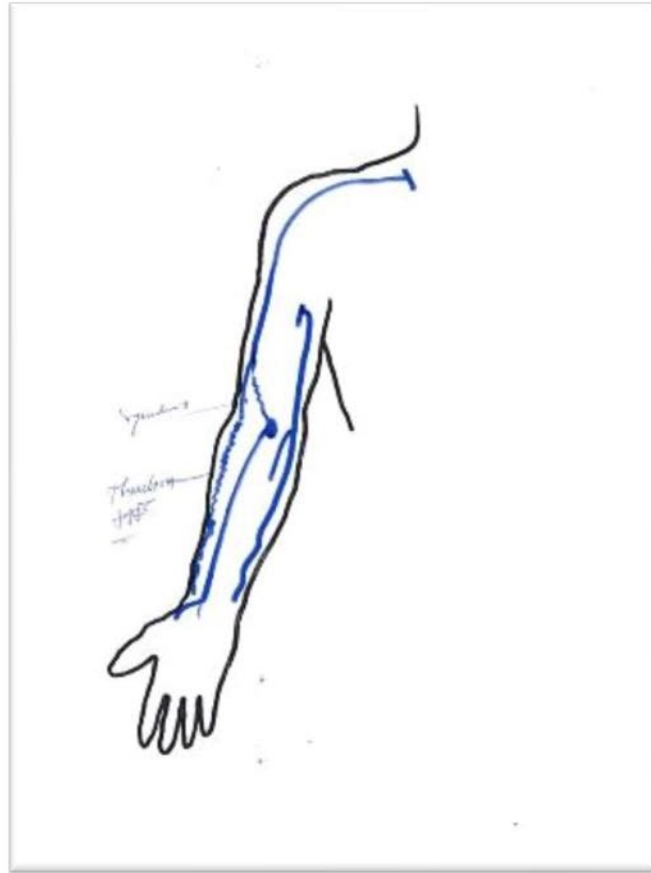


Fist clenching

Echographie: A.radiale,V.céphalique



Duplex (Dr Franco)



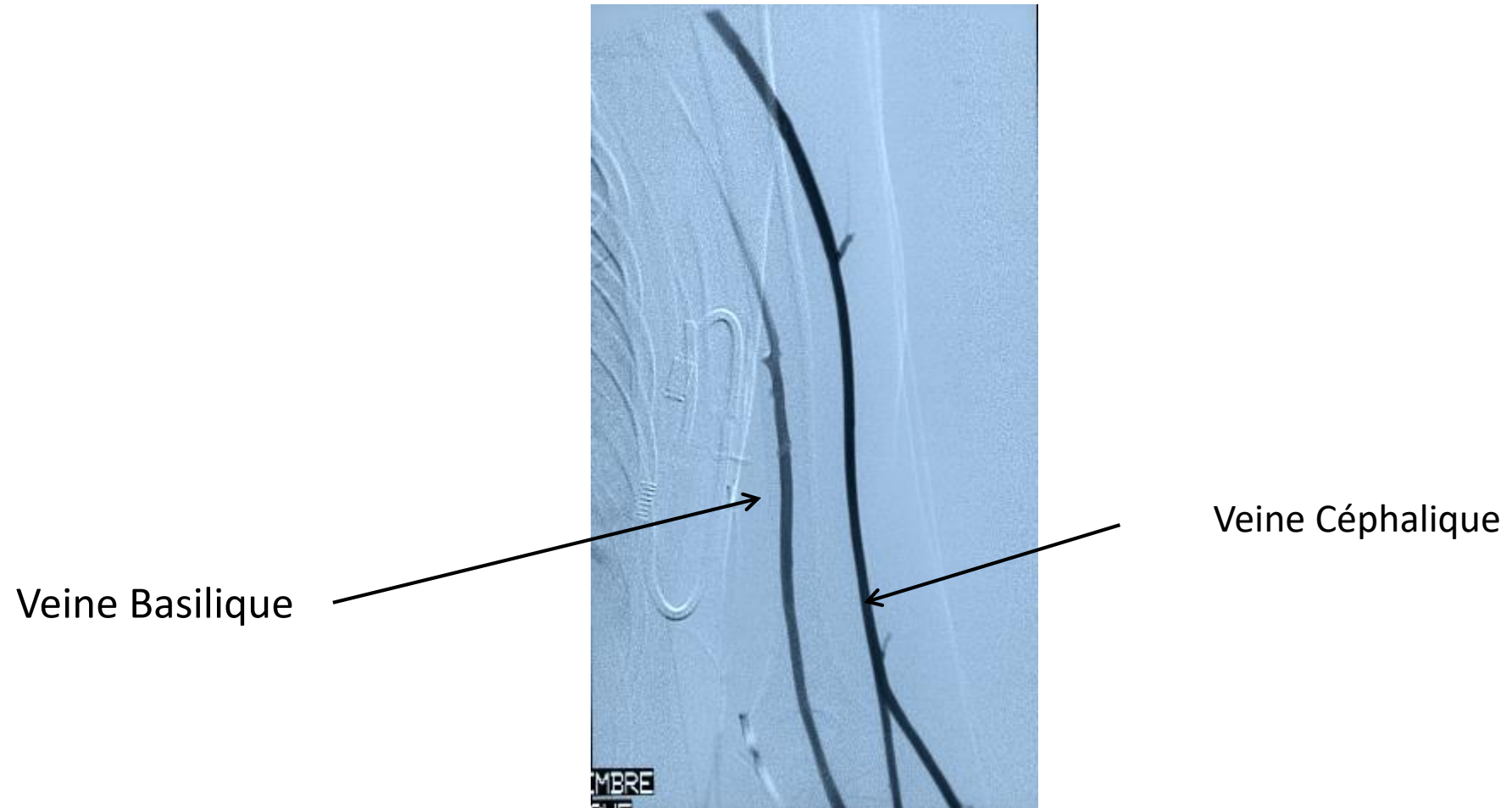
Phlébographie 1/3

Veine
céphalique
Médiane avant-
bras
thrombosée



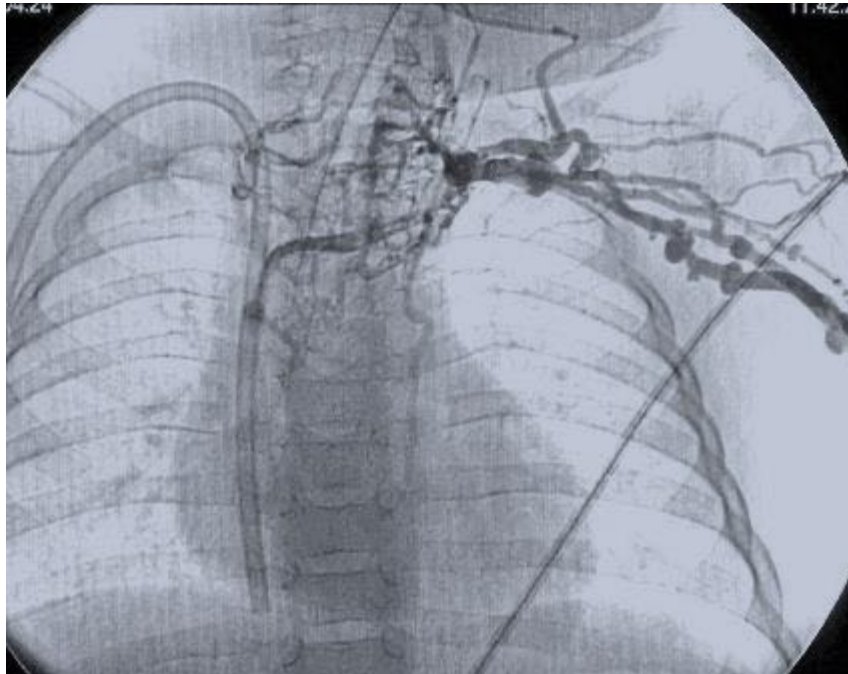
Veine
céphalique
Principale à
l'avant-bras

Phlébographie 2/3





Venography



Creation Chirurgicale

Microchirurgie



Instruments



Microscope

GARROT PNEUMATIQUE – BANDE D'ESMARCH

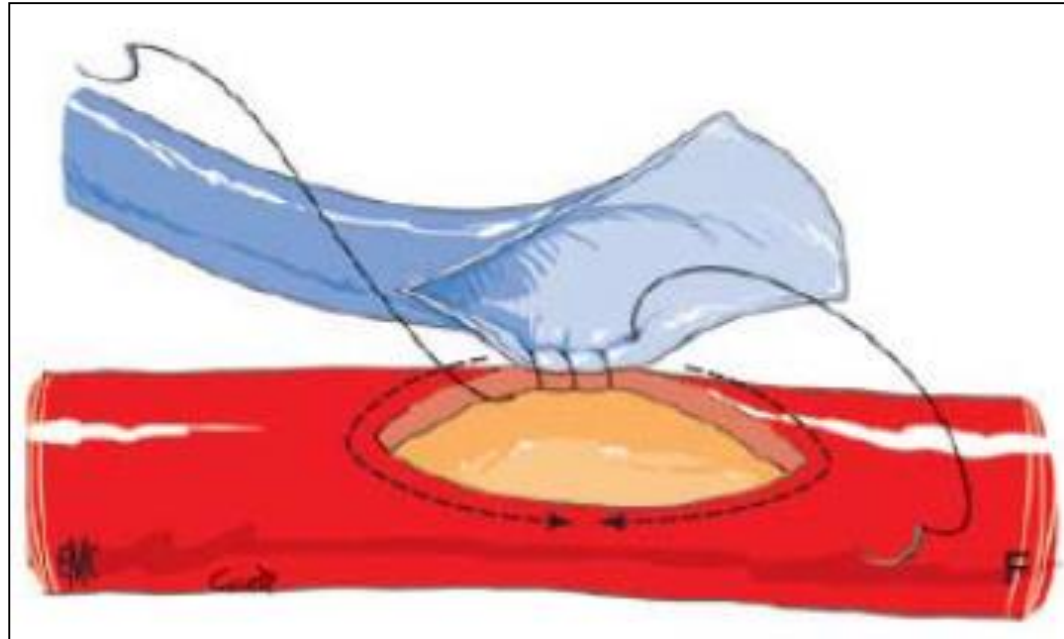
Salle d'op



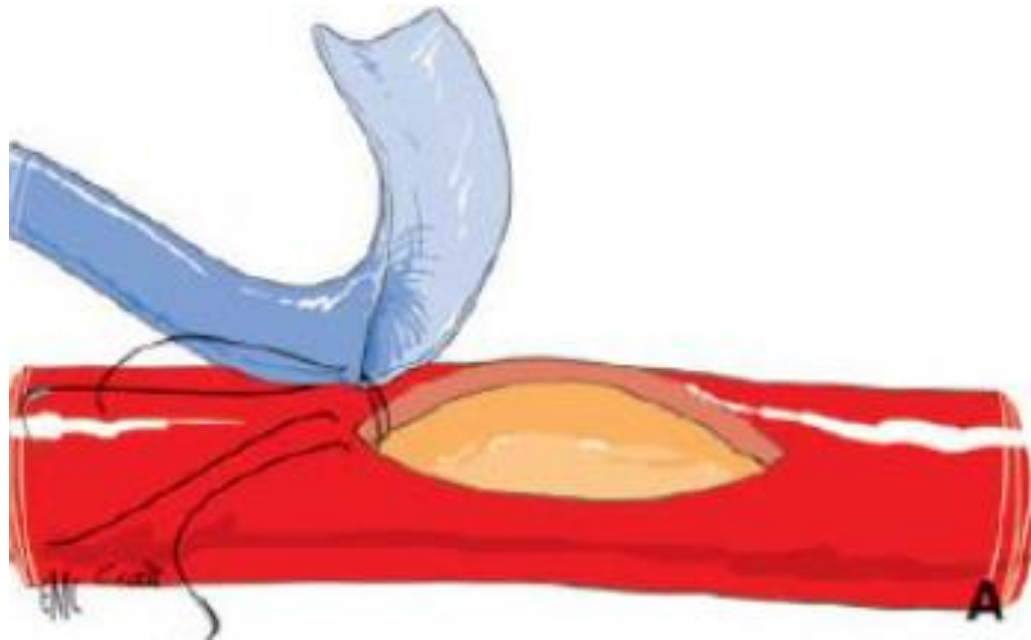
LA FISTULE ARTERIO-VEINEUSE

Brescia et Cimino 1966

Anastomose 1 surjet



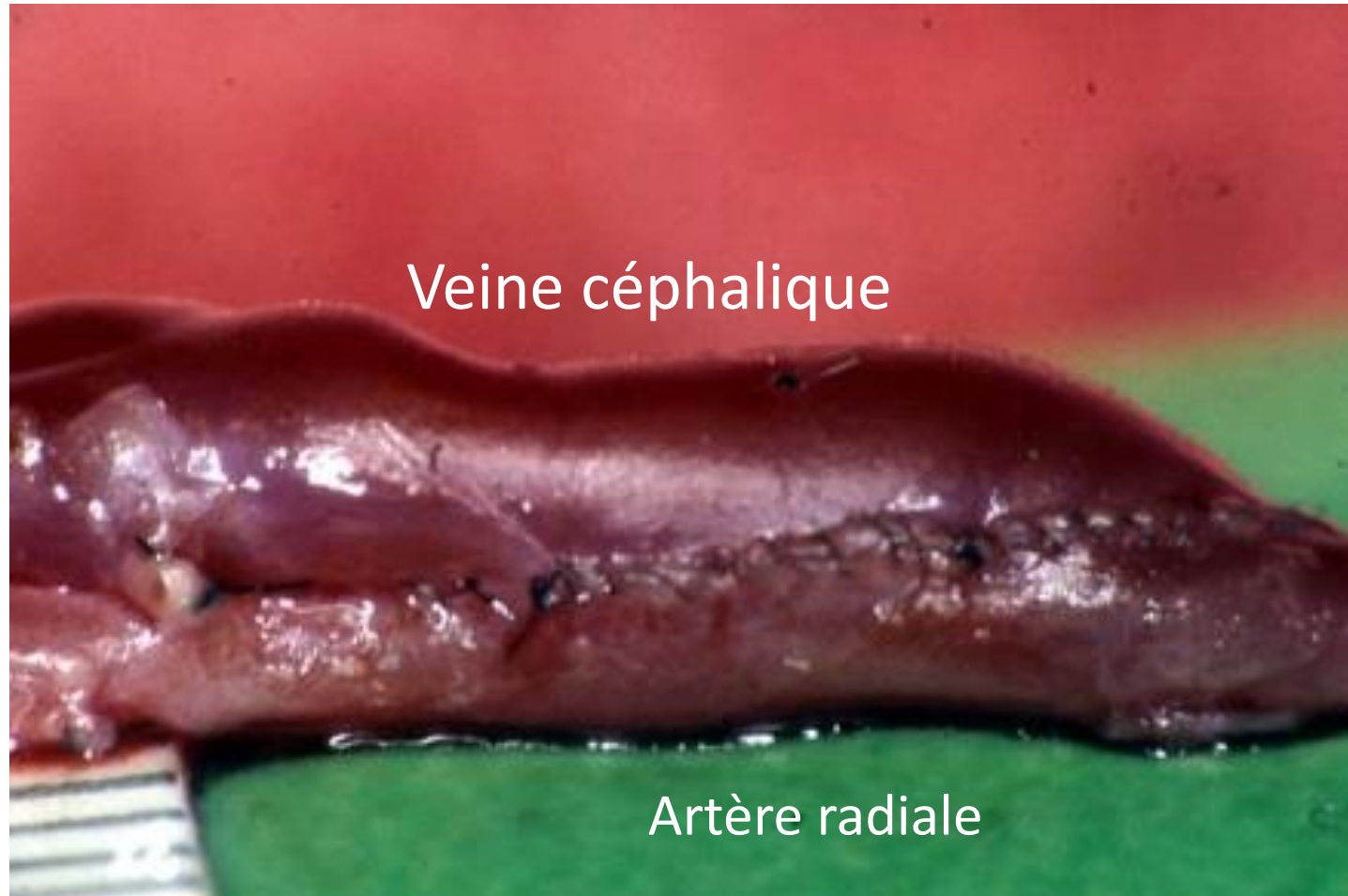
Anastomose 4 surjets



Sans garrot



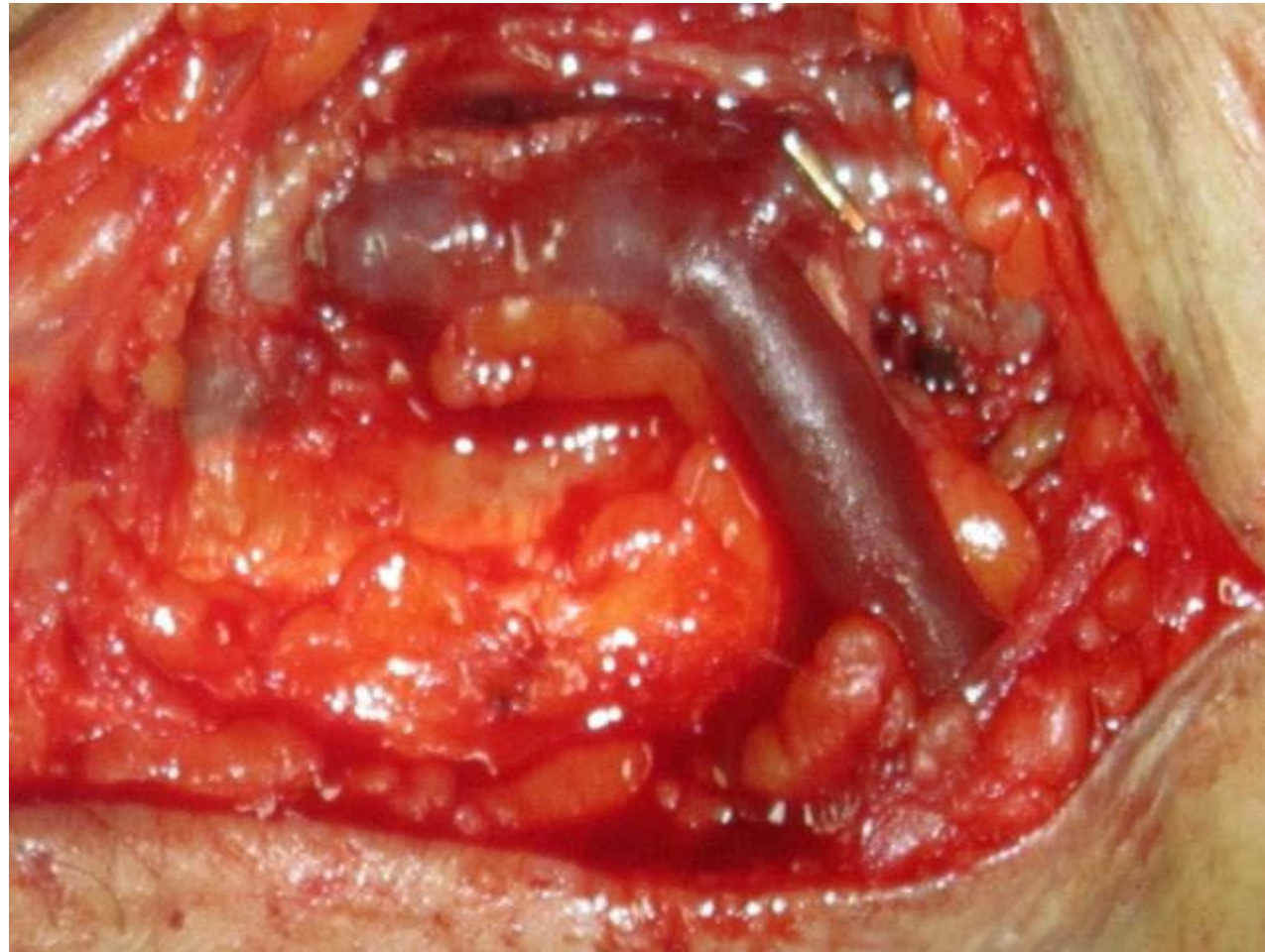
Sans garrot



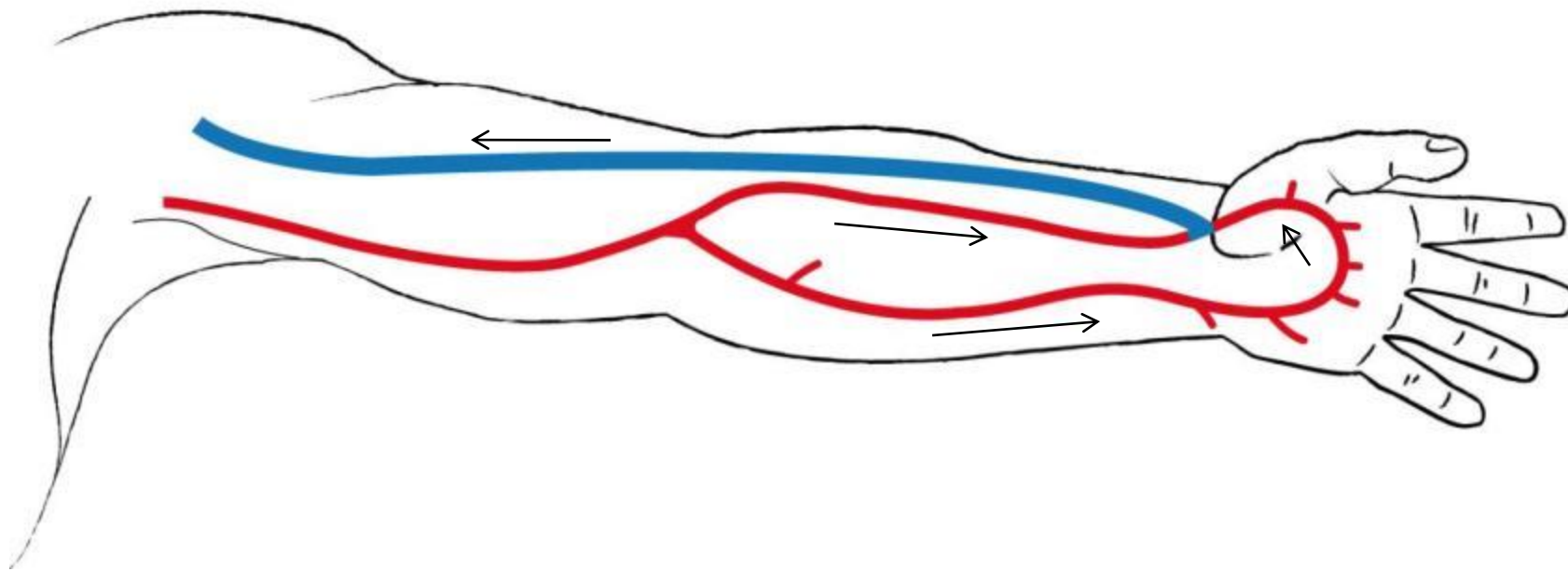
Avec garrot



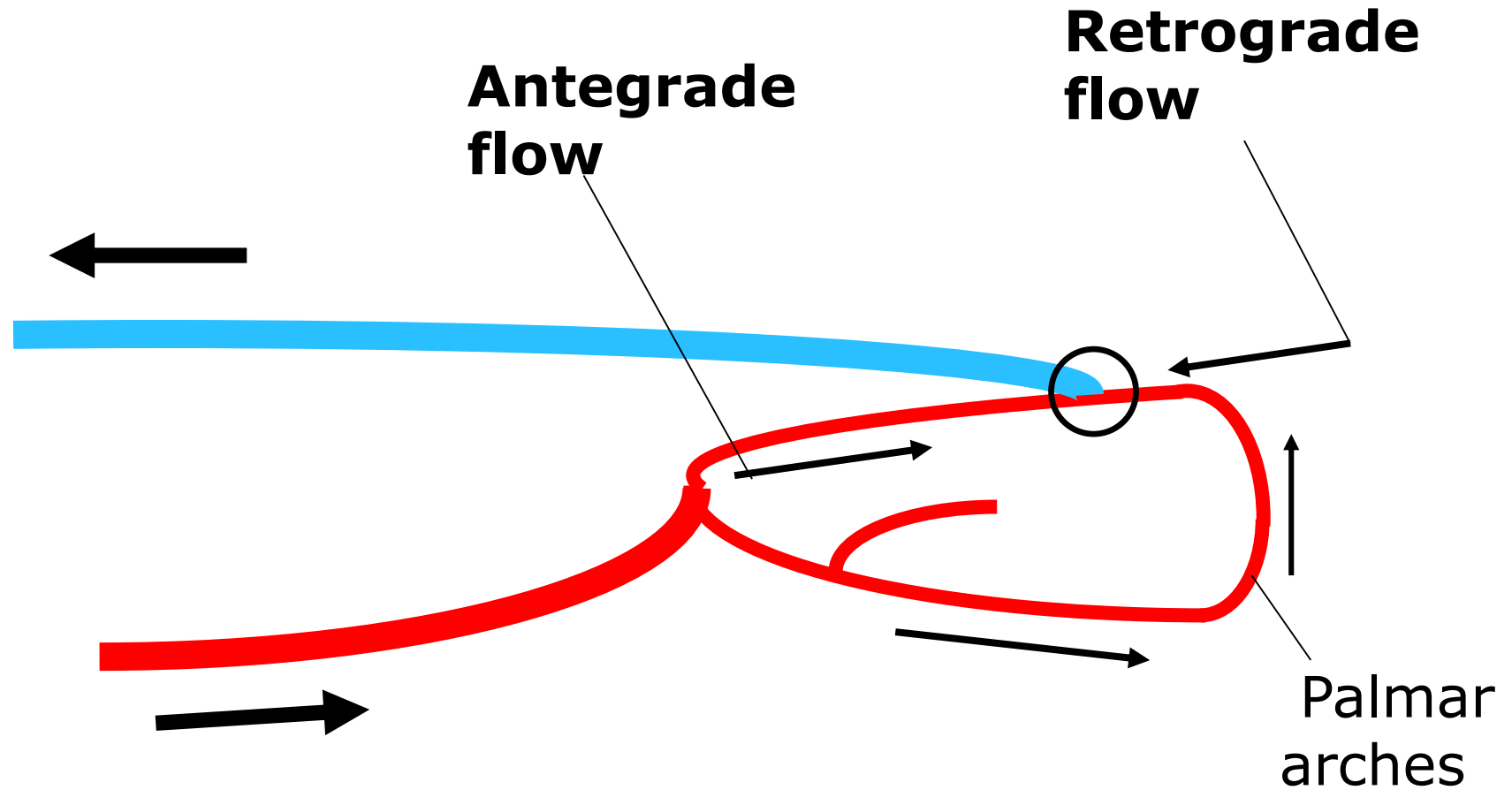
Garrot lâché



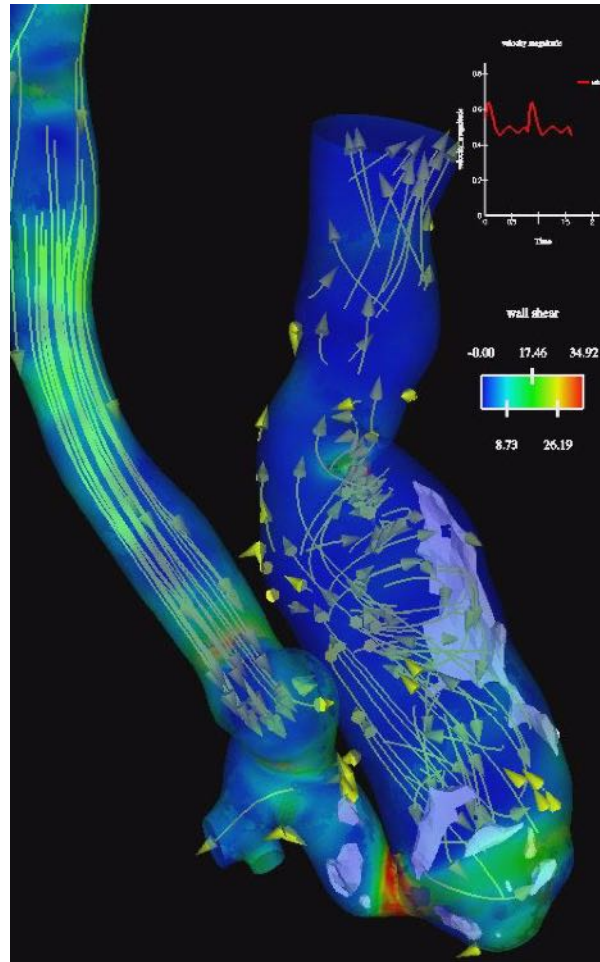
Radial Cephalic AVF



FAV Radio-Céphalique - Hémodynamique



Simulation Numérique



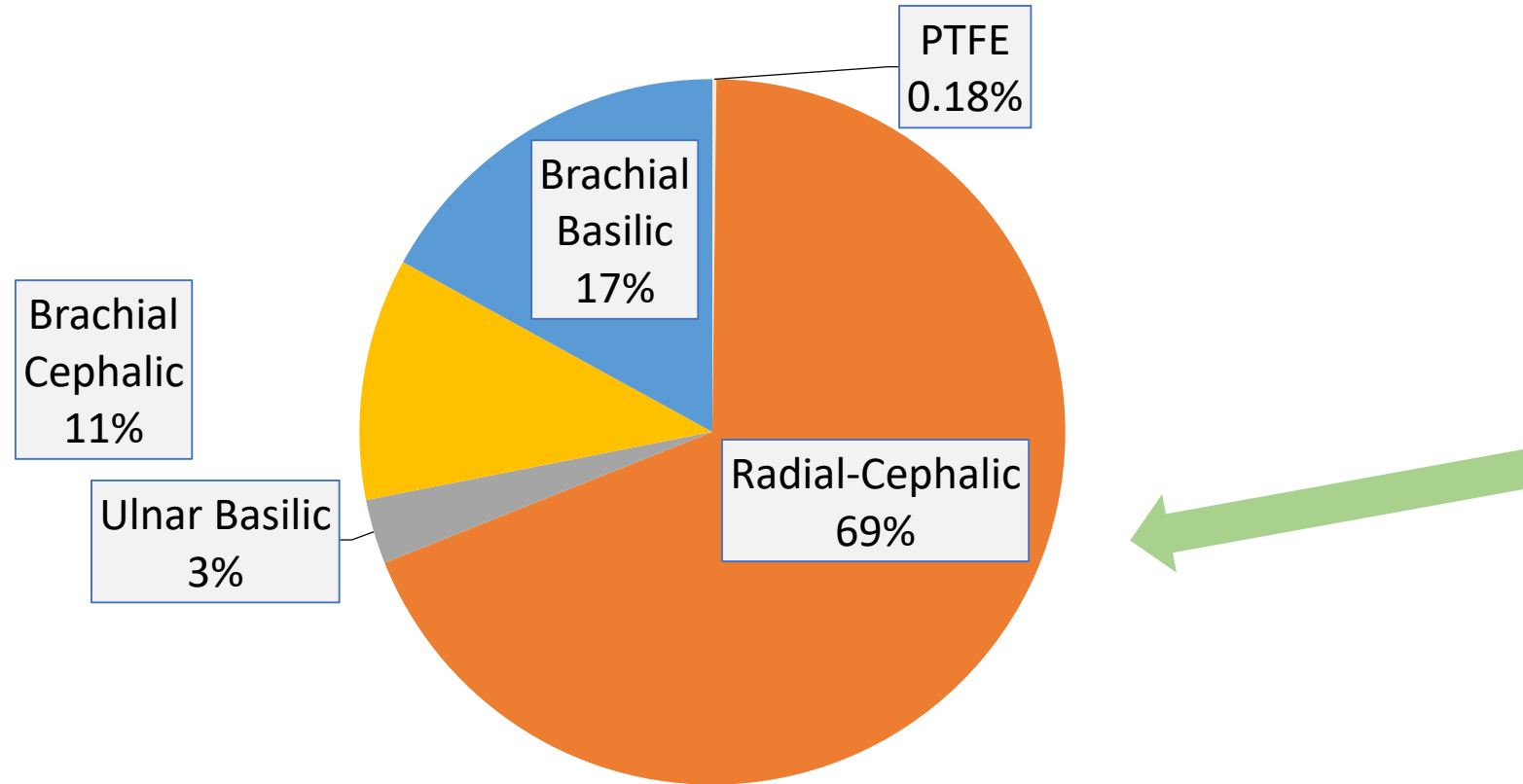
FAV Radio-Céphalique



FAV Radio-Céphalique (82y)



542 First AV Accesses

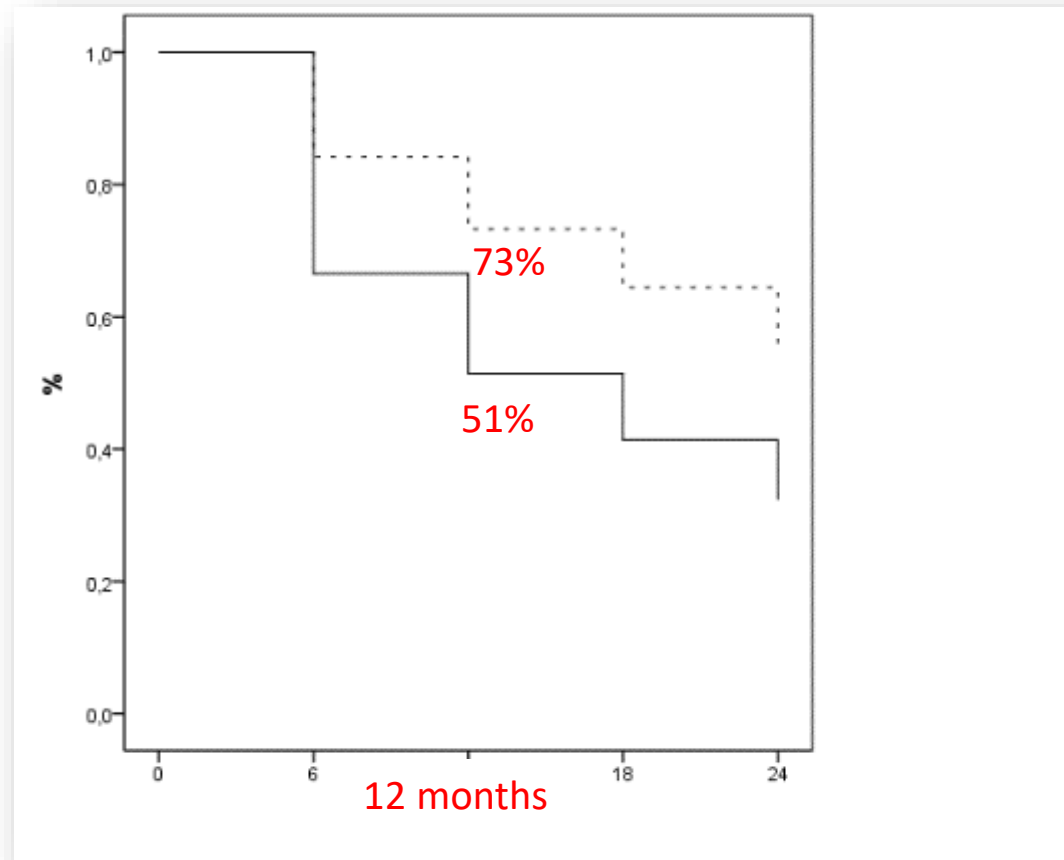


542 First AV Accesses

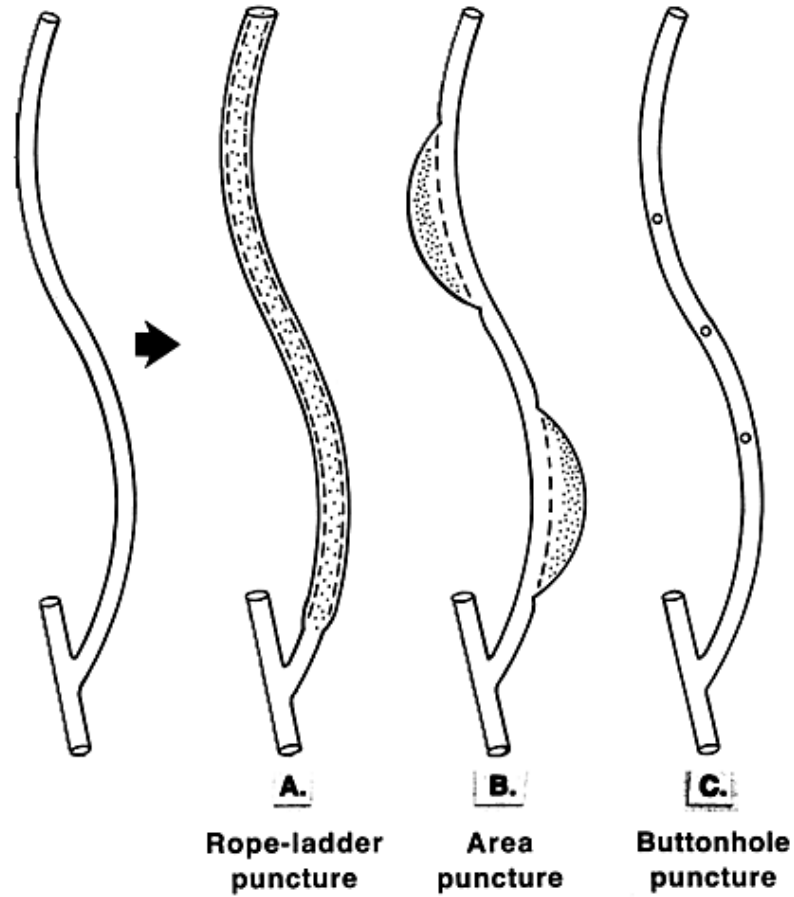
- Overall non-maturation rate :

7% (40/542 pts)

Overall Patency Rates



Zones de ponction



Radial-Cephalic AVF (8 kg)



- Hyperoxaluria
- PD at 1 year
- **Radial Cephalic AVF at 14 months (8 kg)**
- Hemodialysis at 2 years
- Kidney & Liver Transplantation at 3.5 years.

FAV 22 ans



FAV 35 ans

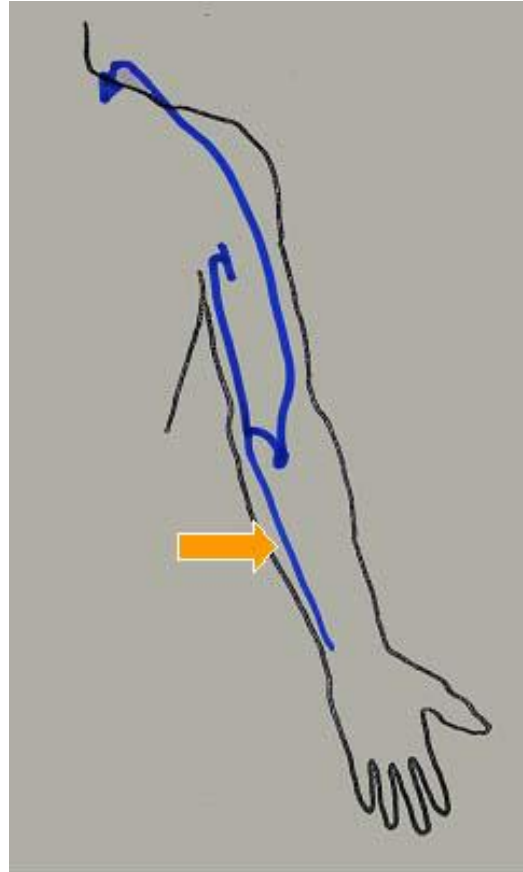


Clinical examination

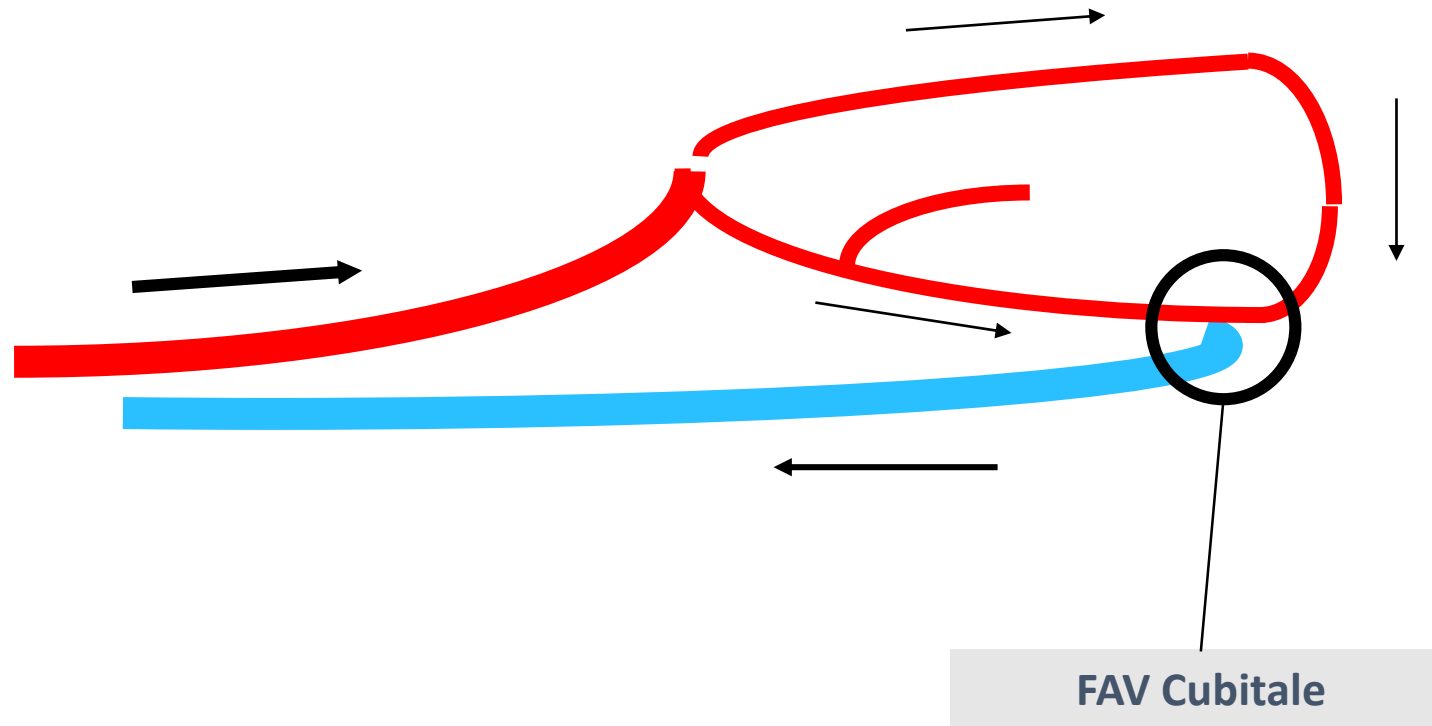


Preop.: 50 year-old woman (after 32 year-kidney transplantation)

Duplex



FAV Ulna-Basilique



FAV Ulna-Basilique



Ulnar-Basilic AVF



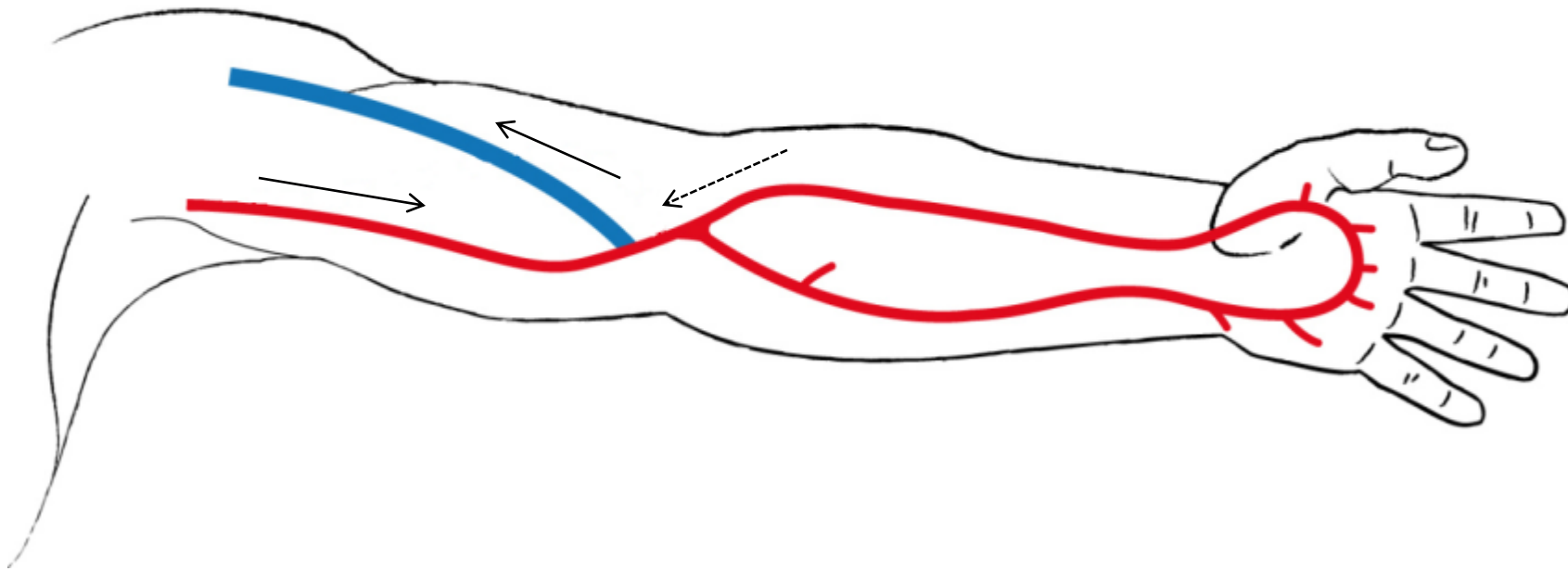
- Needle positions for dialysis

Courtesy:
CP Gibbons

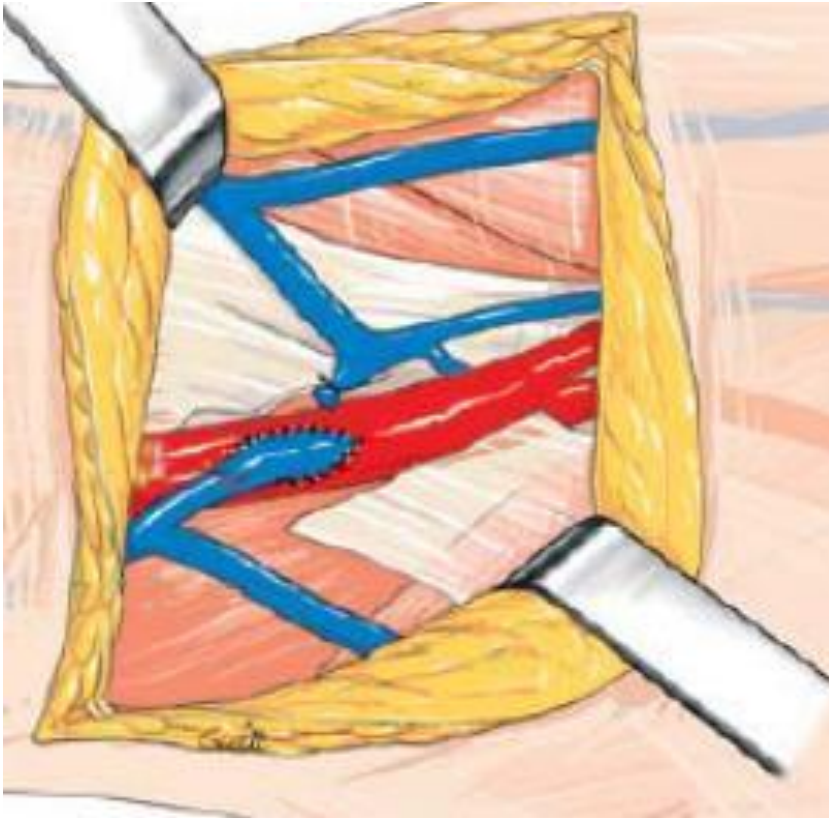
Normal UB AVF after 3 months



FAV Brachio-Cephalique & -Basilique



Basilic V. : 1st stage

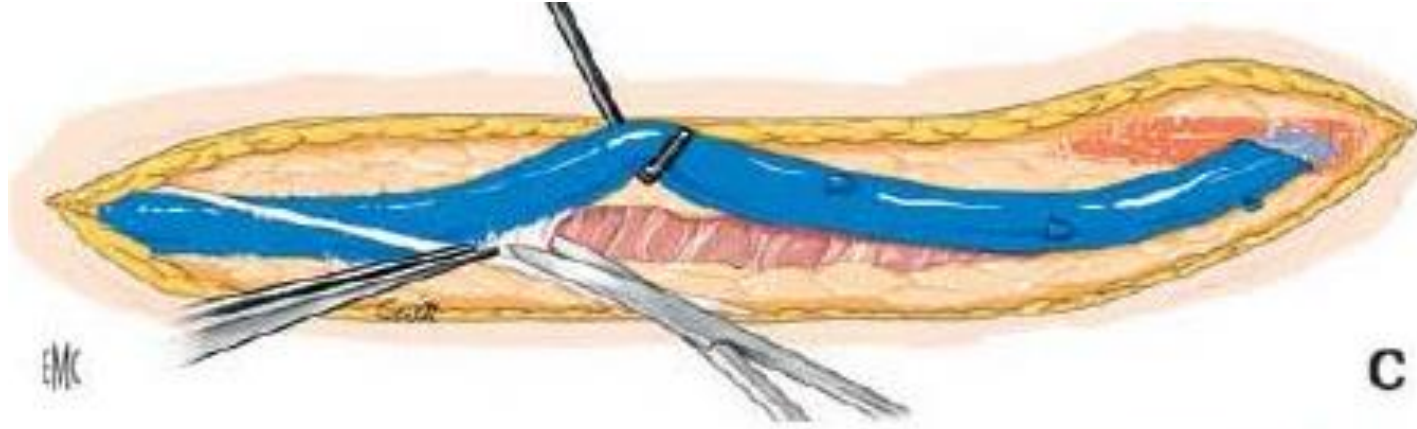


A side-to-end anastomosis is created between the brachial artery and the median antecubital vein.

When this branch of the basilic vein is absent, the upper part of the forearm basilic vein is used.

We routinely use prophylactic haemostasis and surgical microscope

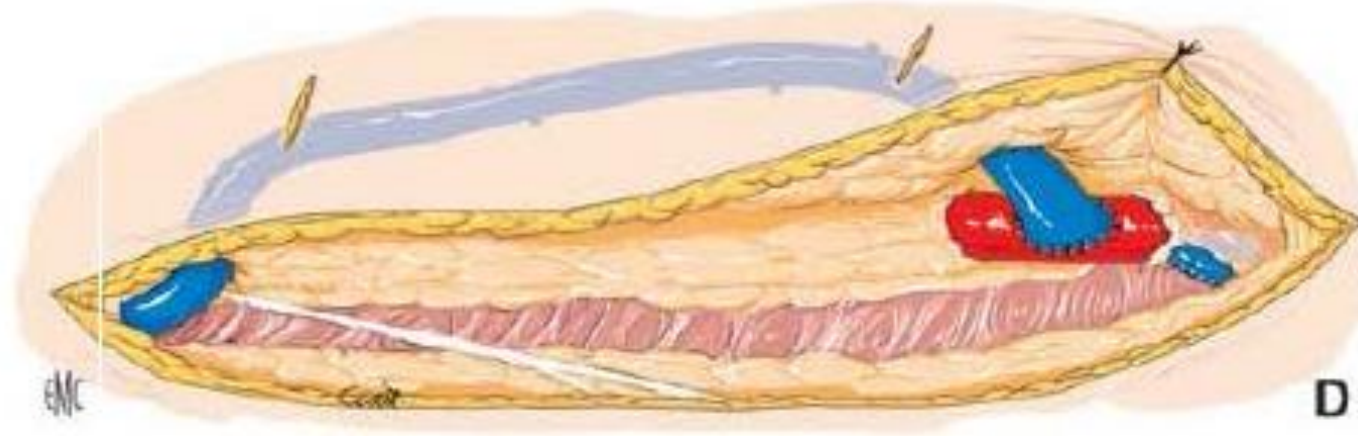
Basilic V. : 2nd stage



Longitudinal skin incision is made along the medial upper arm. The vein is dissected free with

ligation of side branches, and careful attention to adjacent nerves.

Basilic V. : 2nd stage



The vein is divided at its lower extremity, flushed with heparinized saline solution and transposed through a separate anterior superficial tunnel,

taking great care to avoid any angulation or twisting.

Most frequently, a new anastomosis is created above the first one.

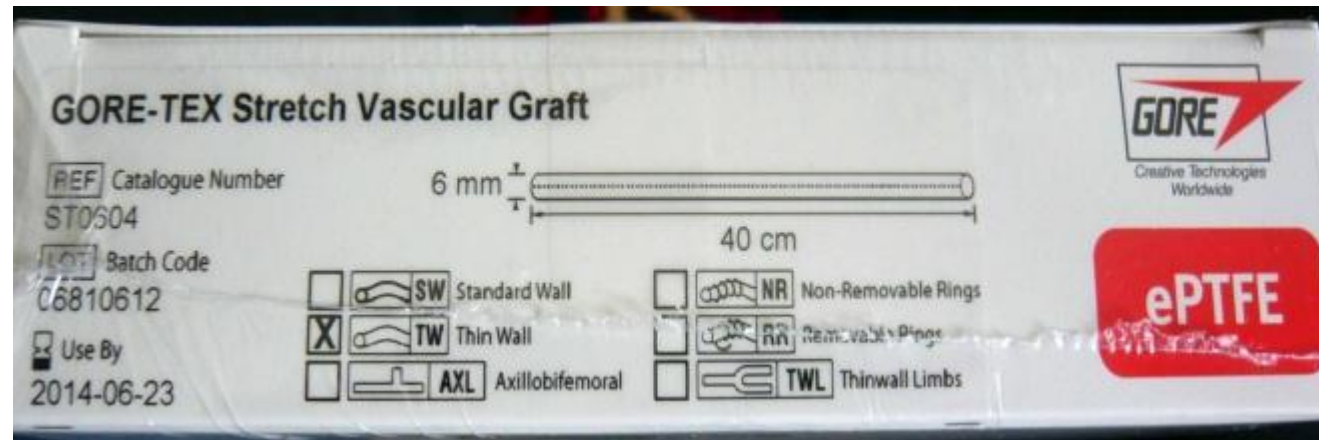
Superficialisation-Tunnellisation V. Basilique



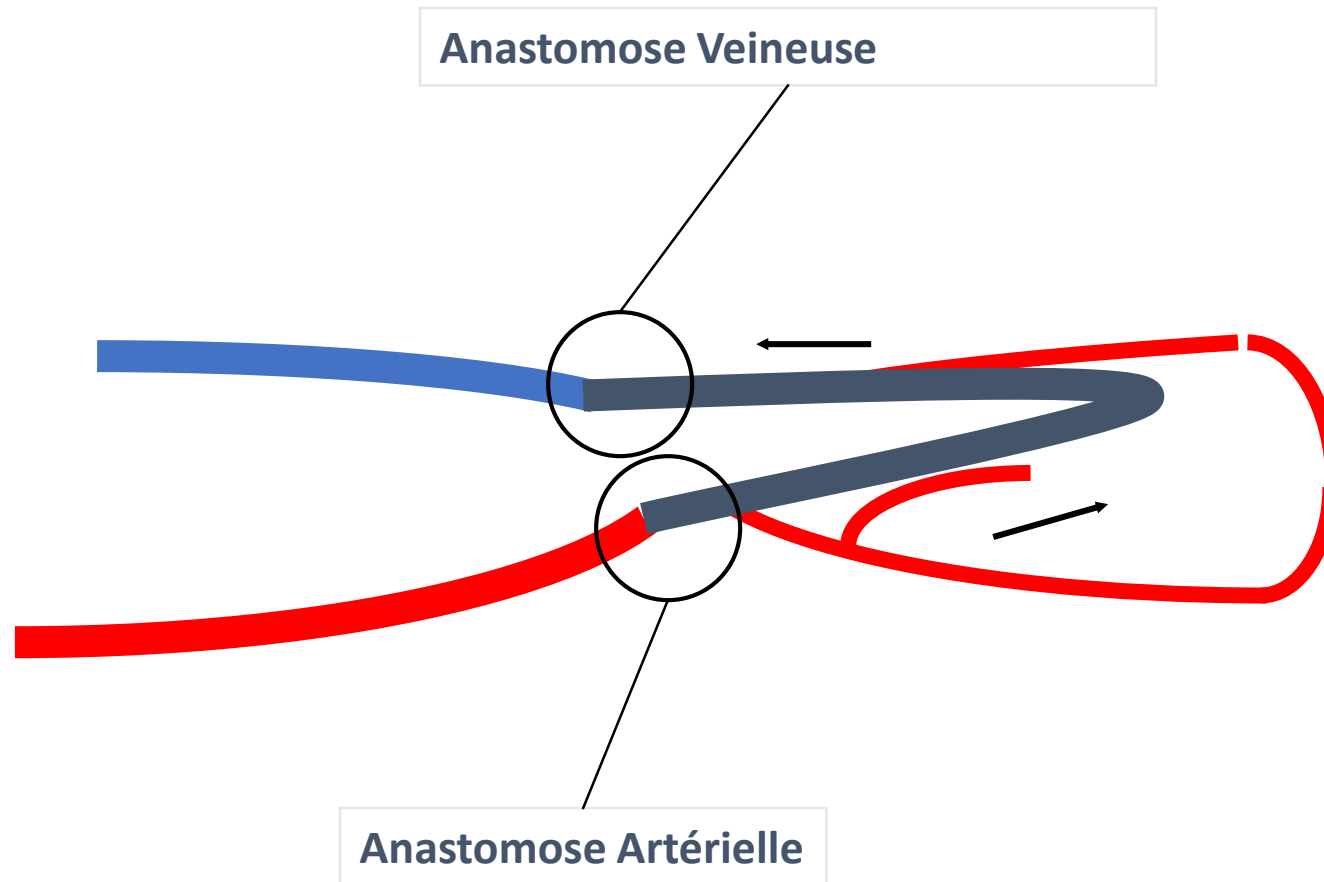
Superficialisation sur place



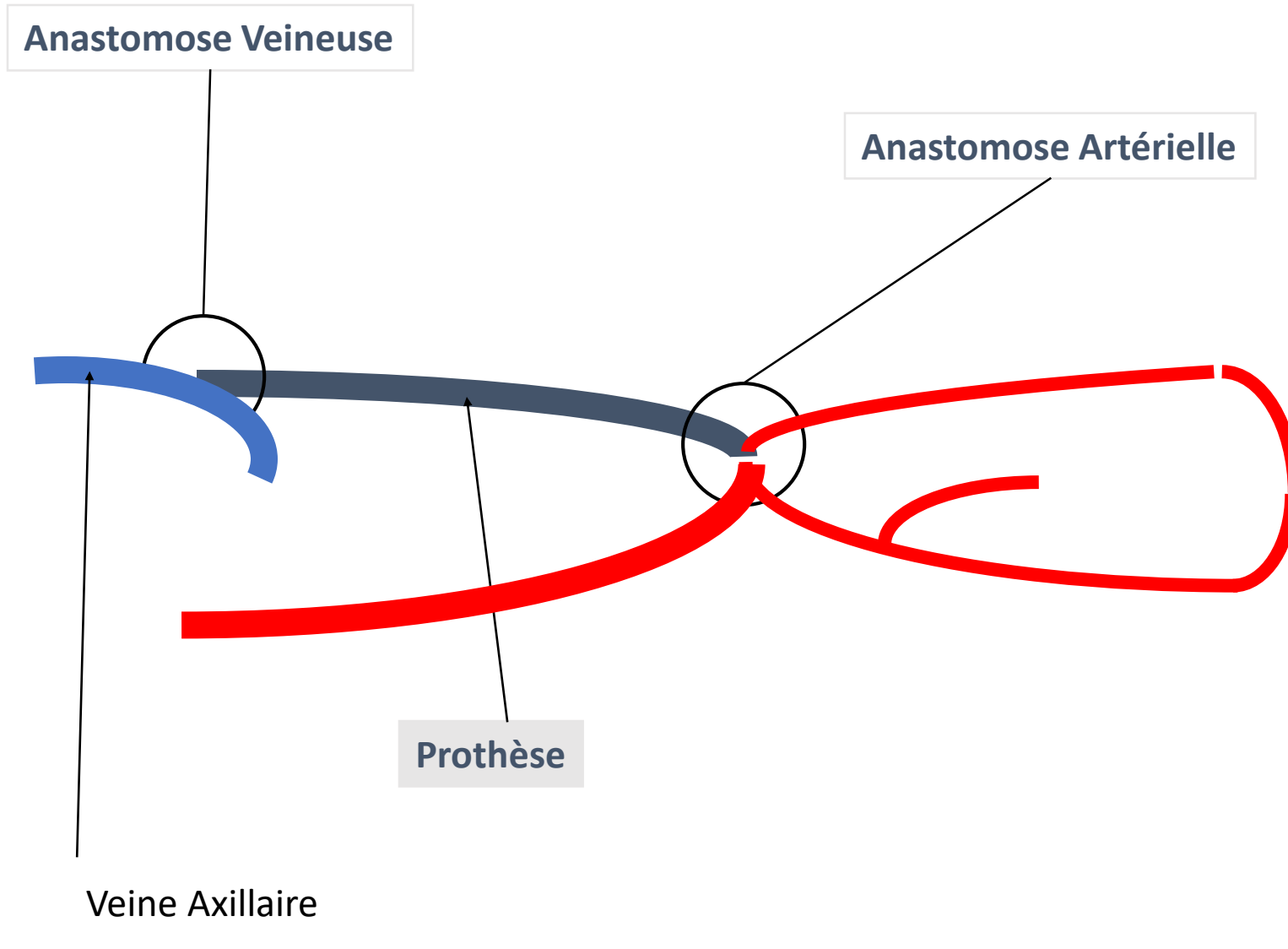
Les Prothèses



Prothèse à l'Avant-Bras

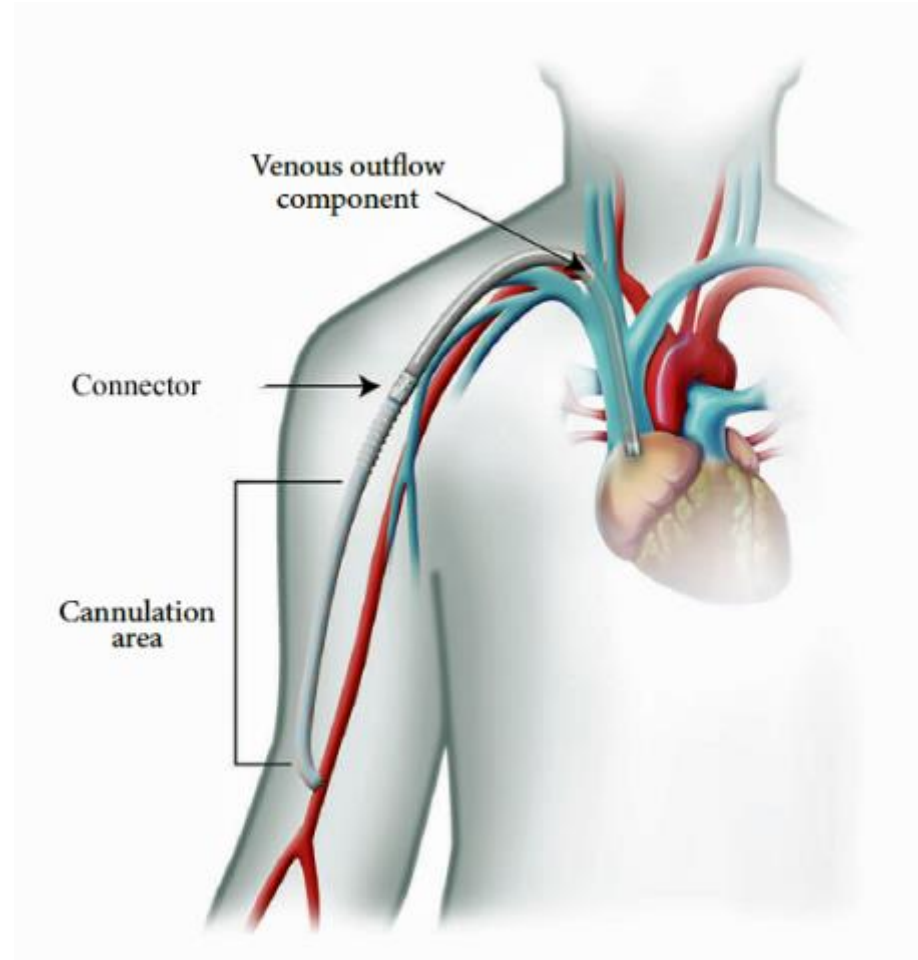


Prothèse au Bras



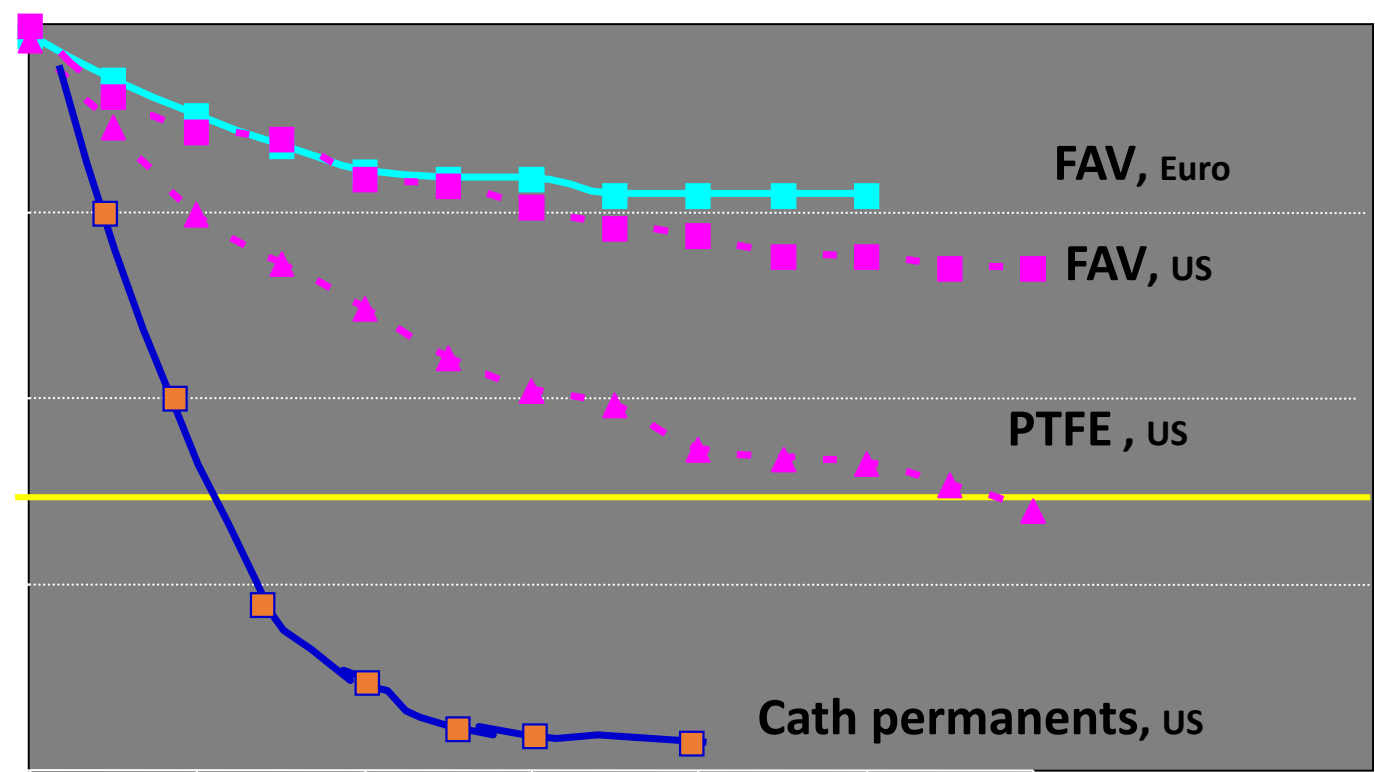
HeRO

(Hemodialysis Reliable Outflow)



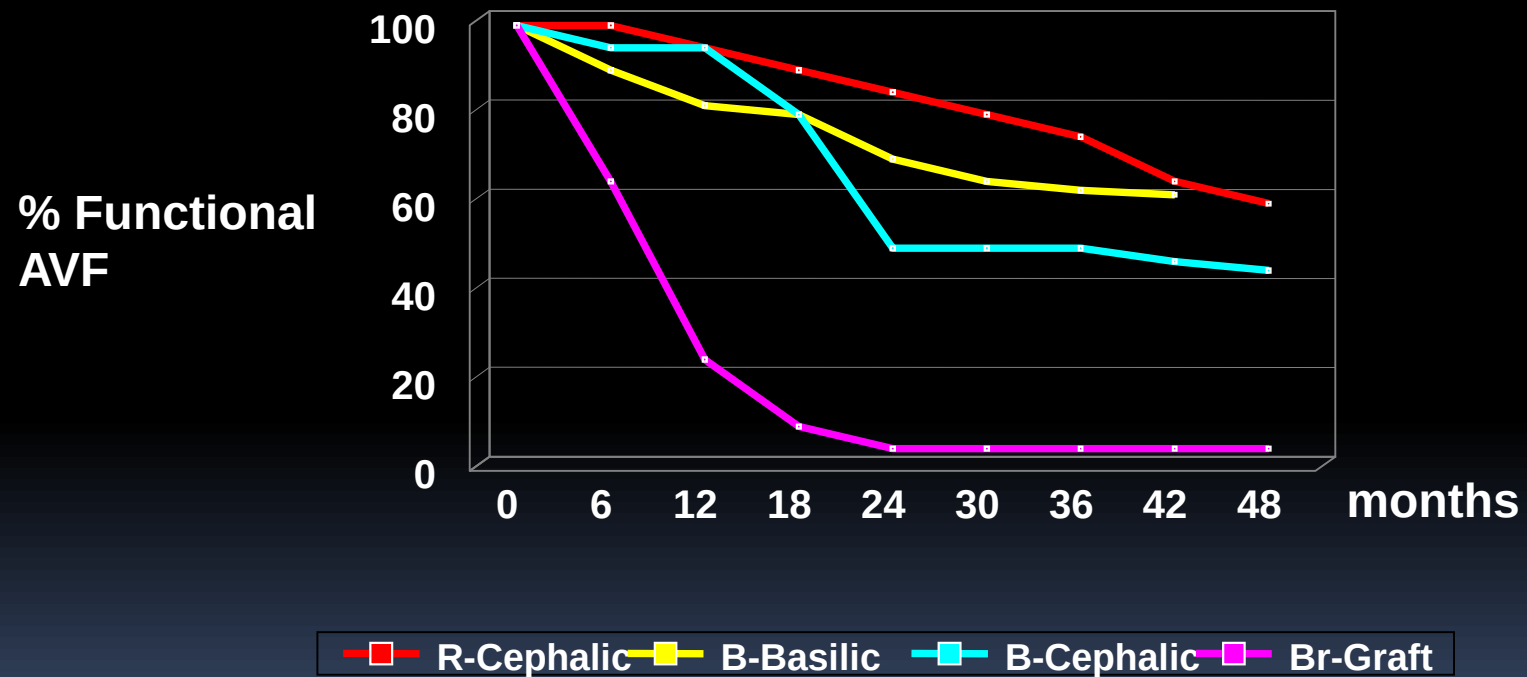
Survie de l'Accès Vasculaire

Survie technique

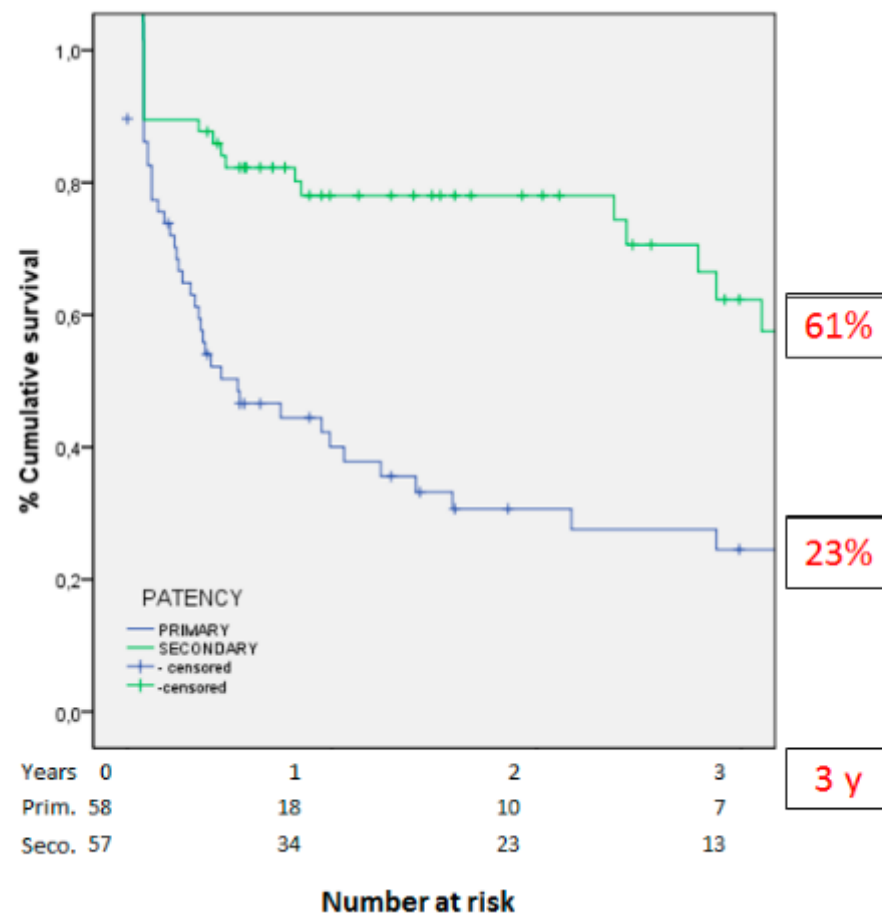


DOPPS

434 FAV chez 380 Enfants



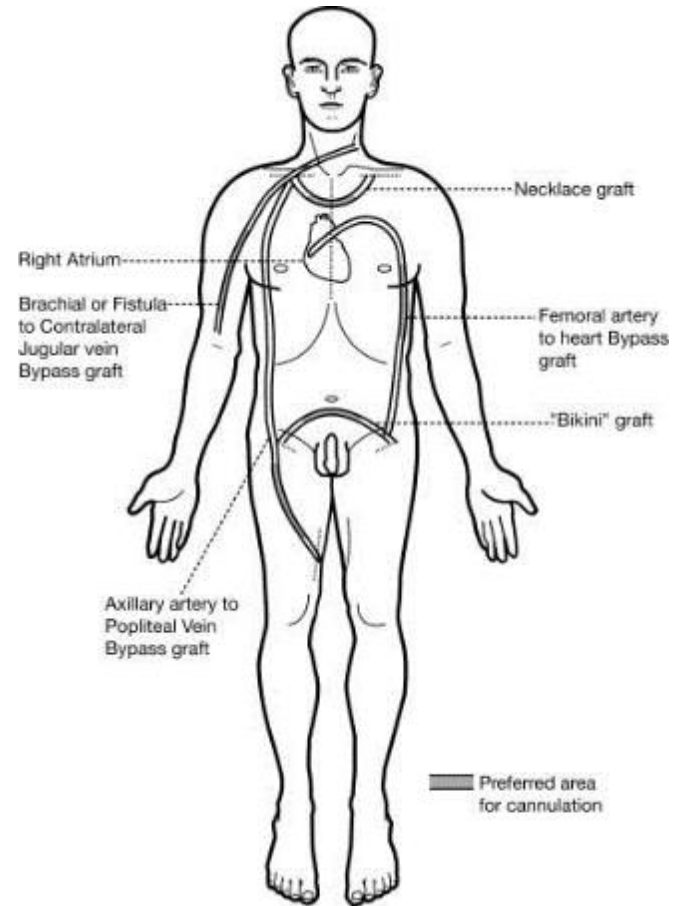
Children < 20 kg



Montages Exotiques

- Pontages Thoraciques: sténose v. précoce
- Pontages MI: infection, sténose
- Pontages Artério-Artériels: non
- **Superficialisation Veine Fémorale, Axillaire, Brachiale**

Pontages exotiques

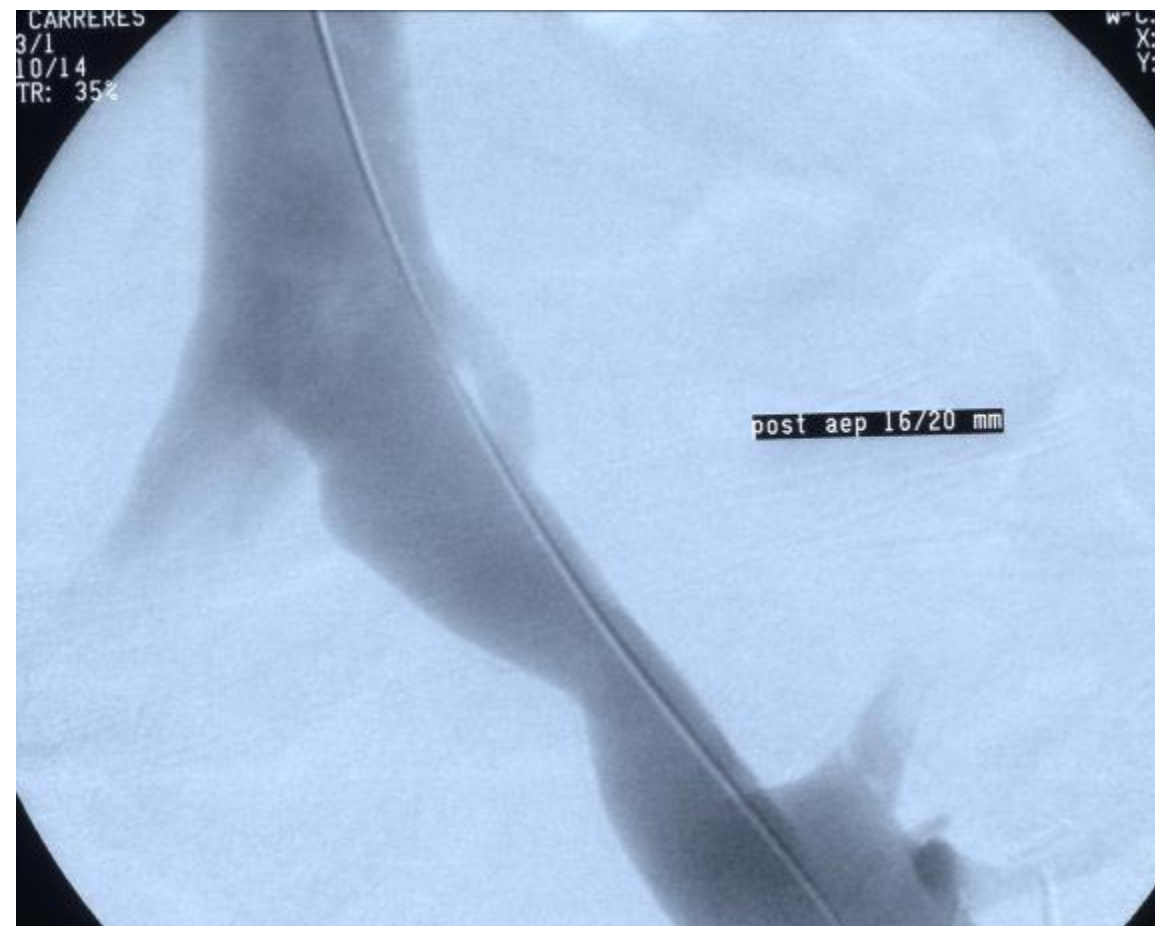


Superficialisation Veine Fémorale

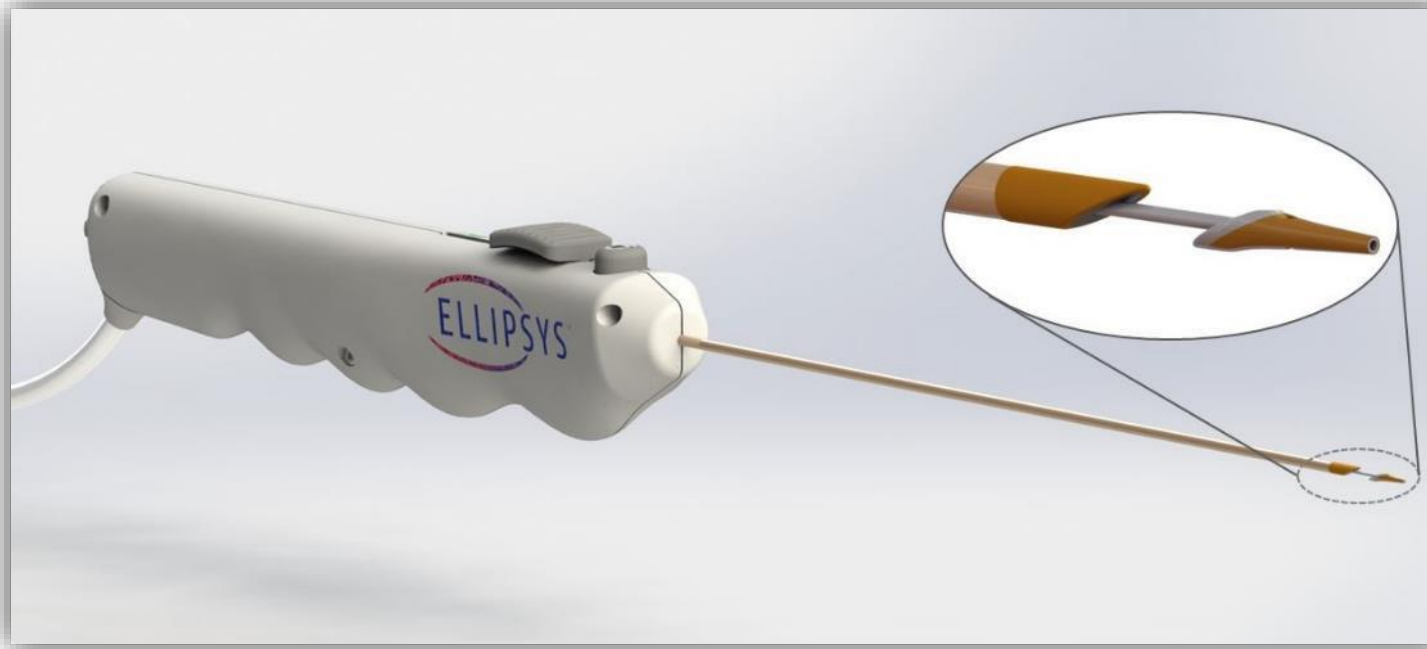


7 years later

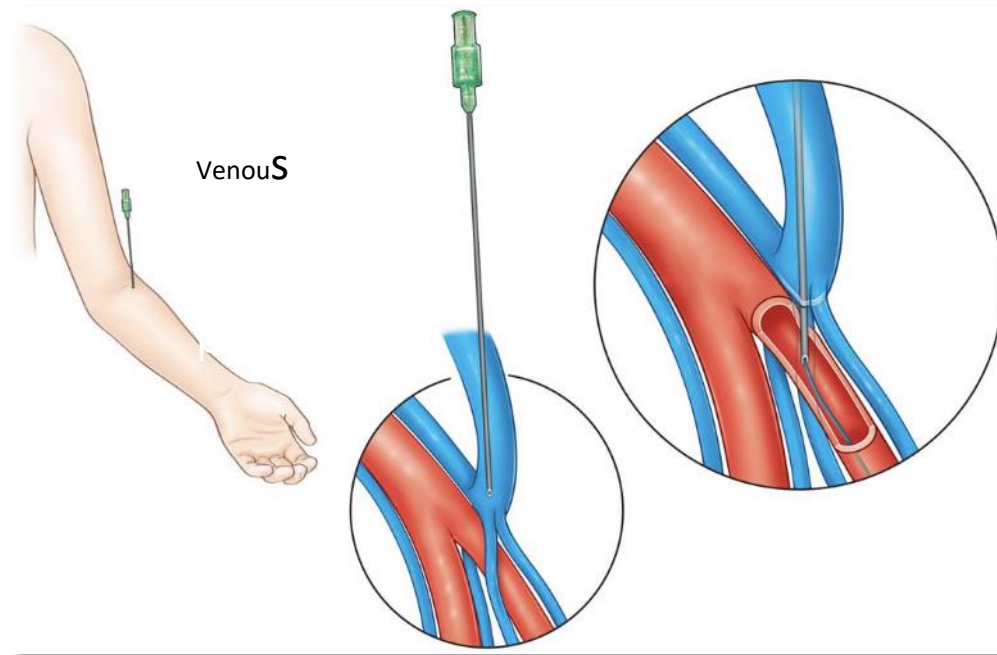




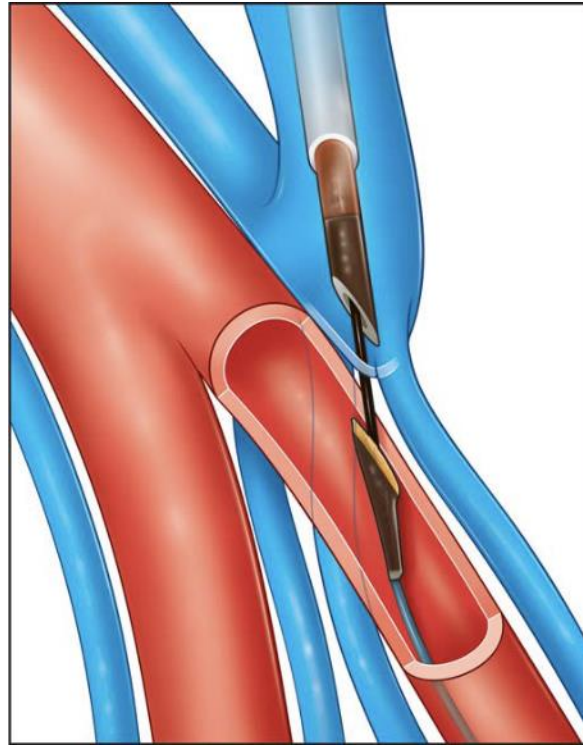
Ellipsys System



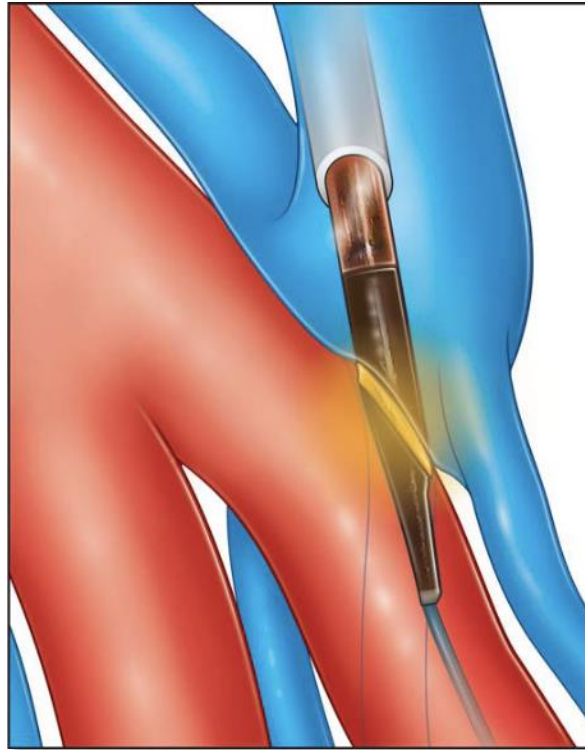
Ellipsys® Vascular Access System



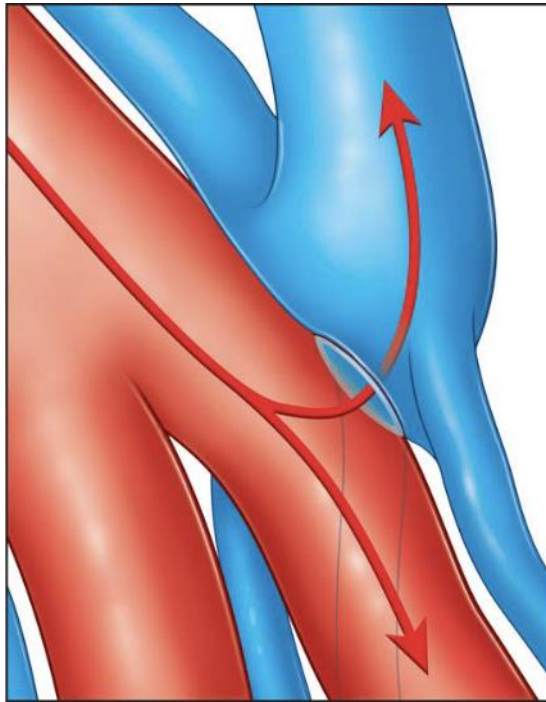
Positioning of Ellipsys[®] Catheter



Pressure, Activation and Fusion



Creation of AVF + Balloon dilatation

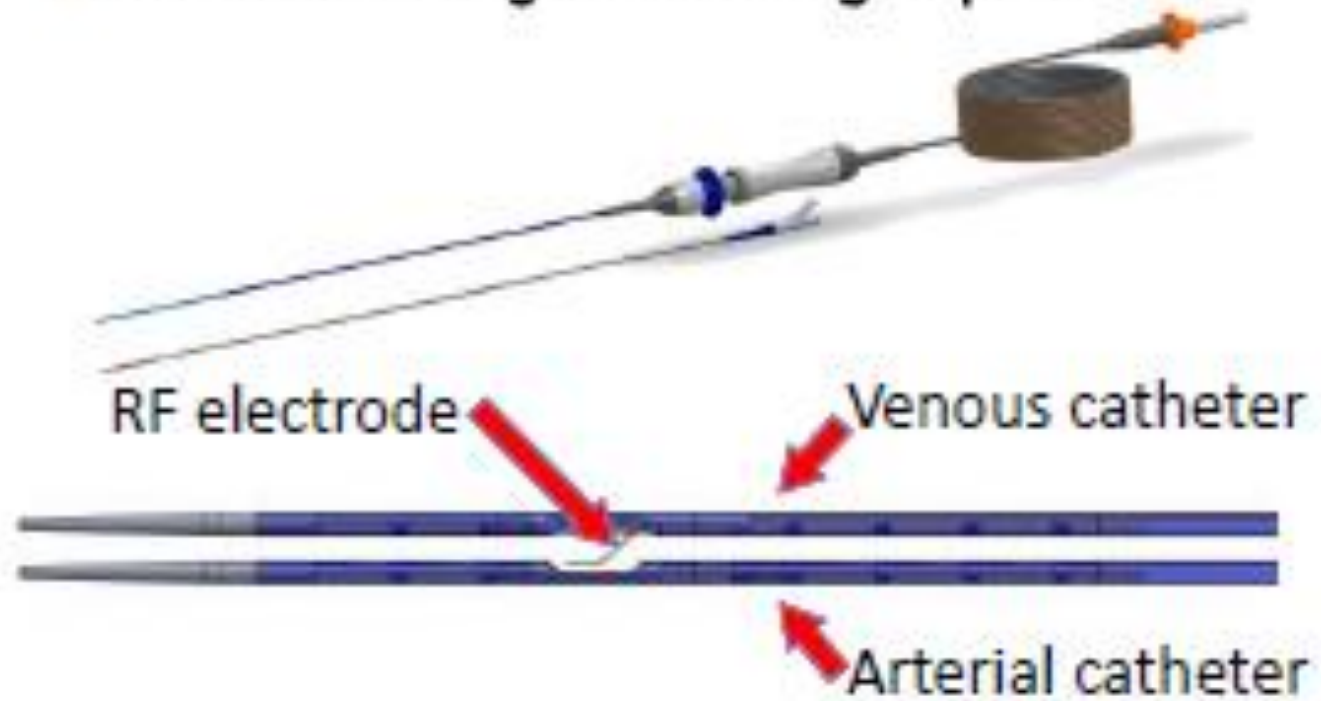


Cephalic Vein Cannulation in the Arm

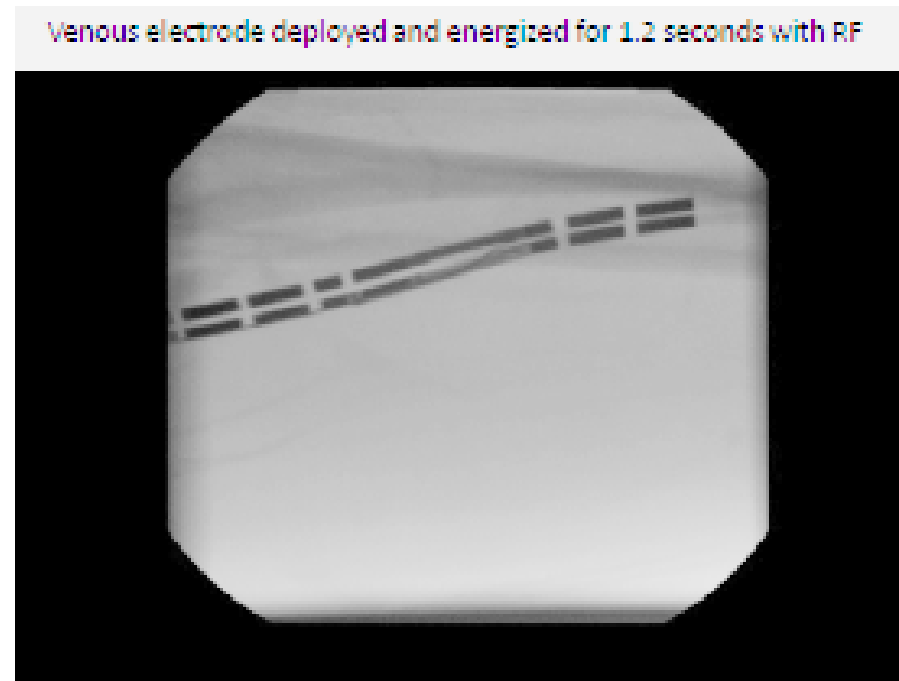


Création percutanée de Fav EverlinQ endoAVF System

Paired magnetic catheters
with electrosurgical cutting capabilities



Création percutanée de Fav



Early Results (A.Mallios JVS 2018)

- May – Nov 2017
- 34 patients: 10 Two-stage, 14 One-stage
- 97% technical success
- After 91 days mean follow-up:
 - 82% primary patency
 - 94% secondary cumulative patency
- Mean access flow: 1114ml/min (range, 645-1486)

Conclusion 1 : Open Surgery AVF

Pros:

- 50 year-experience
- Angiologist Ultra-Sound mapping,
- Microsurgery -> Distal AVF first, even in children
- Long term patency : up to 30 yrs

Cons:

- 58% maturation rate at 3 mos (Distal AVF, Al Jaishi review)
- Proximal AVF: High flow, Distal Ischemia ??
- Un-aesthetic scars and veins dilatations

Conclusion 2 : Percutaneous AVF

- Cons:
 - Prices of the devices
 - Patients selection opposite to « Distal Fistula First »
 - Learning curve
 - Possible future High Flow with cardiac issues and distal ischemia
 - Secondary distal AVF ??
 - Long-term patency ?
- Pros:
 - Minimally invasive one-stage AVF creation
 - Early maturation
 - High patient satisfaction
 - Low pressure fistula

92 year-old, 8 Days Post Ellipsys[®] Procedure



12th July 1789

Louis XVI : « A revolt ? »

Duc de la Rochefoucauld : « No Sir, it is a revolution ! »

14th July 1789

The storming of the Bastille

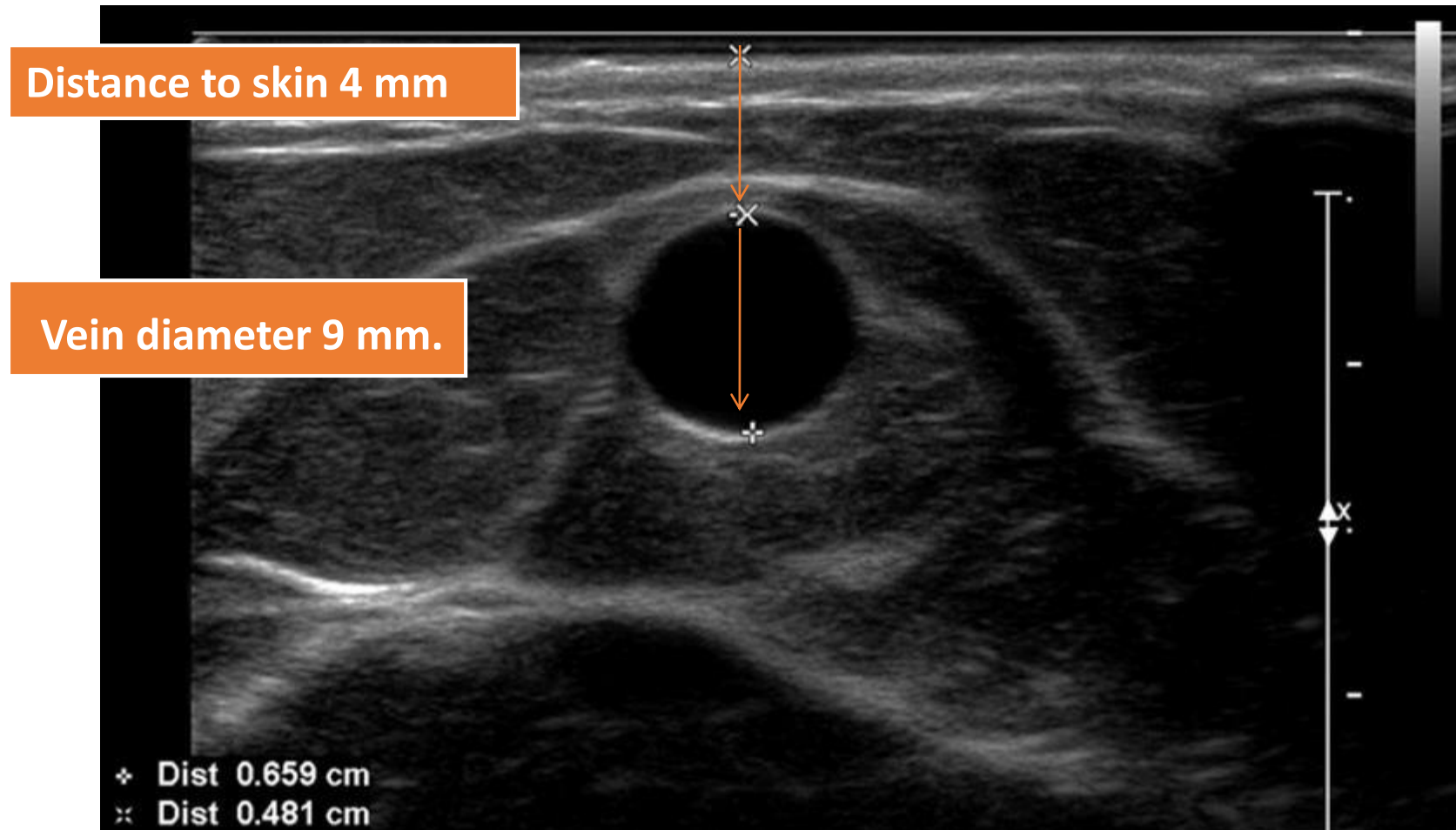
Complications

Défaut de Maturation

Fistule Mature – Règle des “6”

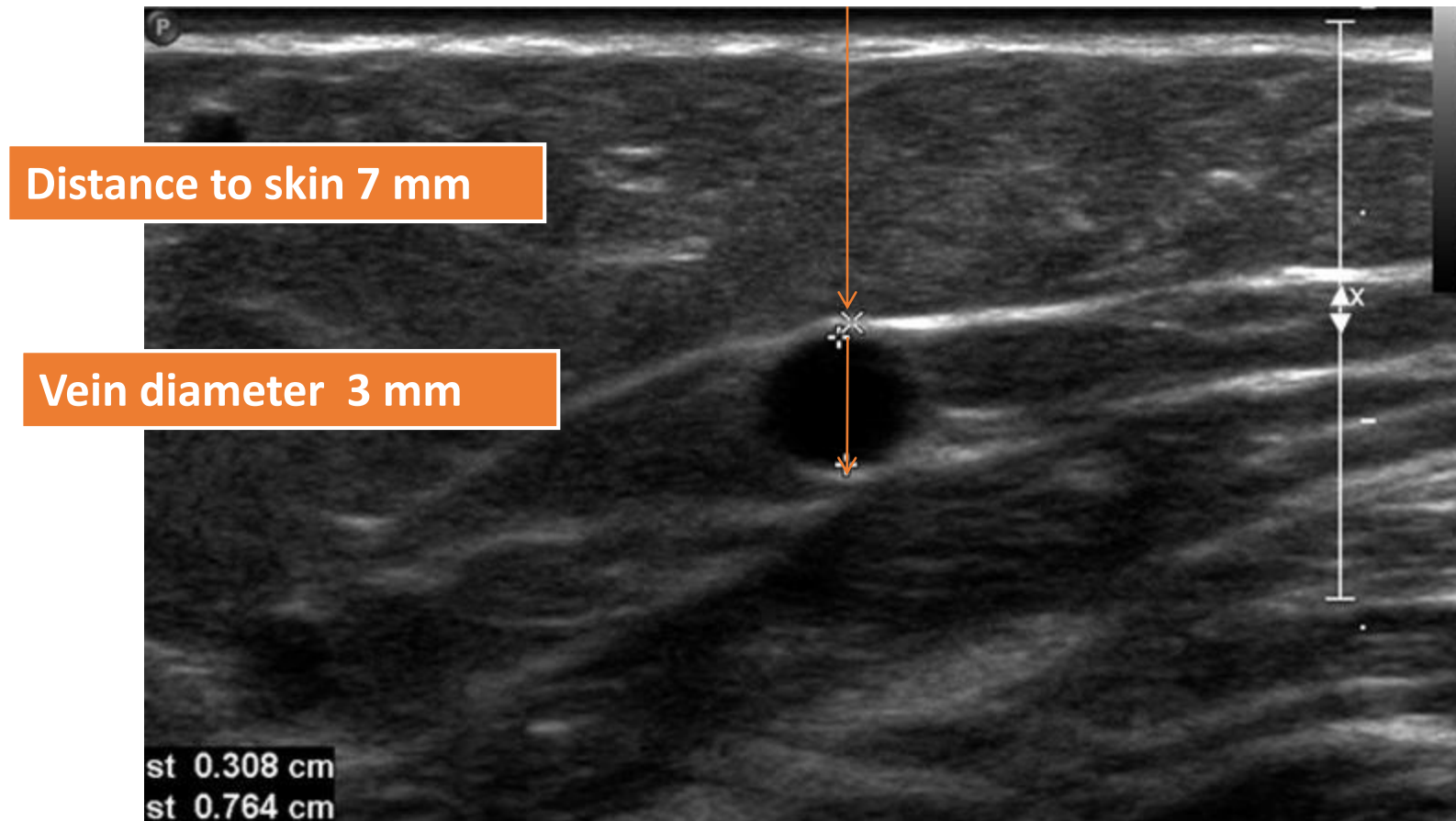
- Diamètre > 6 mm,
- Débit > 600 mL/min,
- Profondeur < 6 mm,
- 6 semaines post-intervention.

FAV mature



Singh et al, Radiology, 2008

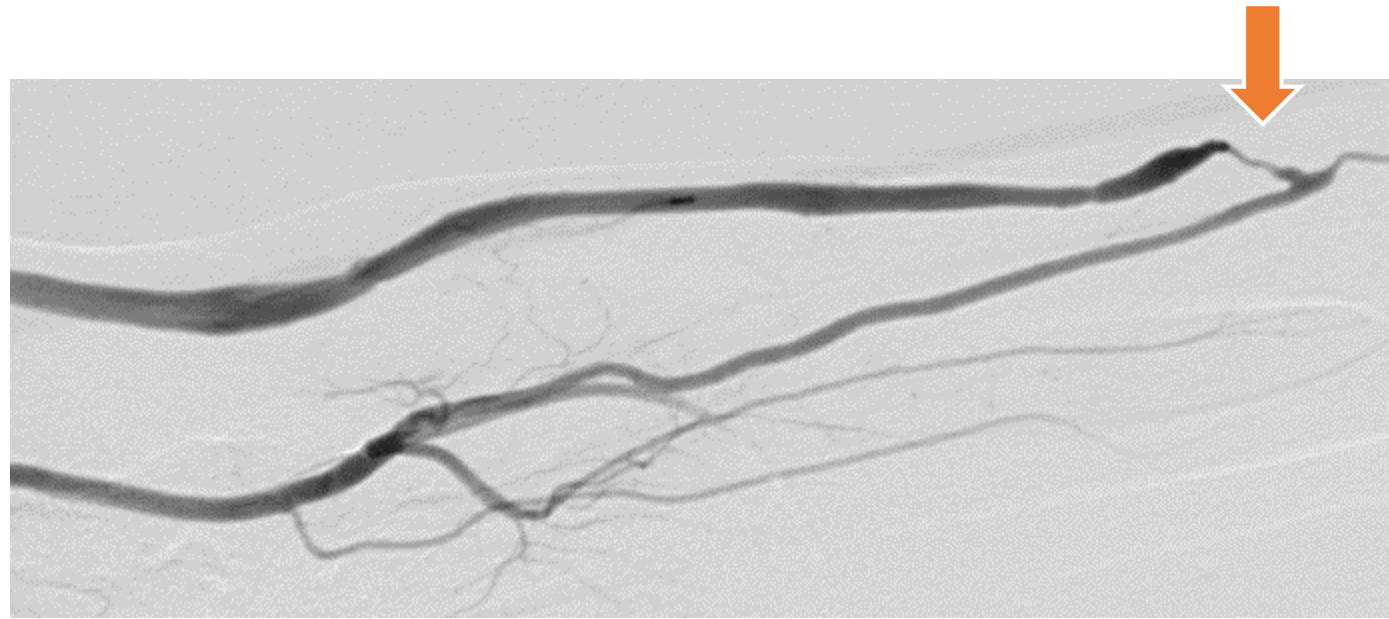
Fistule Immature



Singh et al, Radiology, 2008

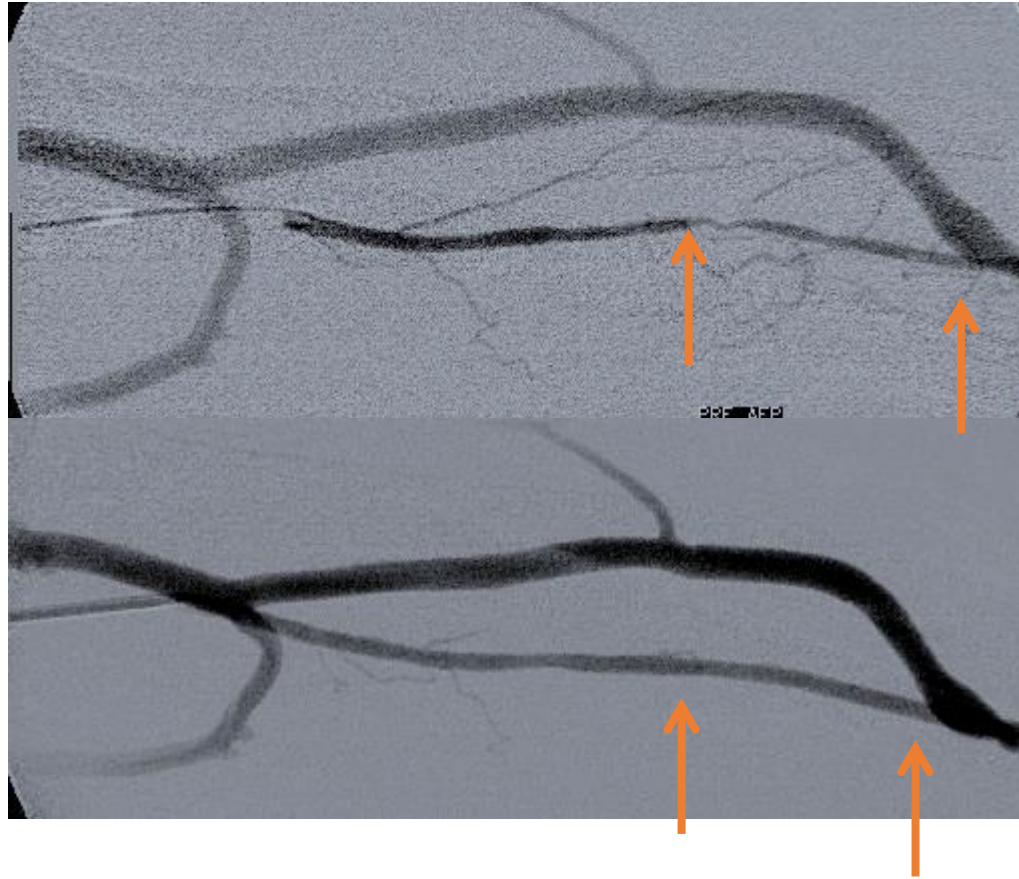
Sténose

Non-maturation Juxta-anastomosis stenosis



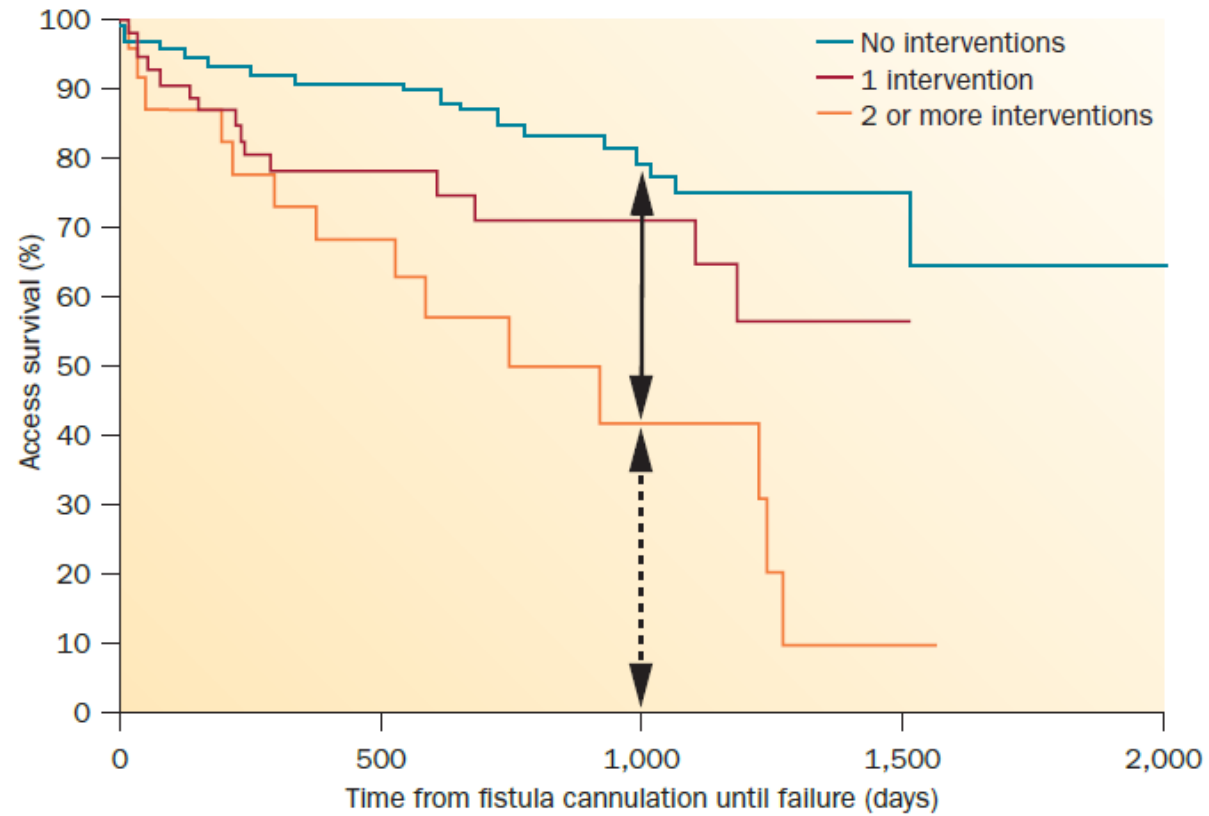
Re-anastomosis

Non-mature AVF : Radial A. stenosis



PTA

Lee & Chaudhury 2011: role of interventions to promote maturation on cumulative patency



Veine trop profonde

Superficialisation sur place Fav Radiale



Superficialisation Tunnellisation Fav Céphalique

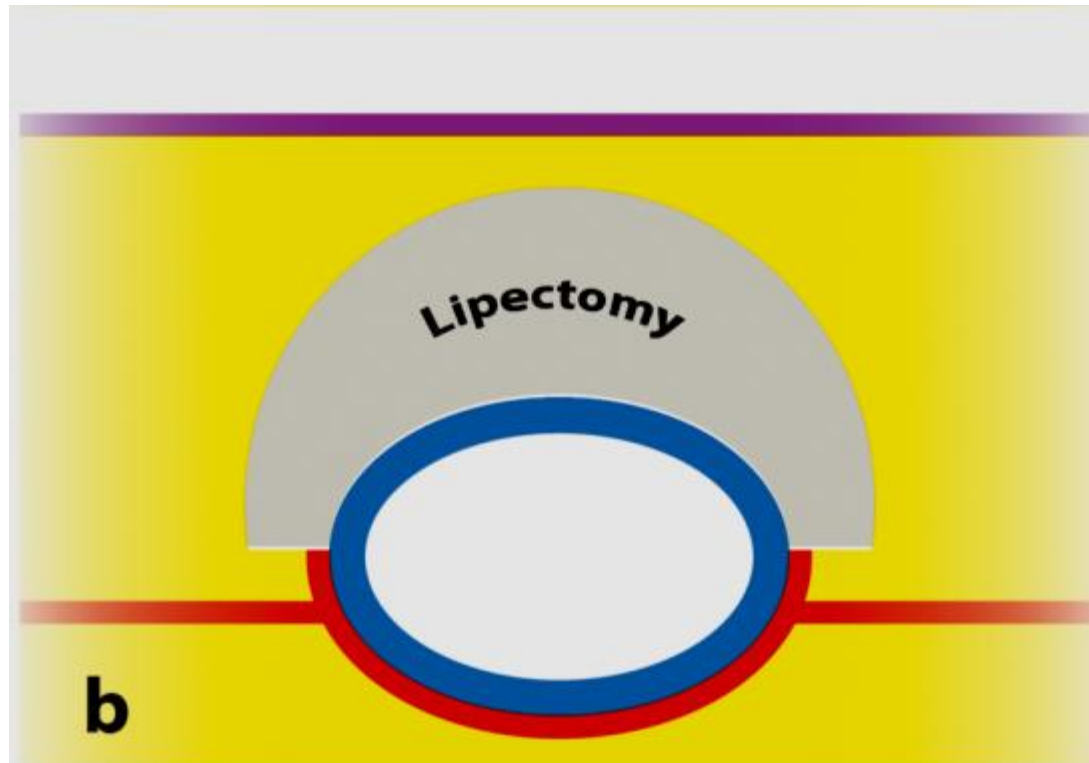


Superficialisation-Tunnellisation FAV Radiale



Superficialisation par Lipectomie FAV Radiale

Operating diagram: During L.



skin

adipose
tissue

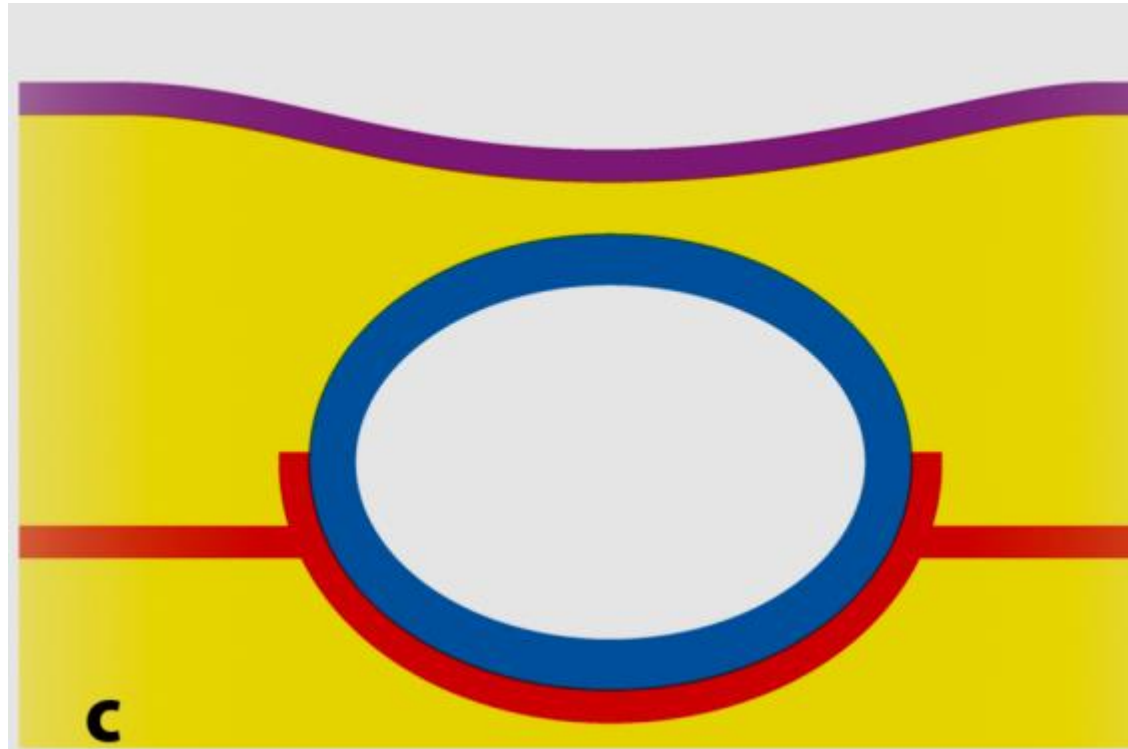
fascia
superficialis

vein

Removed fat pads



Operating diagram: After L.



skin

adipose
tissue

fascia
superficialis

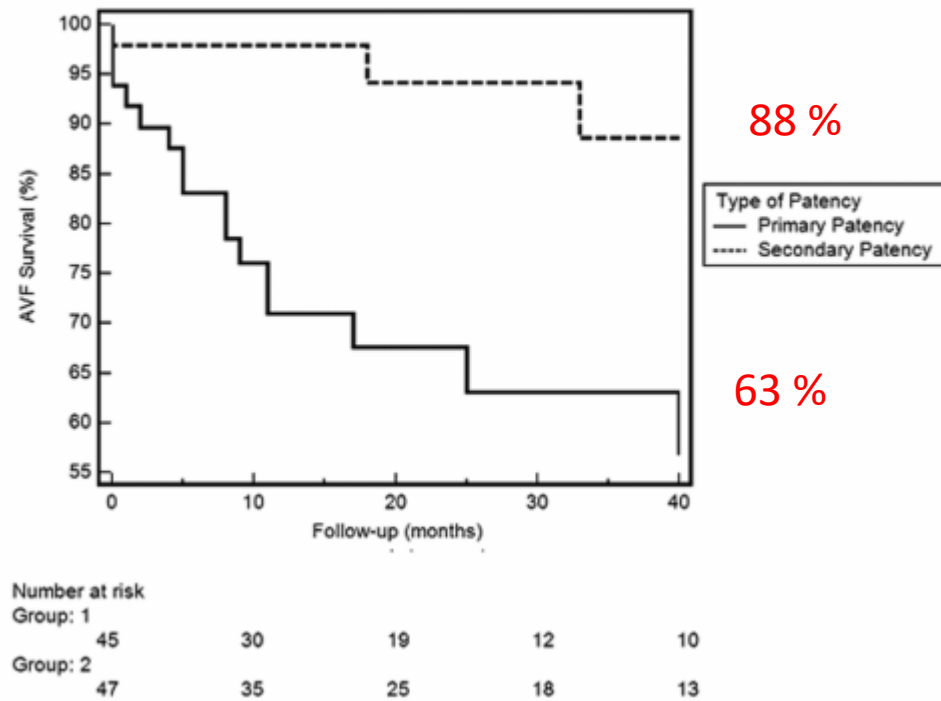
vein

3-year
Superficialisation par lipectomie



3-year patency rates (Kaplan-Meier) Bourquelot et al.JVS 2009

49 pts



Complications tardives

- Sténose, Thrombose

Stenoses

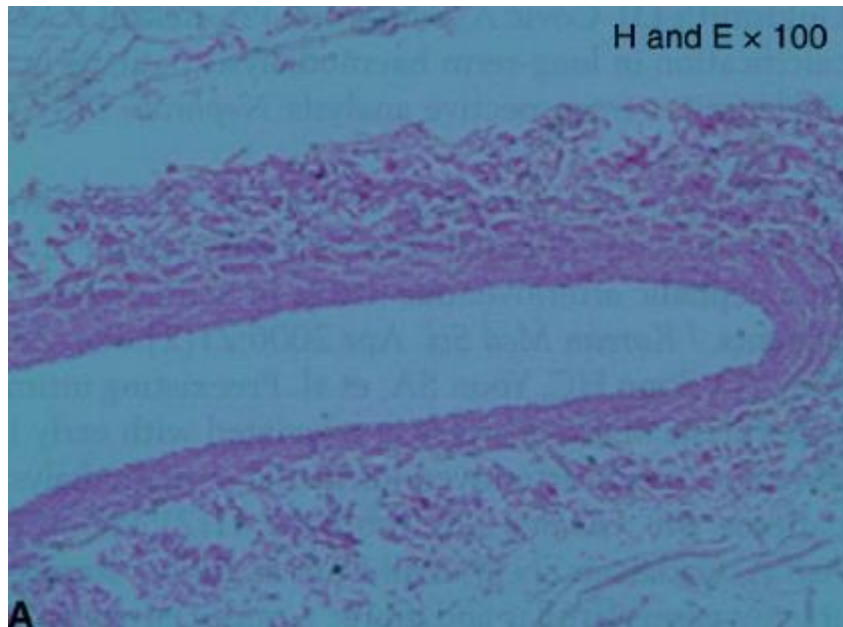
☐-Anastomose a-v (FAV)

☒-Sur point de ponction (FAV)

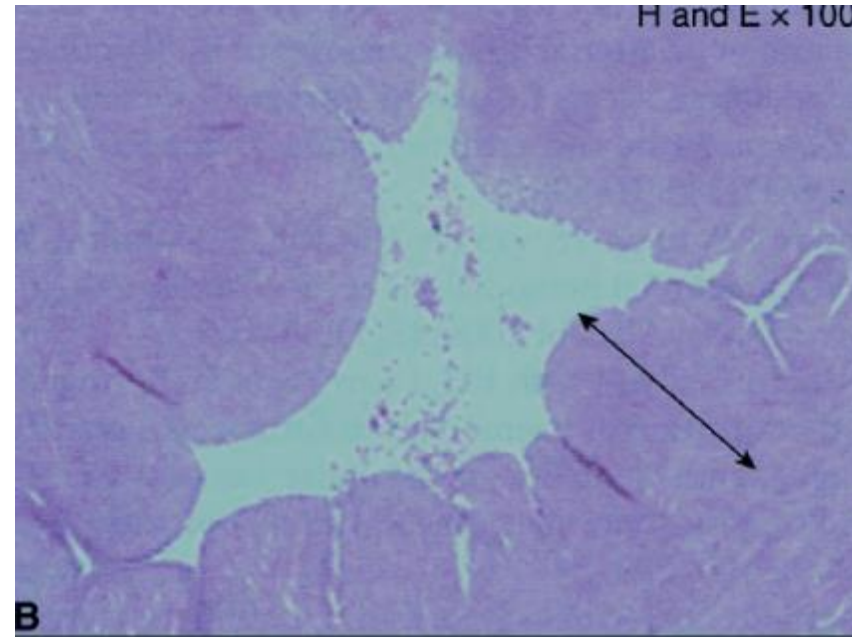
☐-Anastomose Veineuse (PTFE)

Hypertrophie intimale -> Sténose J-A

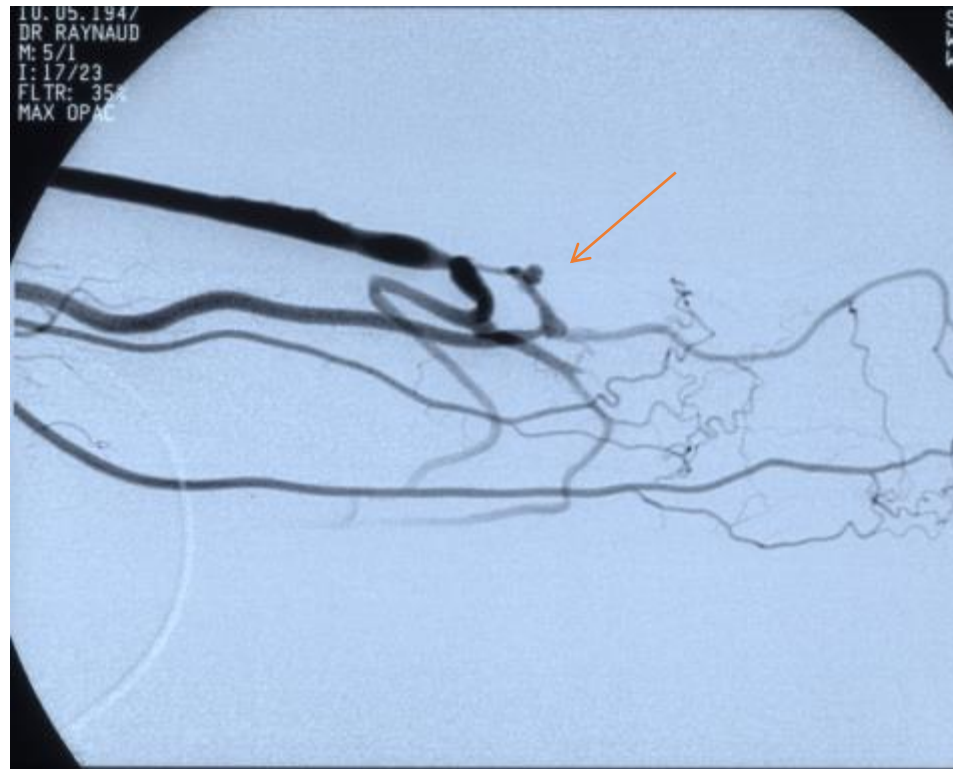
Veine normale



HI



Sténose veineuse Juxta-Anastomotique



Ulna Basilic AVF

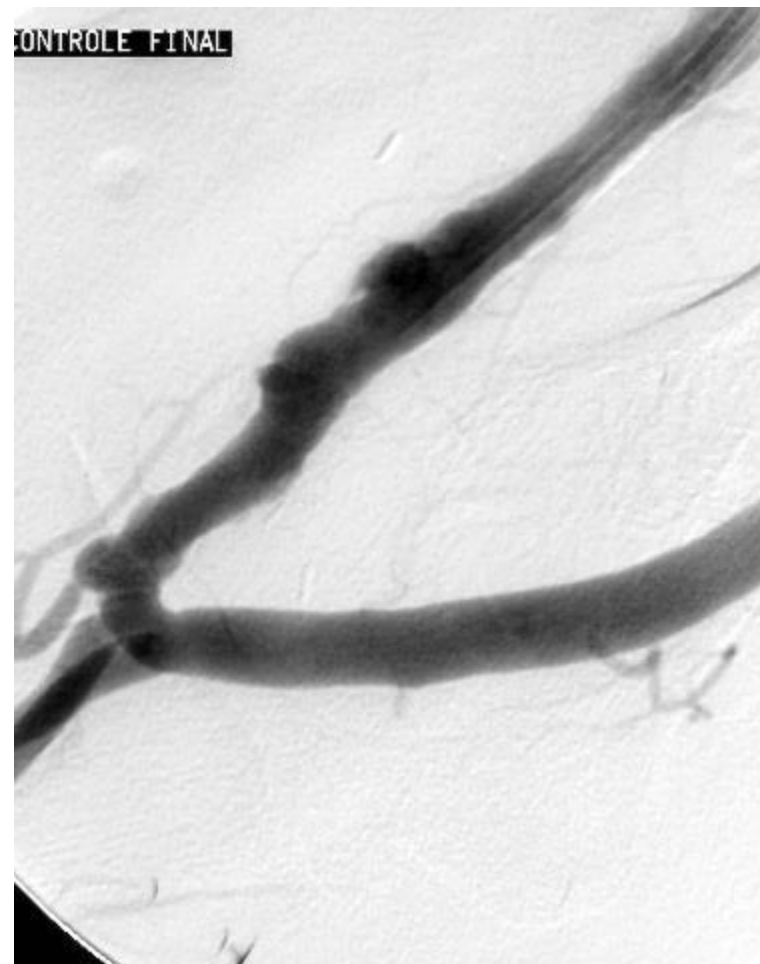
Juxta-anastomosis stenosis



Surgery

FAV Brachio-Céphalique





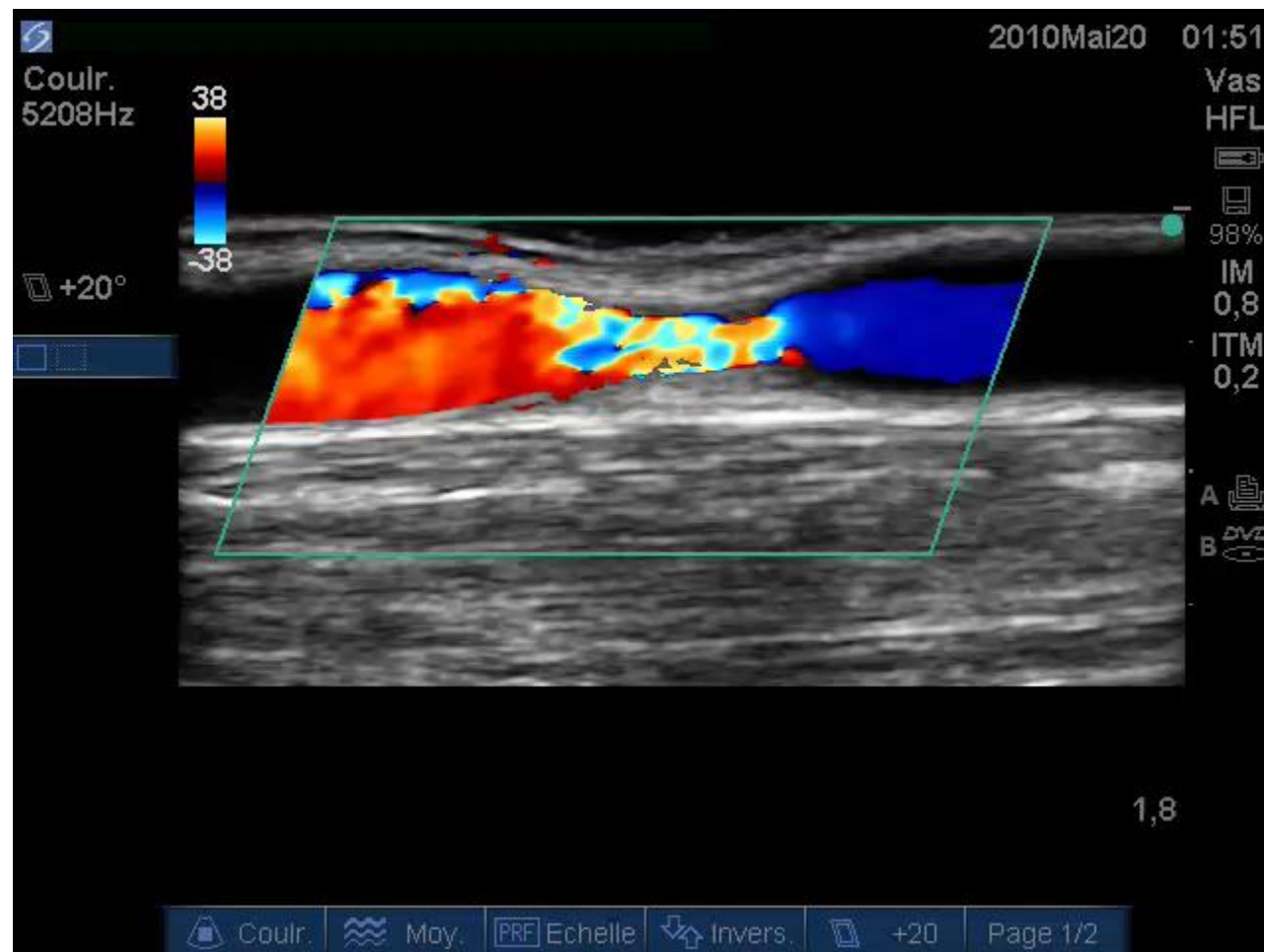
Stenoses

☐-Anastomose a-v (FAV)

☐-Sur point de ponction (FAV)

☒-Anastomose Veineuse (PTFE)

AEP sous Echographie



AEP sous Echographie



AEP sous Echographie



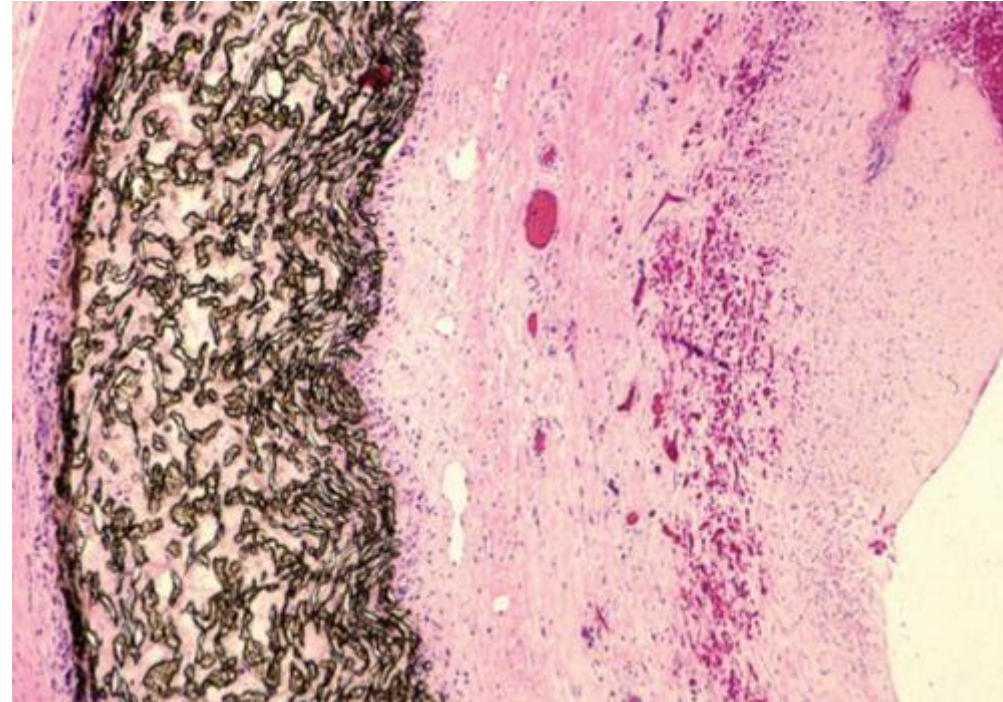
Stenoses

☐-Anastomose a-v (FAV)

☐-Sur point de ponction (FAV)

☒-Anastomose Veineuse (PTFE)

Intimal hypertrophy / PTFE



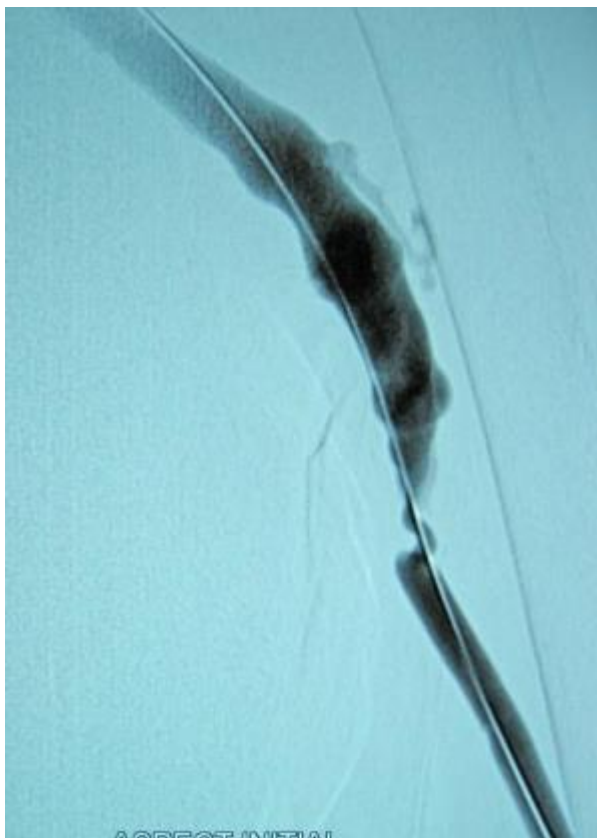
PTFE



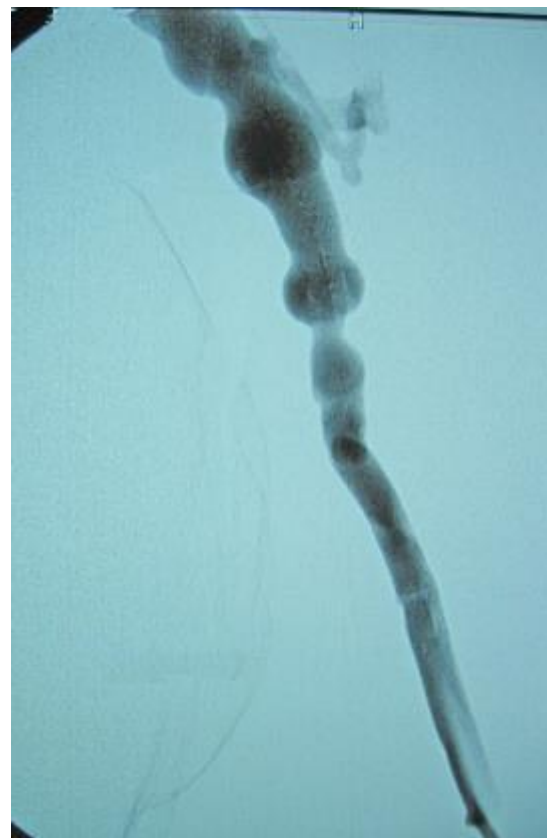
Neo Intimal Hyperplasia

St. Haute / FAV Basilique

Avant



Après AEP



Hypertrophie Intima / Stent



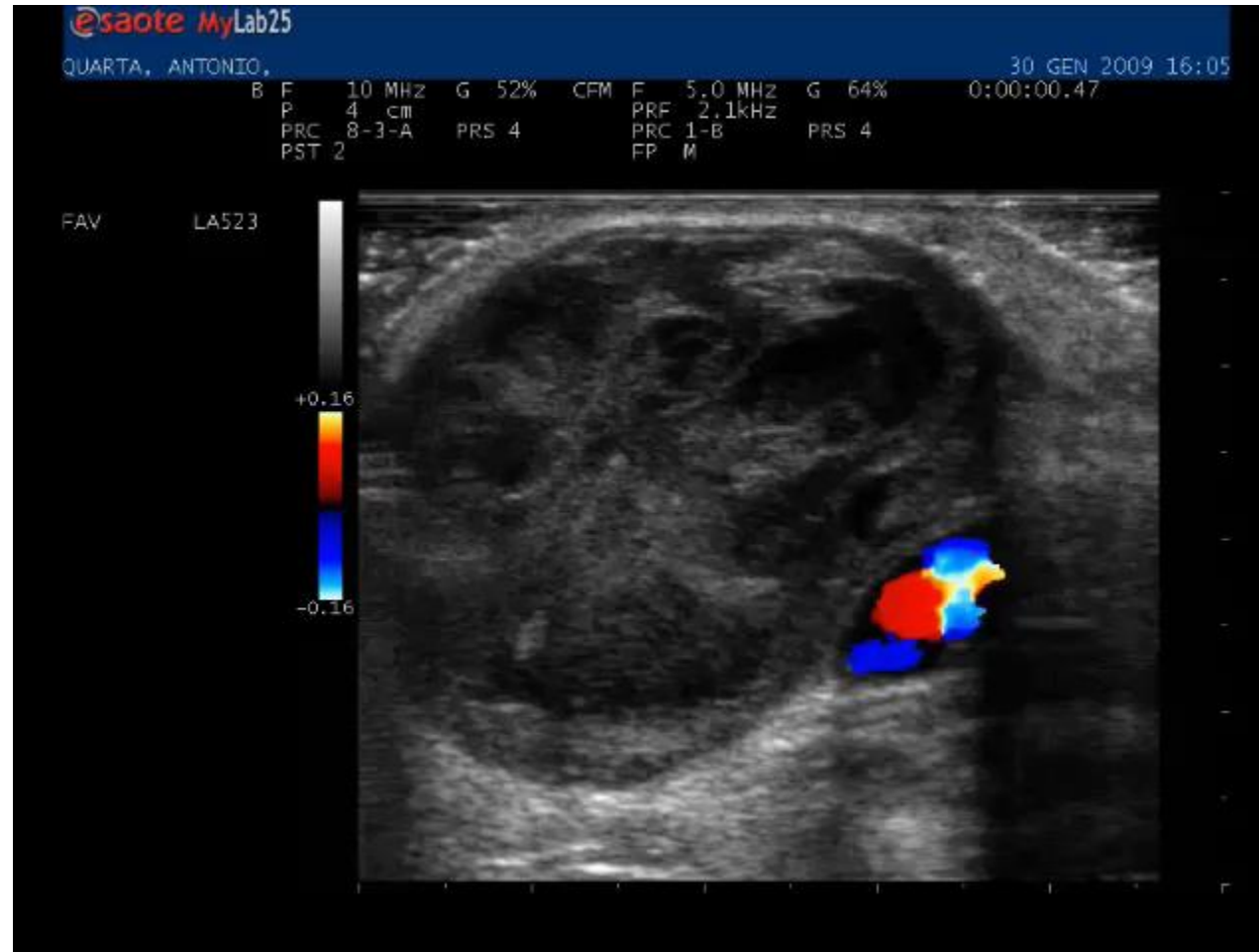
Complications tardives

- Aneurysm

False Arterial Aneurysm



False Arterial Aneurysm*





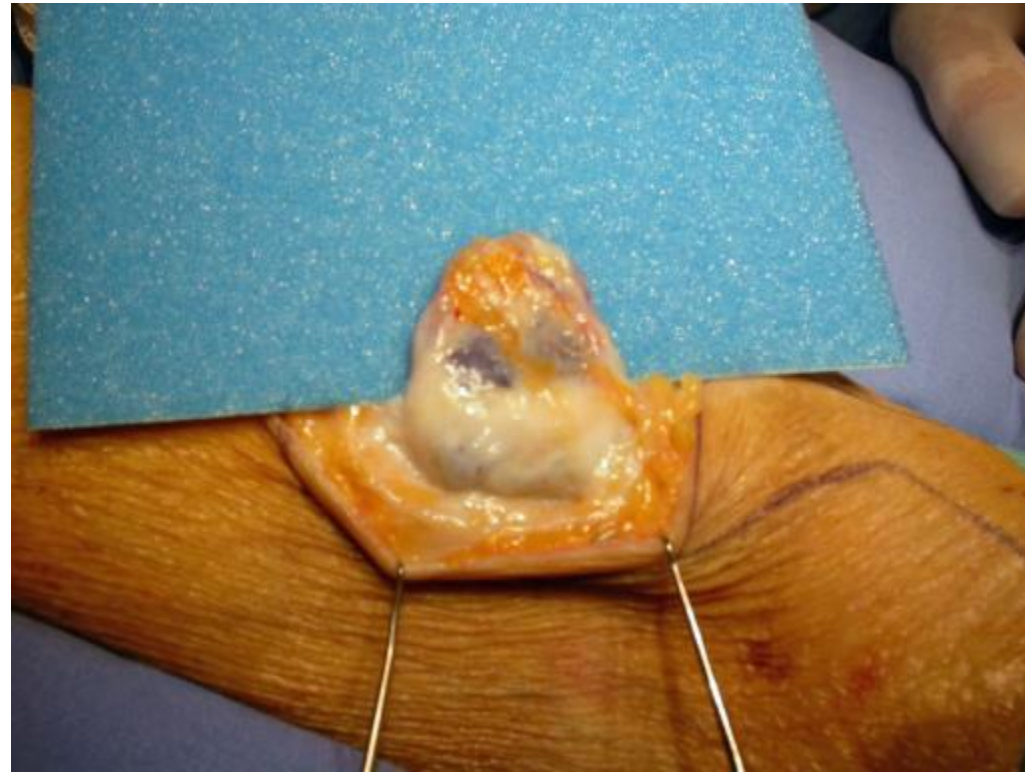
Venous Aneurysm



False Venous Aneurysm



False Venous Aneurysm



False Venous Aneurysm



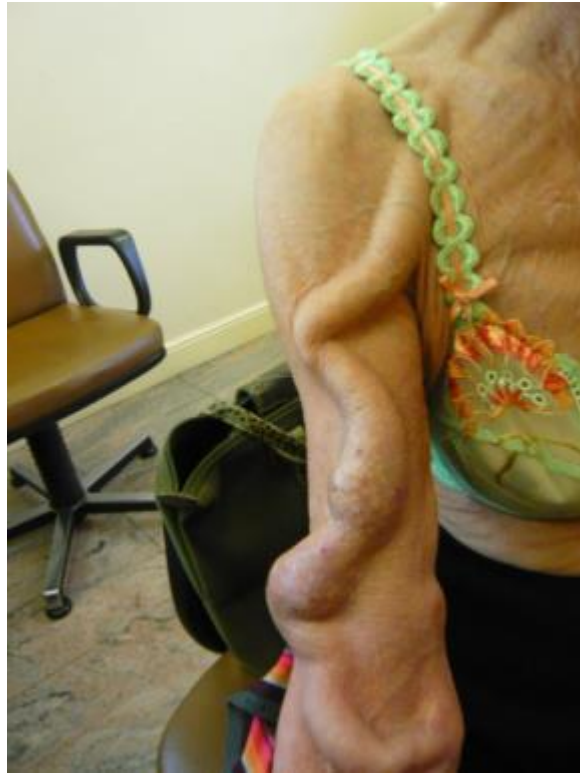
-> Ligation Resection



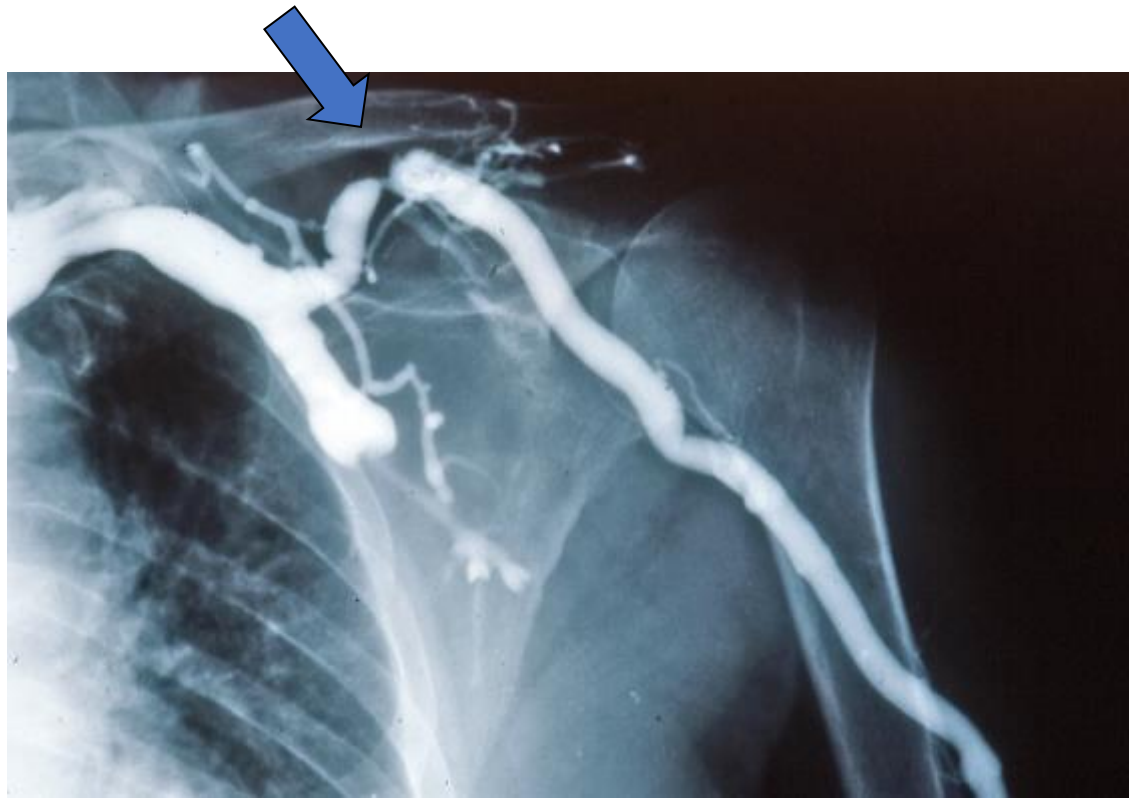
-> Ligation Resection
+ New Anastomosis



Aneurysmal Degeneration

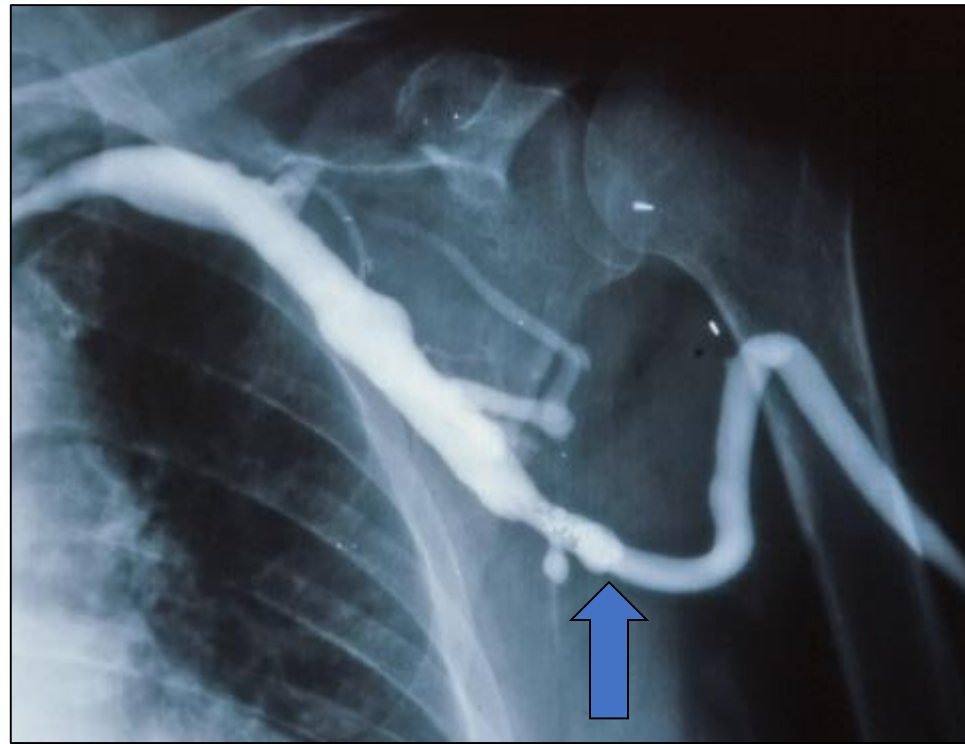


Cephalic vein arch stenosis



Cephalic arch stenosis

Transposition to Basilic V.



-> Ligation Resection



Complications tardives

- Necrosis at Puncture site

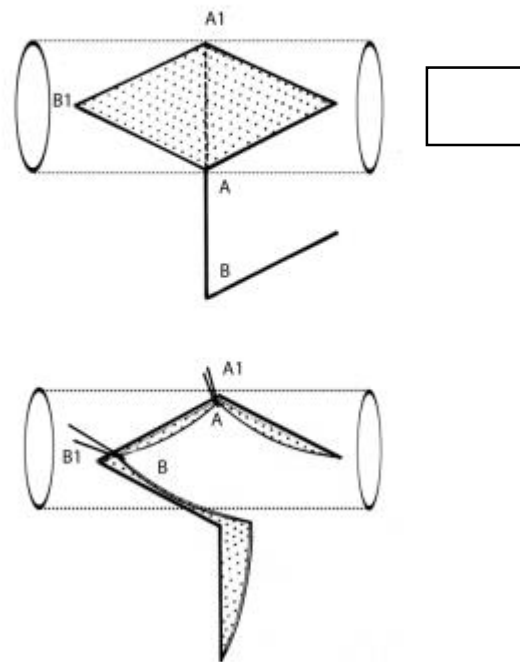
Nécrose sur Point de Ponction



Necrosis at Puncture site



Limberg Flap



Nécrose / Faux anévrisme



+ AEP

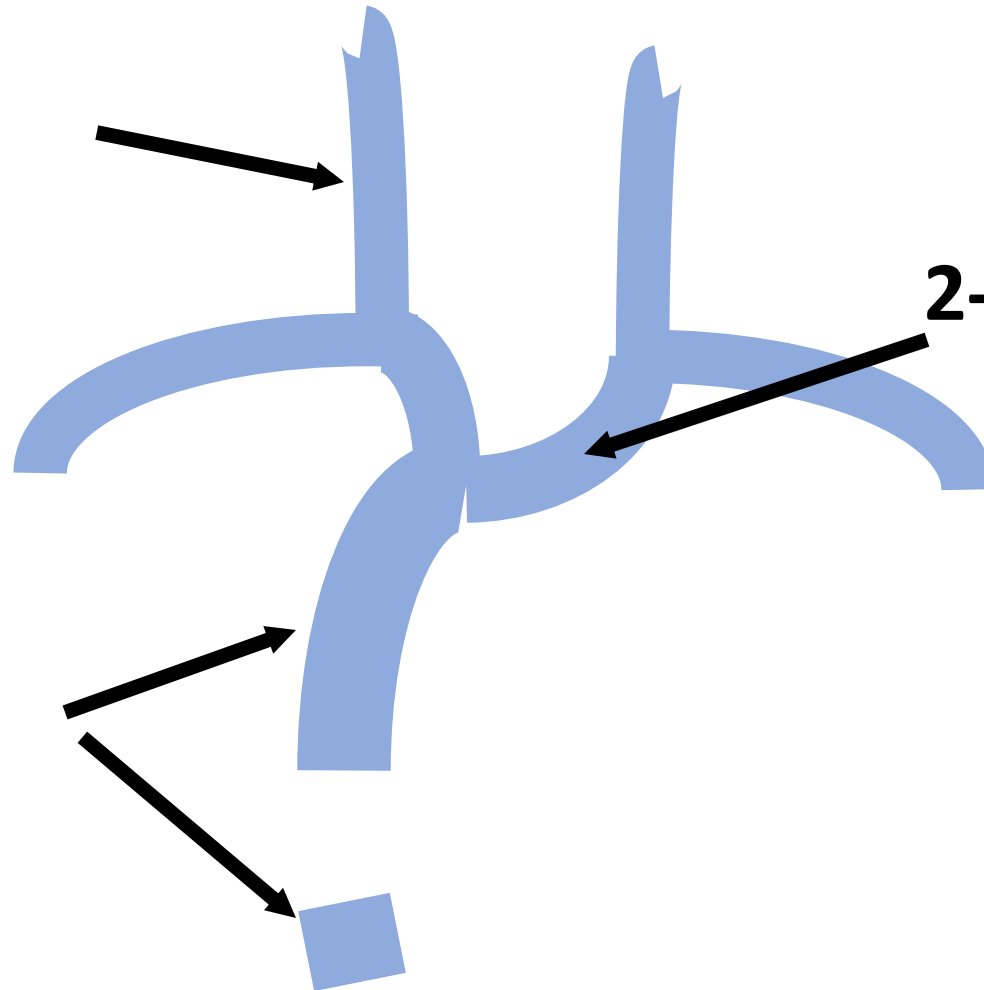
Central Venous Stenosis

Site of the Stenosis

**1- Cathéter
Insertion**

2- Trajet

3- Extrémité



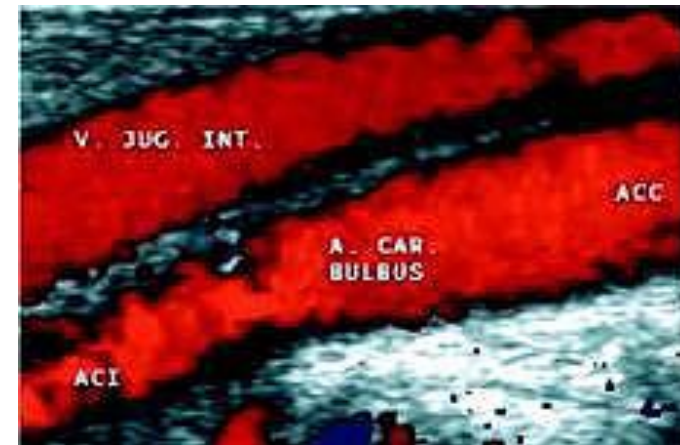
Sténose Veine Centrale sur Cathéter JJ



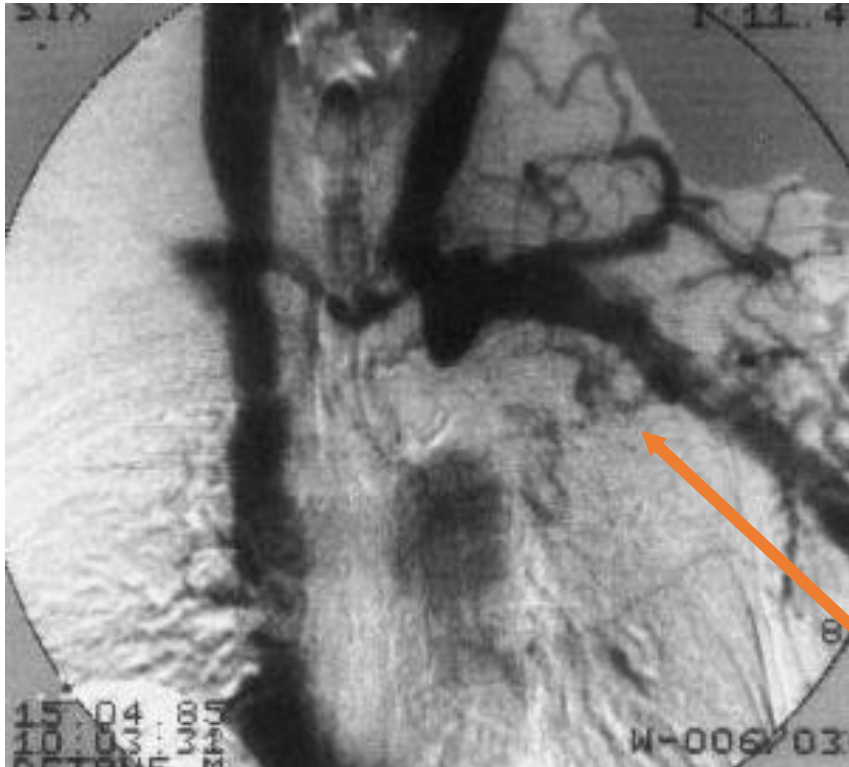
Sténose Veine Centrale + FAV



Oedème Face & Intra-Cranien



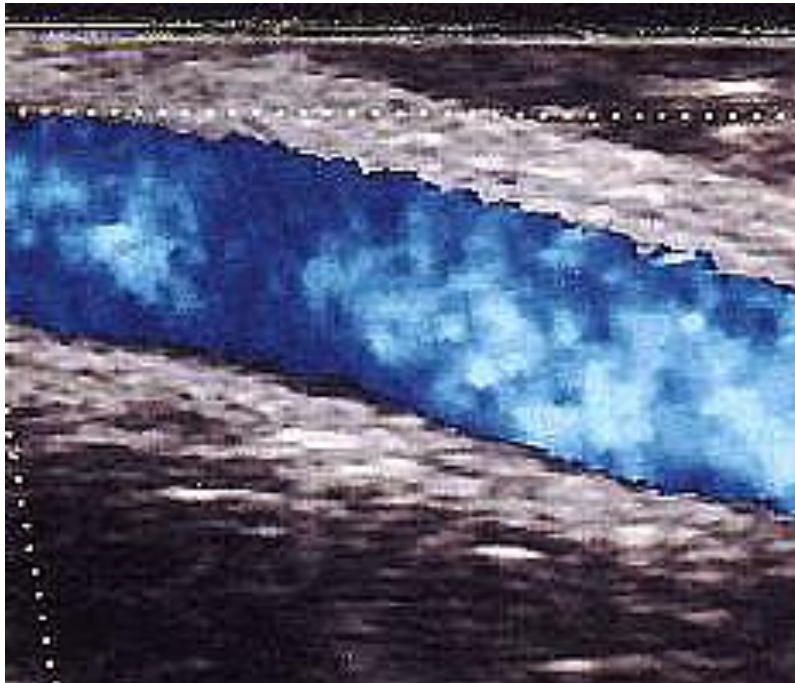
Œdème Face & Intra-Cranien



Complications tardives

- Sténose, Thrombose
- Anévrymes
- Nécrose sur Point de Ponction
- Sténose des Veines Proximales/Centrales
- **Hyperdébit**
- Ischémie Distale

Echo-Doppler



- **FAV Distales :**

800 à 1000 ml/min

- **FAV Proximales :**

1200 à 1400 ml/min

FAV Distale : Radio-Céphalique (< 10 kg)



Retentissement cardiaque



Méthodes de Réduction Classiques

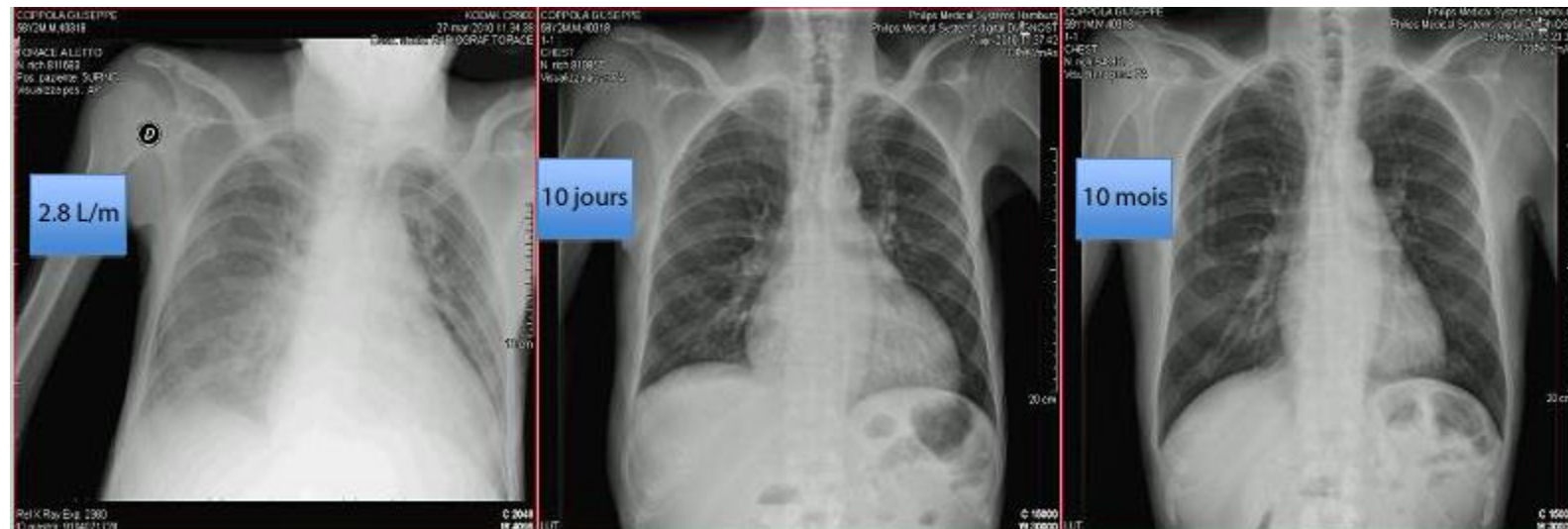
- **Fermeture**
- **Banding**

La Fermeture est parfois obligatoire...



3,5 L/min

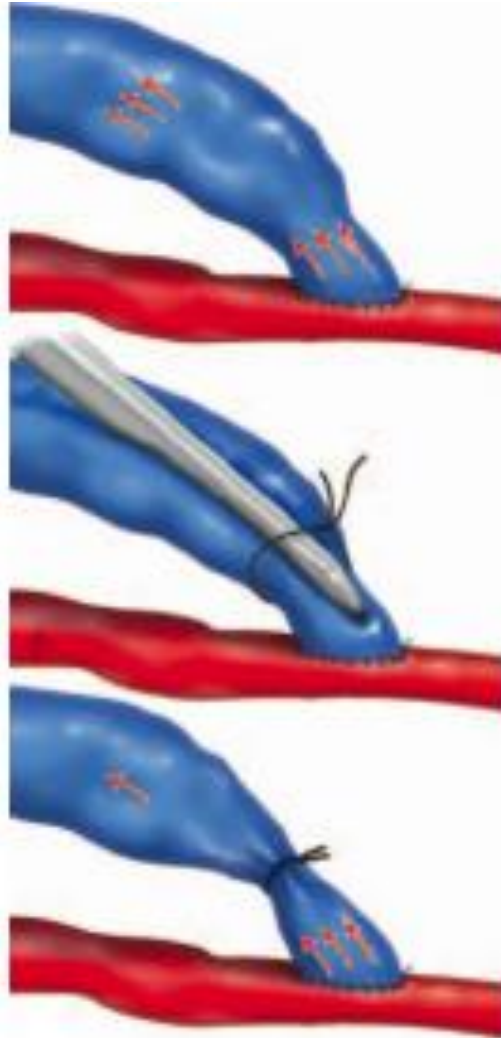
Retentissement cardiaque

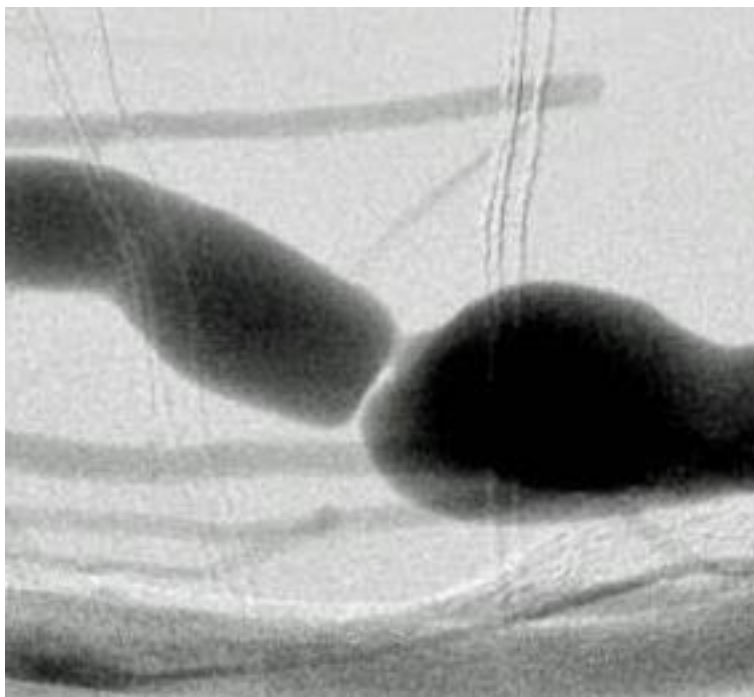


Courtesy: C Basile

Banding : souvent inefficace

- Débitmétrie peropératoire imprécise car spasme dû à la dissection
- La réduction de calibre doit être
 - importante (>80%) & précise
 - suffisamment longue
- 2 risques postopératoires majeurs :
 - Haut débit persistant
 - Thrombose sur bas débit
- 2 séries publiées seulement

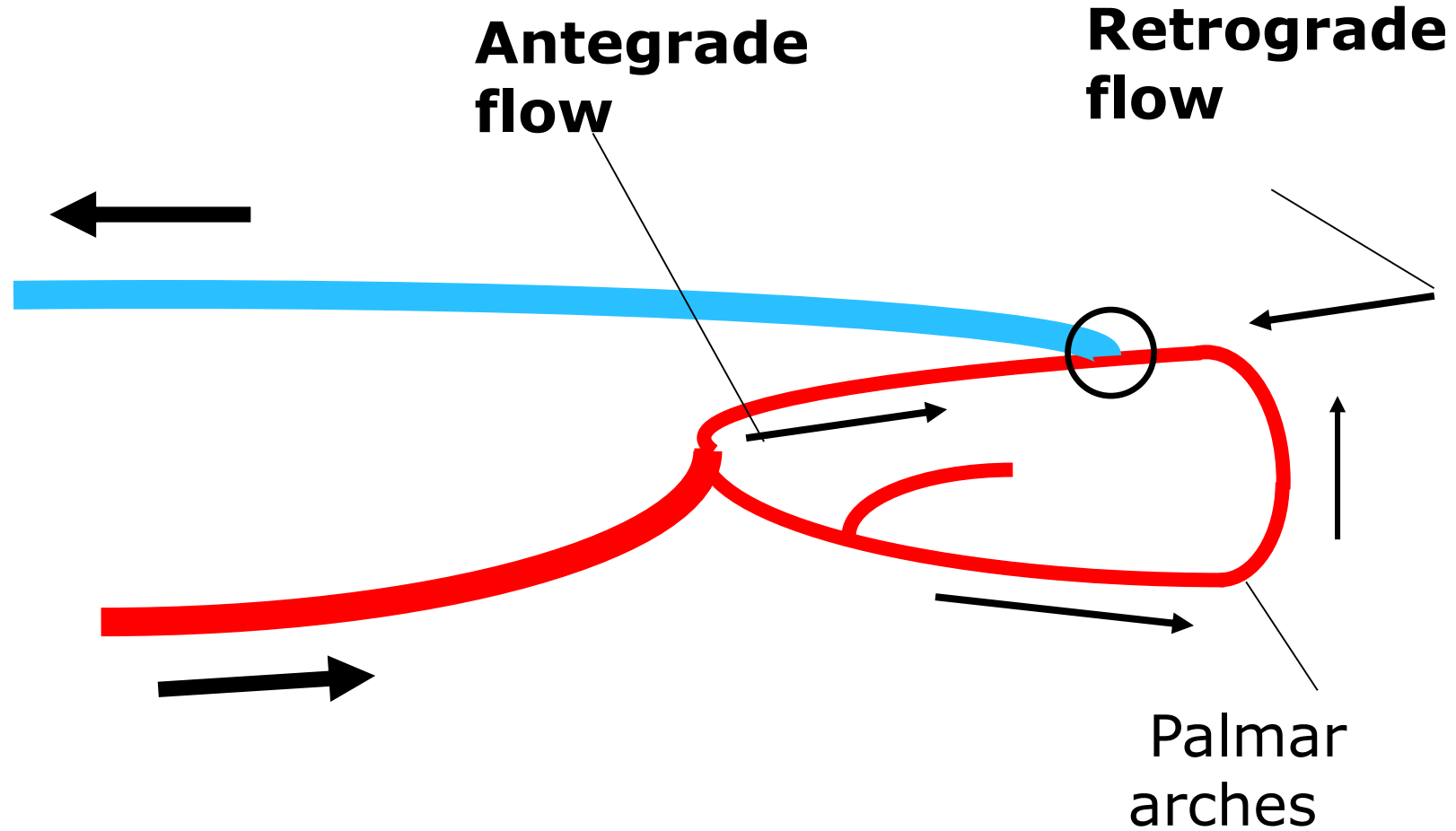




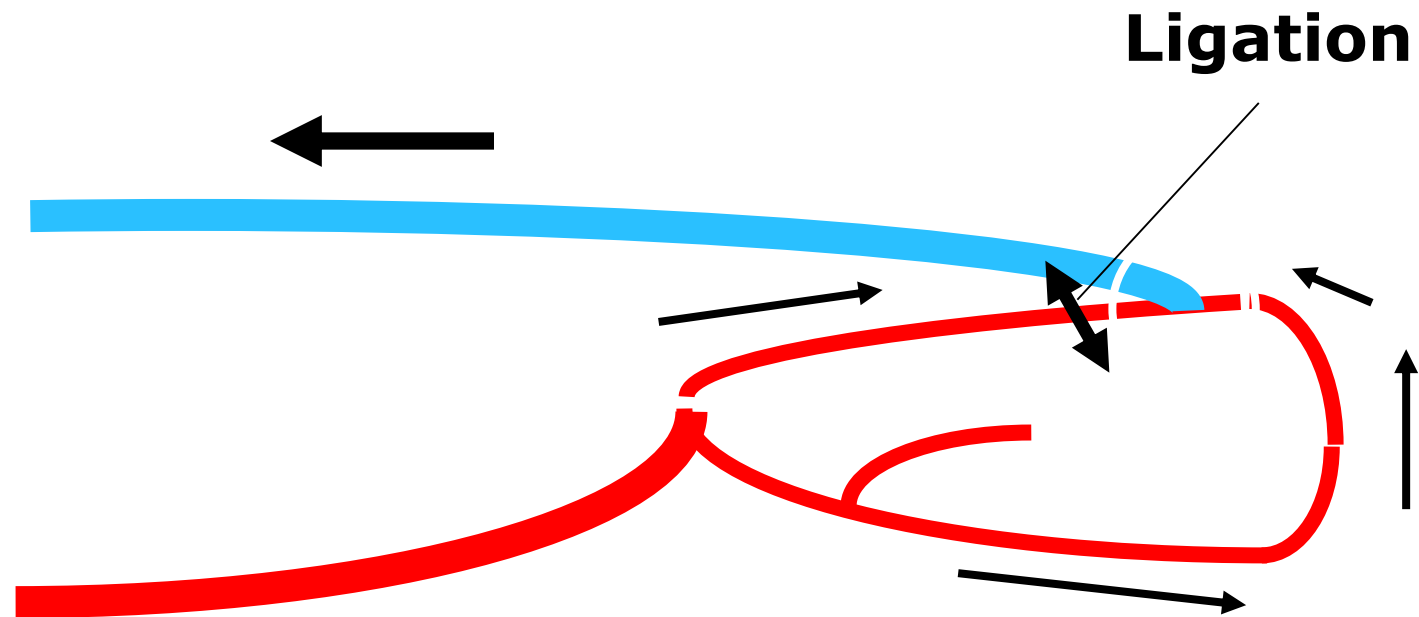
Techniques de réduction (Bourquielot)

- FAV Distale :
 - **Ligature juxta anastomotique de l'artère radiale proximale**
- FAV Proximale :
 - Distalisation-PTFE de l'anastomose artérielle
 - Transposition de l'artère radiale

FAV distale - Hémodynamique



Ligature juxta anastomotique de l'artère radiale proximale (LARP)



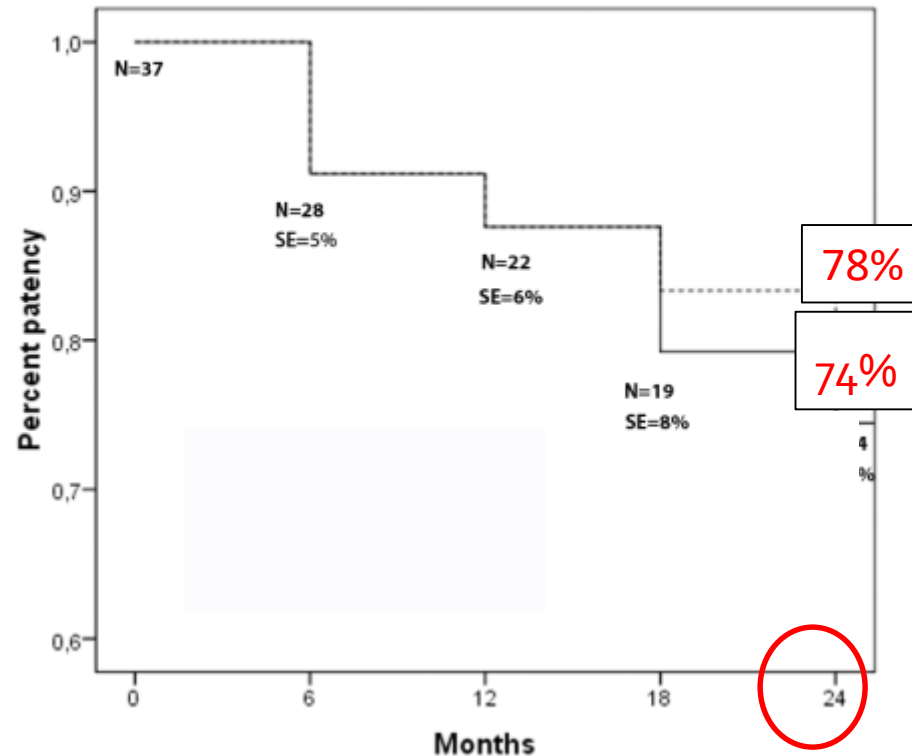
LARP – % Reduction

82 patients	L/min
Mean preop.flow	1.2 L/min
Mean postop.flow	0.6 L/min
Men reduction rate	54%

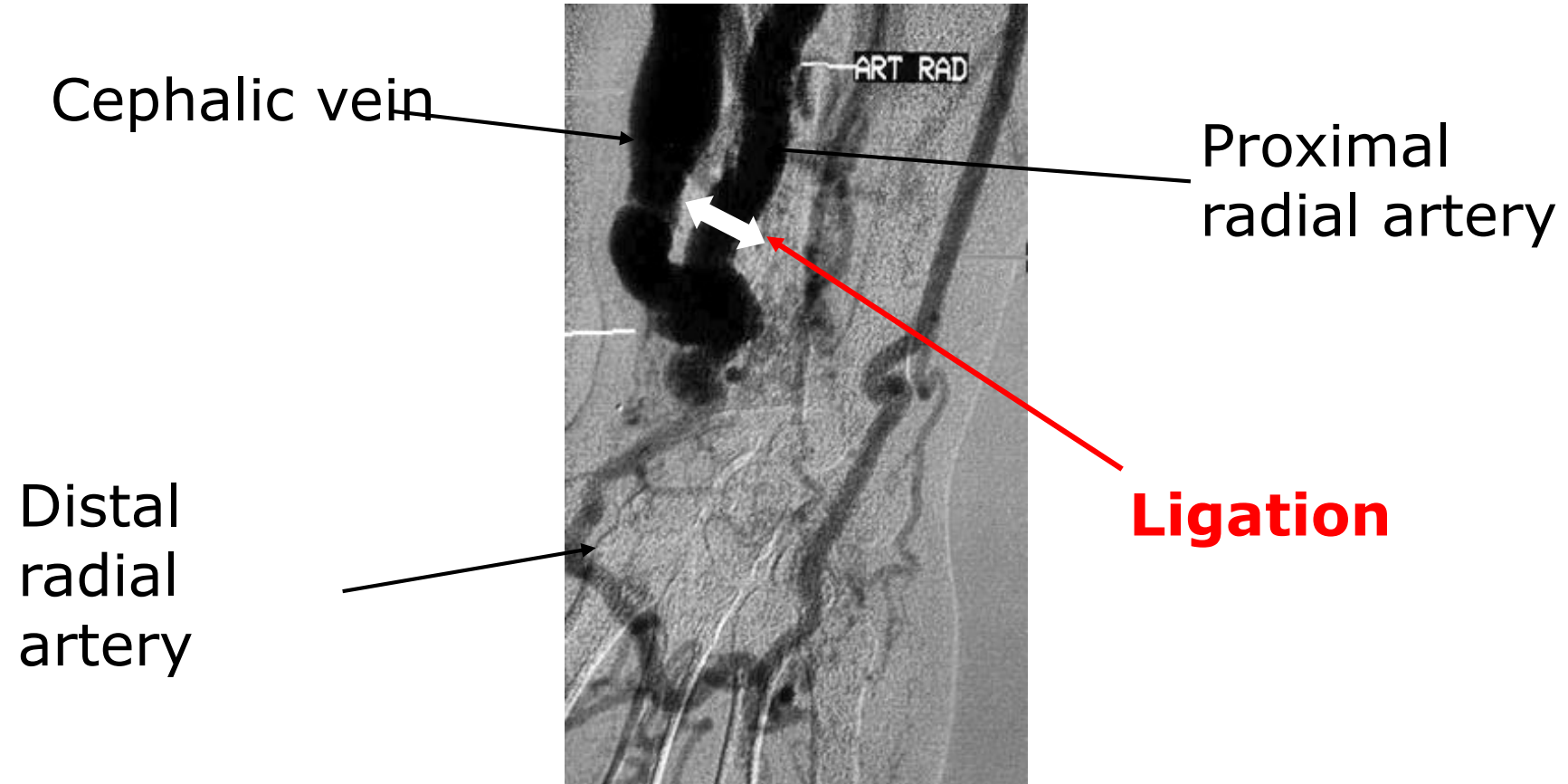
Proximal Radial A. Ligation

Bourquelot et al, Eur J Vasc Endovasc Surg (2010)

**Etude
Prospective
37 pts**



High-flow distal AVF



Techniques de réduction (Bourquielot)

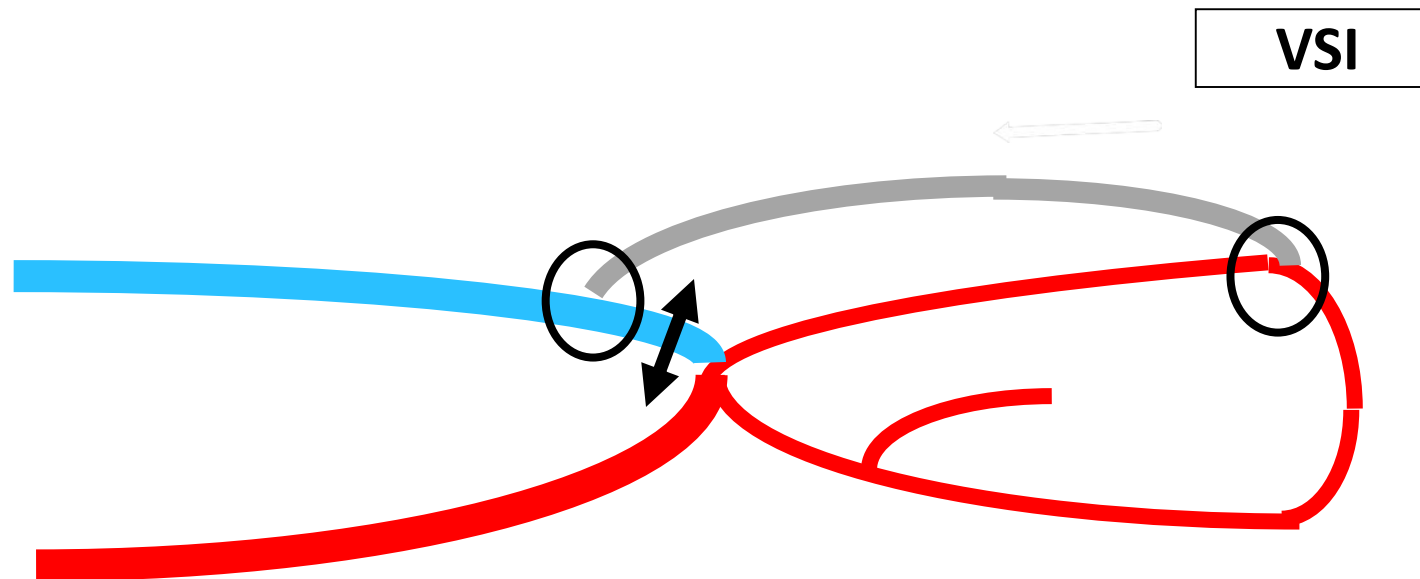
- FAV Distale :

- Ligature juxta anastomotique de l'artère radiale proximale

- FAV Proximale :

- **Distalisation de l'anastomose artérielle**
- Transposition de l'artère radiale

Distalisation de l'anastomose artérielle (RUDI)



Distalisation de l'anastomose artérielle

35 patients	L/min
Mean preop.flow	1.7
Mean postop.flow	0.7
Men reduction rate	60%

Techniques de réduction (Bourquielot)

- FAV Distale :

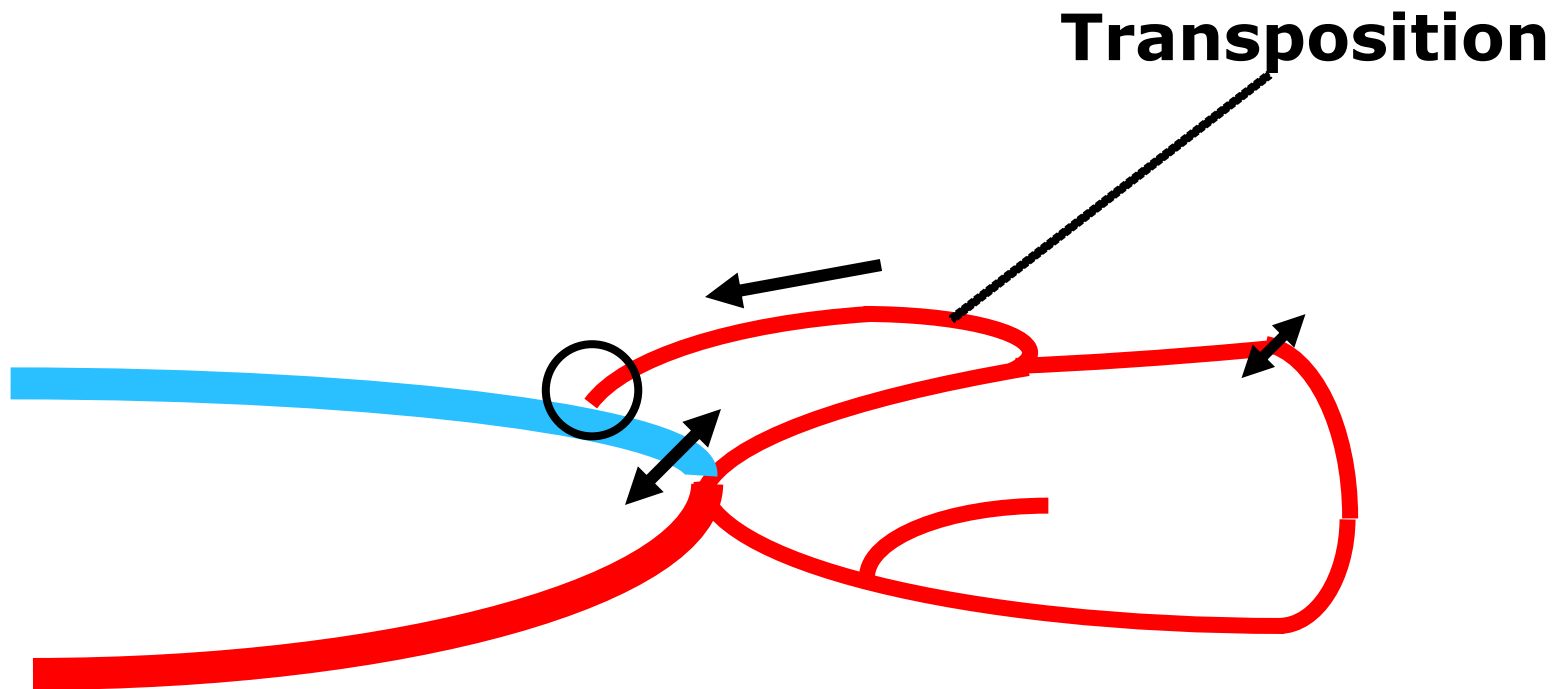
- **Ligature juxta anastomotique de l'artère radiale proximale**

- FAV Proximale :

- **Distalisation de l'anastomose artérielle**

- **Transposition de l'artère radiale**

Transposition de l'artère radiale



Transposition de l'artère radiale



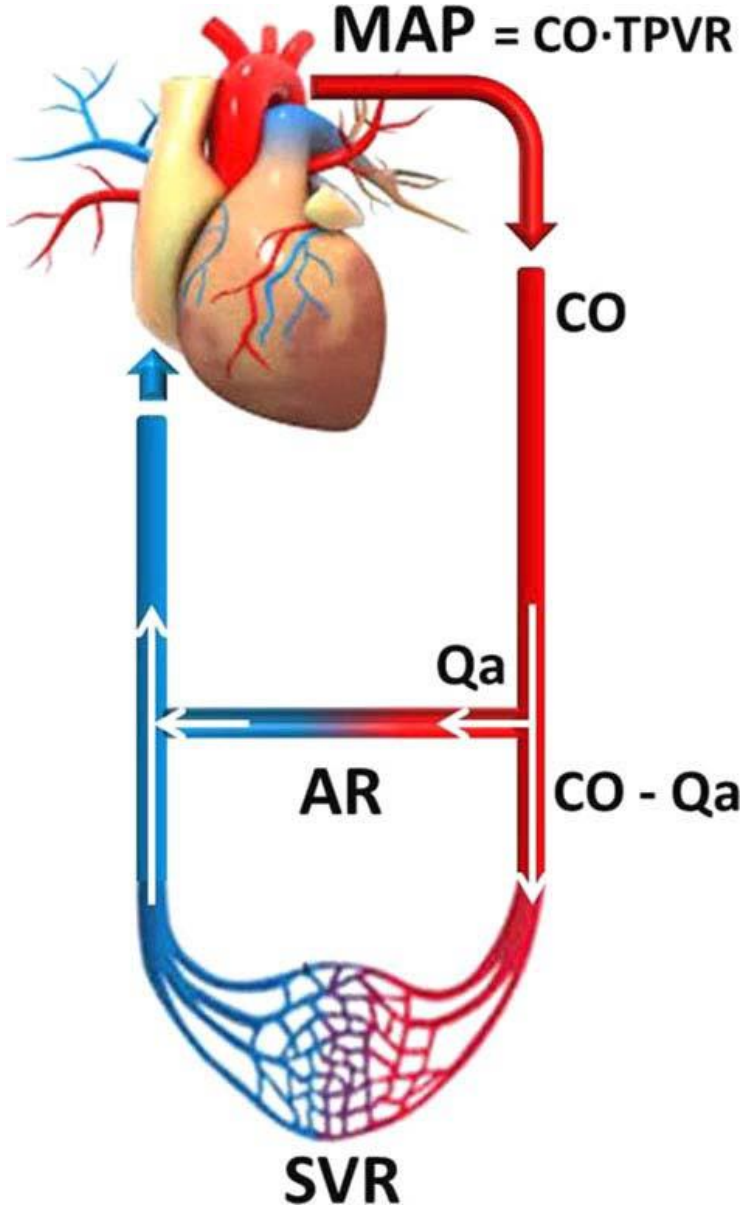
Transposition de l'artère radiale

	Pre-op	Post-op	<u>Reduction</u>
	L/min/1.73m2		%
All pts n=43	2.0	0.7	64
Children n=6/43	2.9	0.6	77

Complications tardives

- Sténose, Thrombose
- Anévrysmes
- Nécrose sur Point de Ponction
- Sténose des Veines Proximales/Centrales
- Hyperdébit
- Ischémie Distale





Basile 2017

- MAP= Mean Arterial Pressure
- CO = Cardiac Output
- TPVR = Total Peripheral Vascular Resistance
- AR = Access Resistance
- SVR = Systemic Vascular Resistance
- CVP = Central Venous Pressure (~ 0)

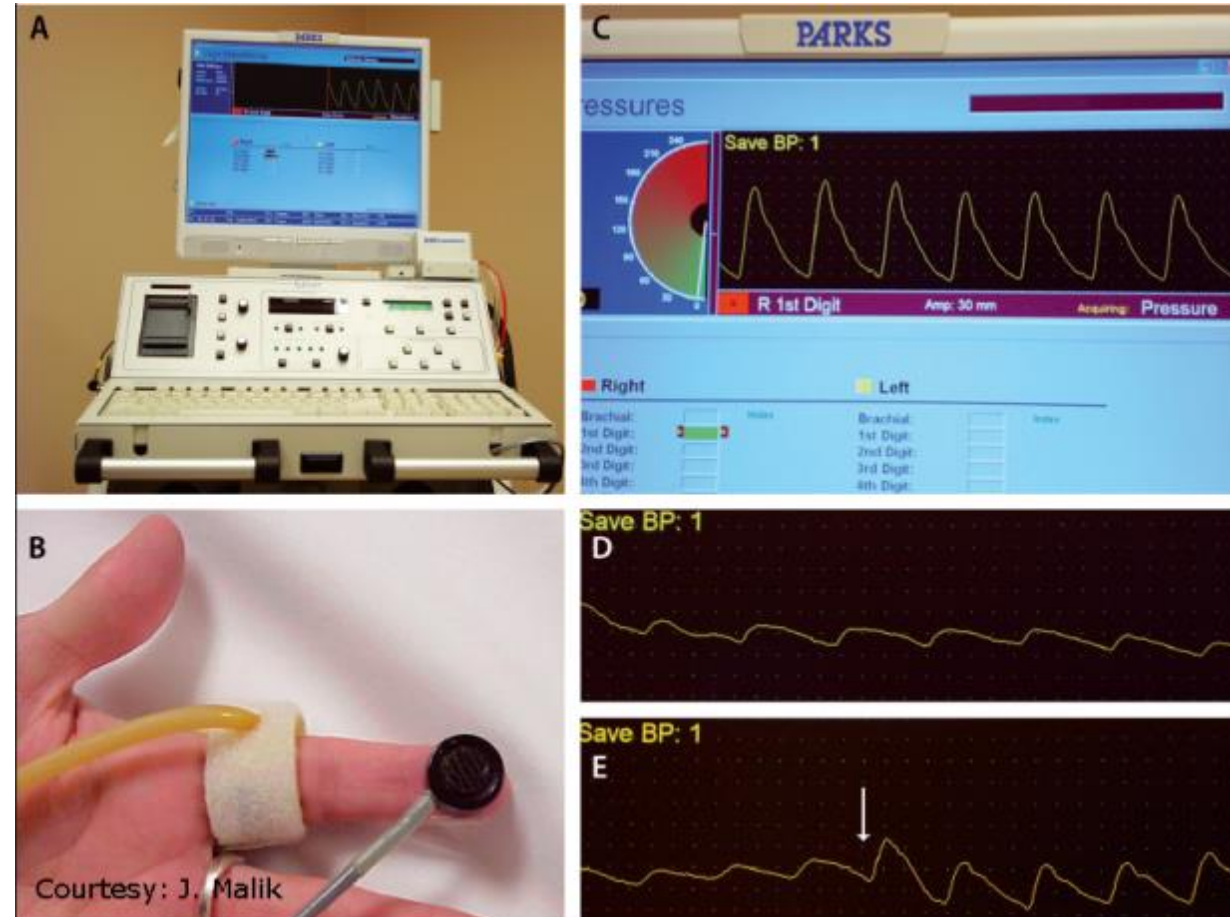
Physiopathologie de l'Ischémie Distale

- Pathologie Artérielle
 - Occlusion Athéromateuse,
 - Diabète
 - Abords préalables
 - Embolisation
- et ...Vol
 - Flux antégrade préférentiel dans la fistule
 - Flux rétrograde dans l'artère sous la fav

Ischémie Distale (Grades)

- ☐ Grade 1.
 - ☐ Cyanose, refroidissement modéré
- ☐ Grade 2.
 - ☐ Douleurs en dialyse
- ☐ Grade 3:
 - ☐ Douleurs au repos, Parésie distale
- ☐ Grade 4.
 - ☐ a- Ulcération ou nécrose limitée
 - ☐ b- Nécrose irréversible

Pressions digitales



Ischémie distale

- FAV Distale : 300 à 600 mL/min

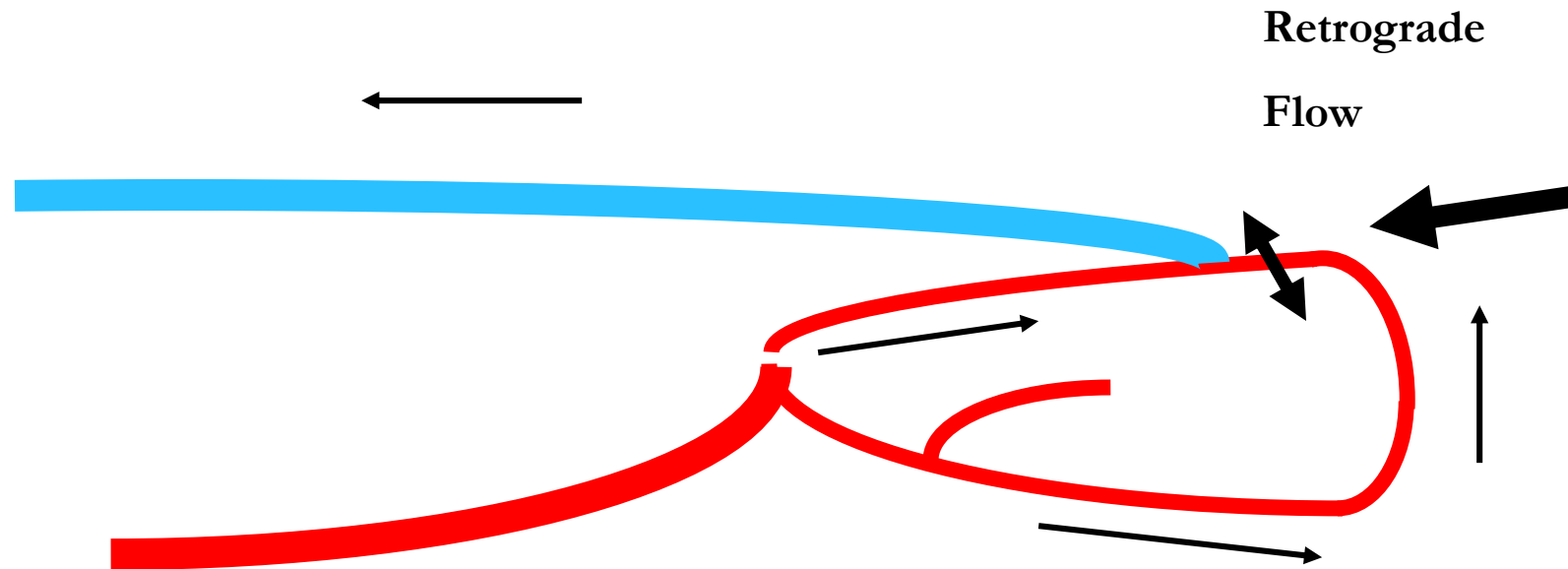
→→ DRAL (Distal Radial Artery Ligation)

- FAV Bras : 400 à 800 mL/min:

→ DRIL (Distal Revascularization Interval Ligation)

→ PAI (Proximalization of Arterial Inflow)

Distal Artery Ligation



Ischémie distale

- FAV Distale : 300 à 600 mL/min

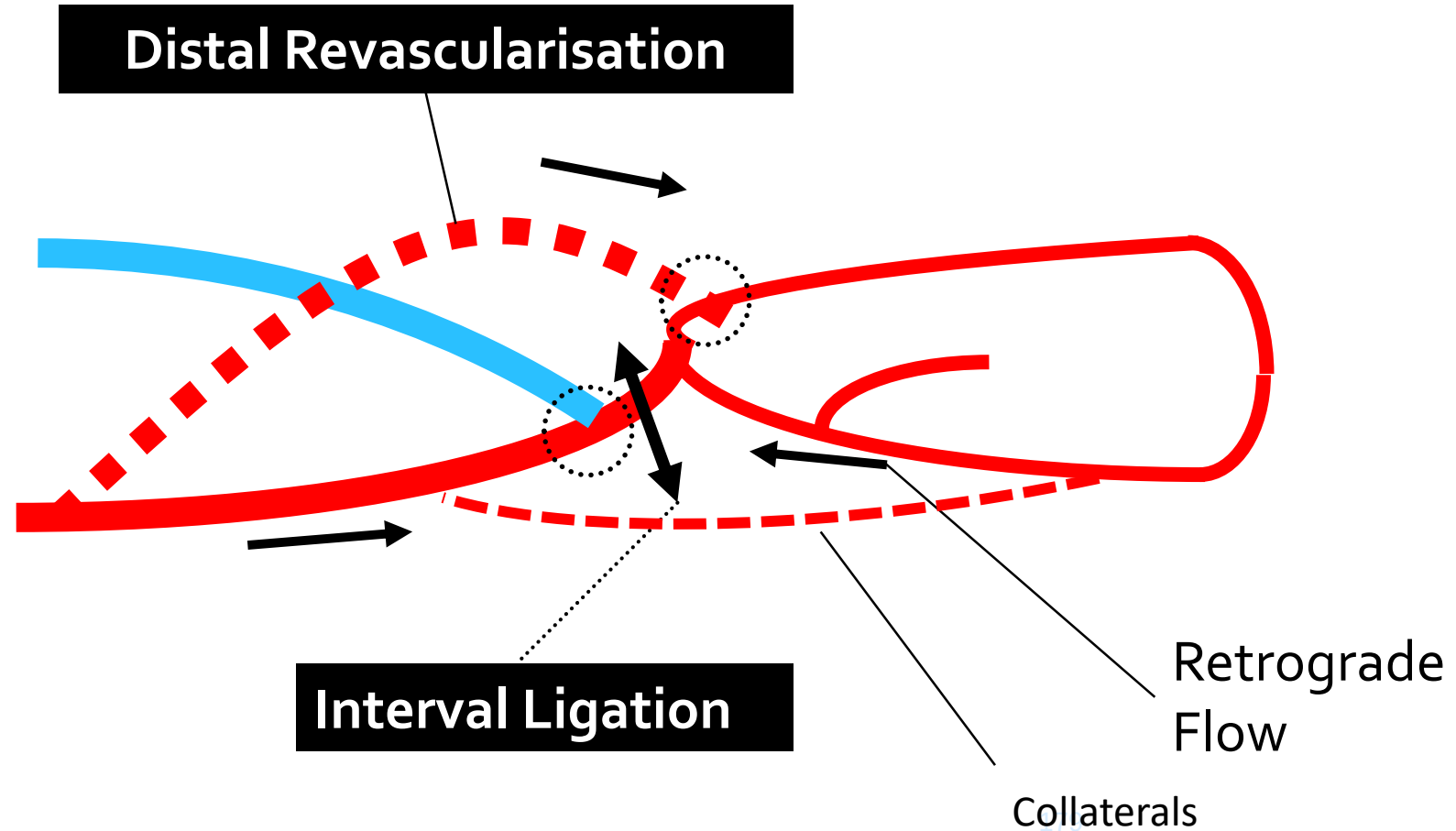
→→ DRAL (Distal Radial Artery Ligation)

- **FAV Bras : 400 à 800 mL/min:**

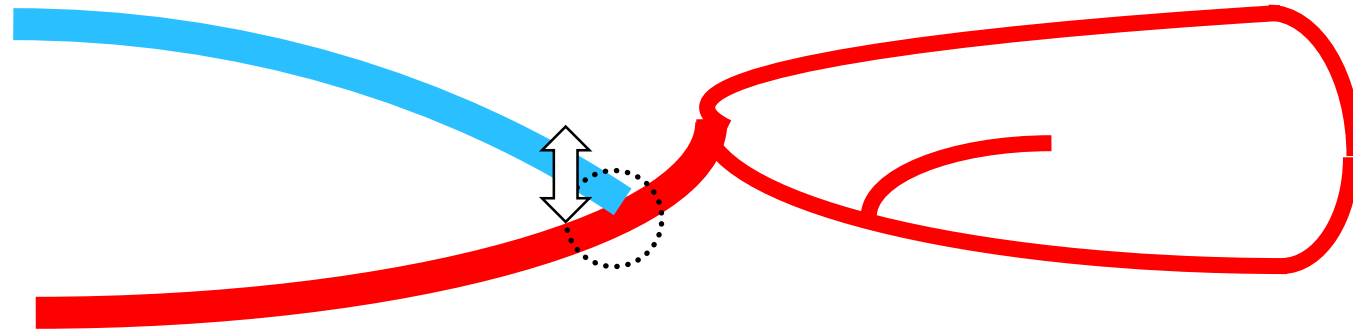
→DRIL (Distal Revascularization Interval Ligation)

→ PAI (Proximalization of Arterial Inflow)

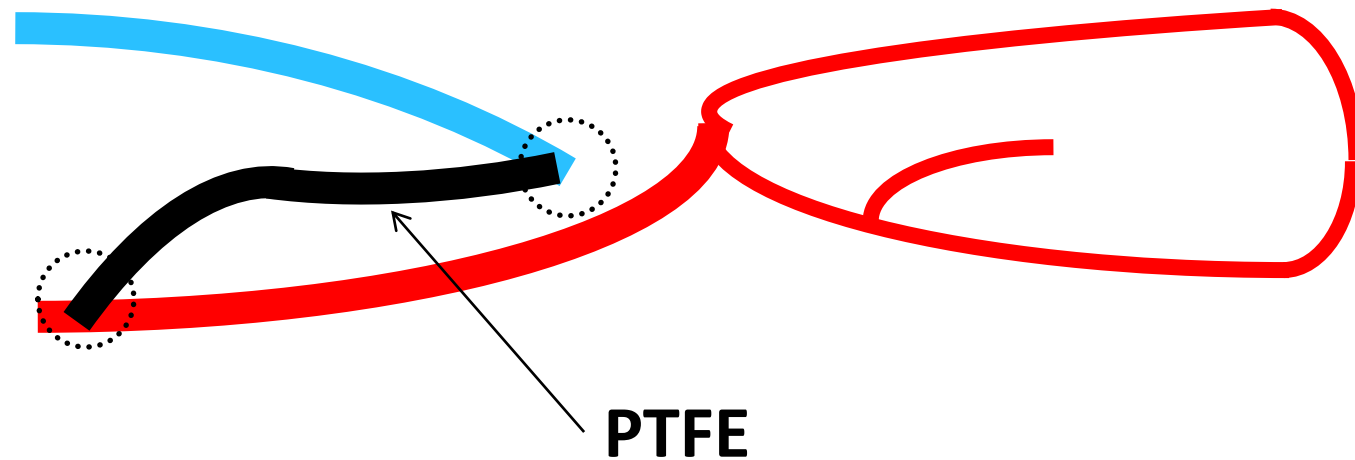
DRIL*

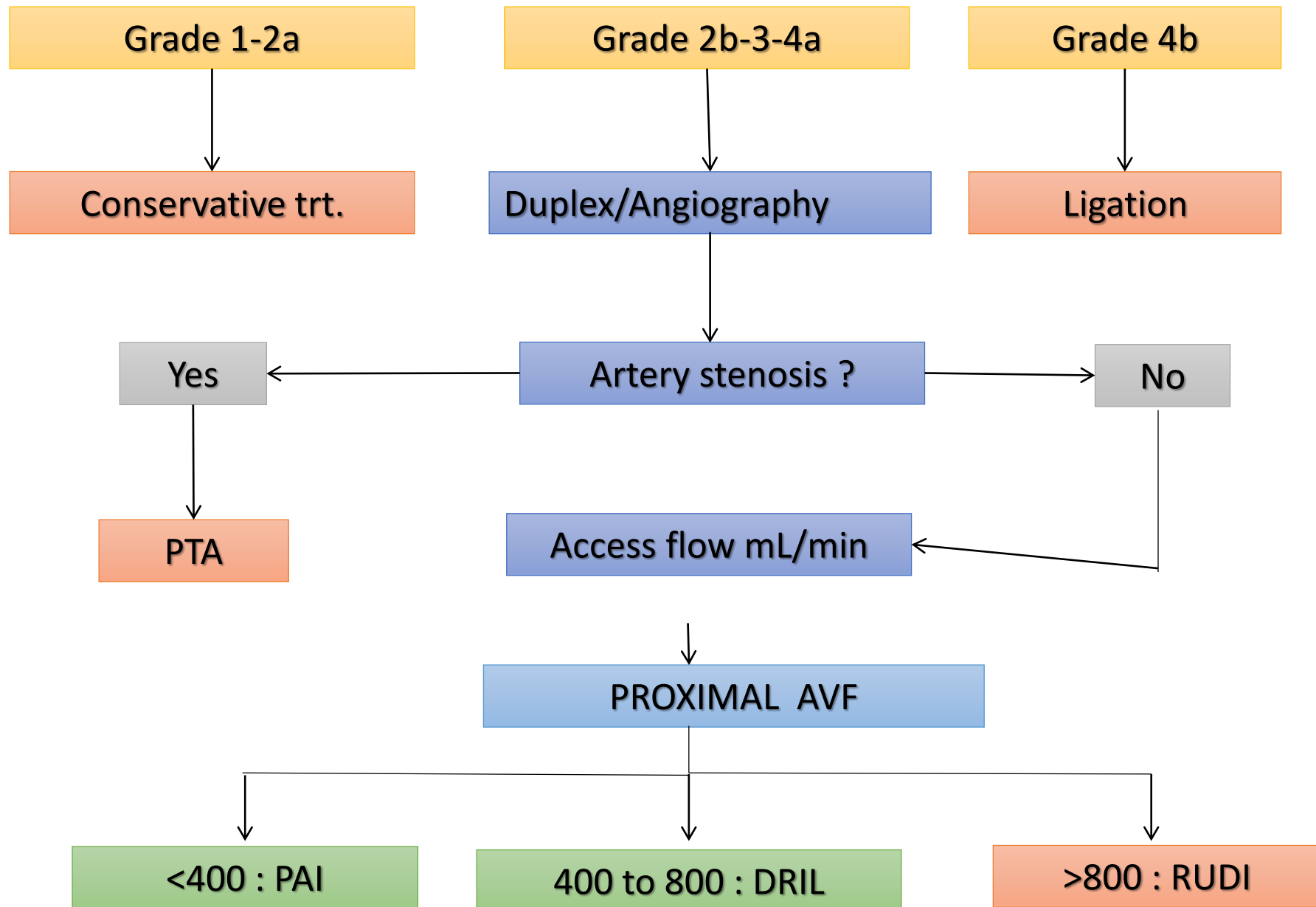


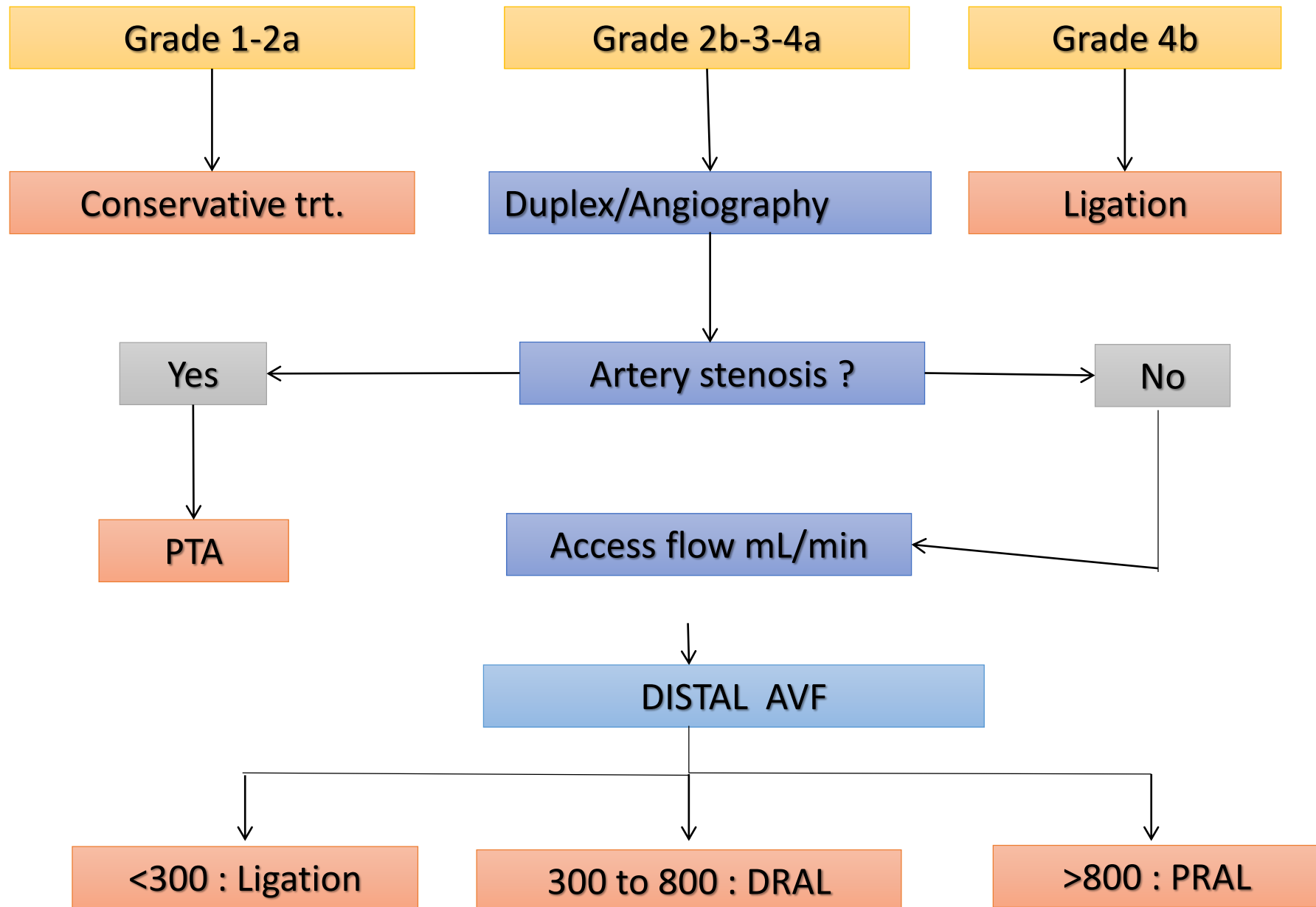
Proximalisation (1)*



Proximalisation (2)*







pierre@bourquelot.fr

FIN