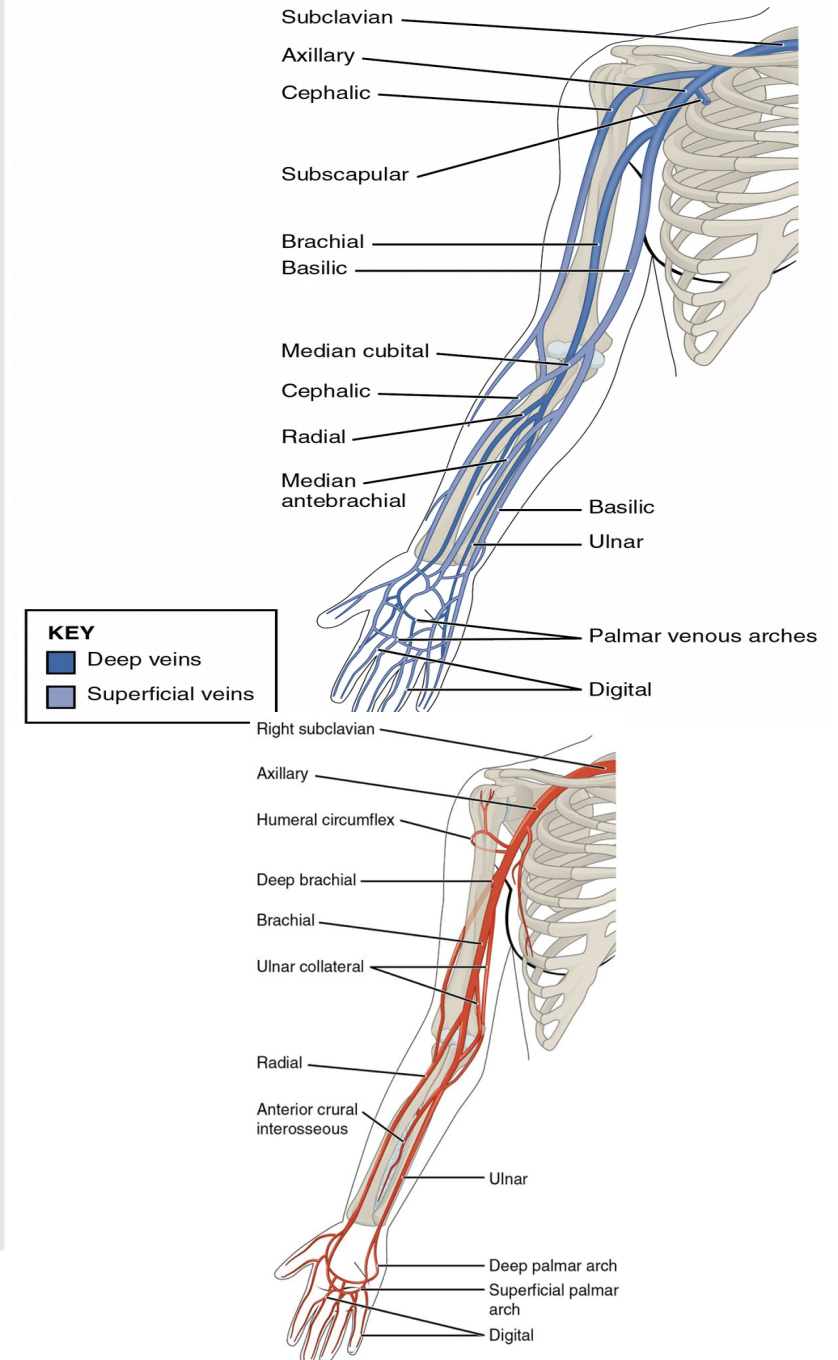


endovascular Management of
failing haemodialysis access
khalil R.Hamza MD

ATCTV (Association Tunisienne de Chirurgie Thoracique
Cardiaque et Vasculaire) ET LA SOCIÉTÉ TUNISIENNE DE
NÉPHROLOGIE ET L'ASSOCIATION TUNISIENNE DE DIALYSE
20 juillet 2019 hotel Vinci Hammamet

endovascular Management of the failing haemodialysis access

- In 1966, Cimmino and Brescia were the first to perform subcutaneous, arteriovenous anastomosis that allowed repeat puncturing, a concept which is still being used until the present day



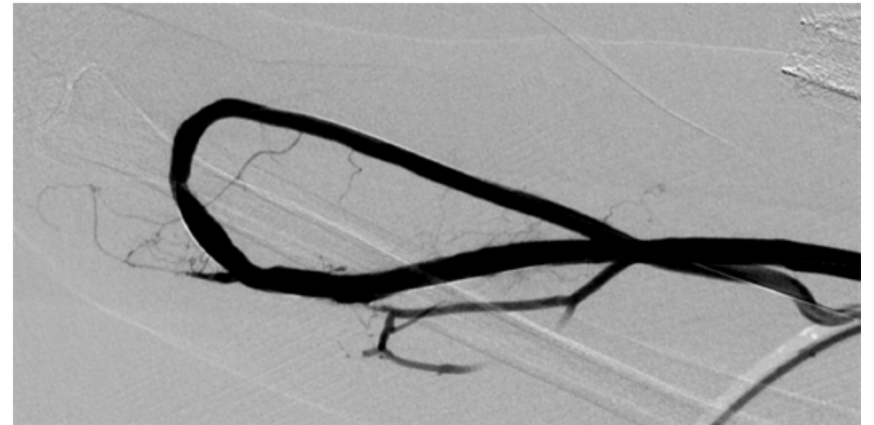
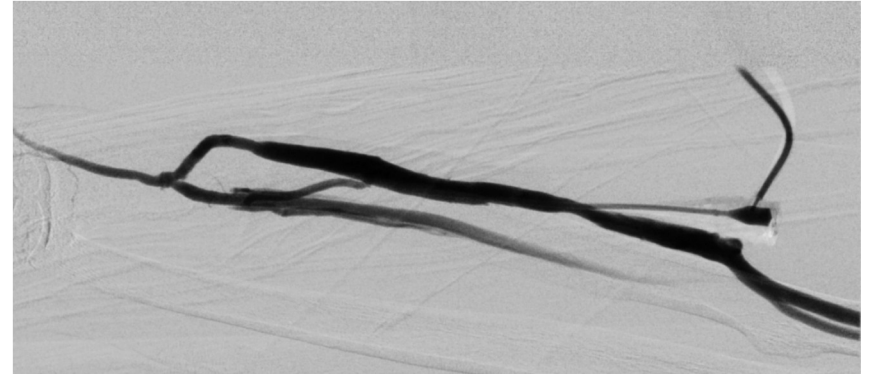
Anatomic reminder

- Superficial veins of the antecubital region are clinically significant puncture sites. They may occur in several anatomical variants:
- **M** classical type (60%), in which the median antebrachial vein continues with two terminal branches, which join the cephalic vein (CV) and basilic vein (BV). The junction is M-shaped
- **Y** type (30%), in which the antebrachial cephalic vein divides into the medial cubital vein and weaker, median cephalic vein. This type is almost always associated with existence of the accessory cephalic vein
- **N** type (8%), with low bifurcation of the antebrachial cephalic vein, which divides into the weaker continuation and a stronger, medial branch known as the medial cubital vein, which runs obliquely upwards and ends on the medial aspect of the basilic vein

The medial cubital vein is the most prominent vein of the antecubital region and is often used for venipuncture.

Pathophysiology & Vascular Access Society (VAS) recommendations

- VAS recommends that end-of-vein to side-of-artery anastomosis should be the preferred type of the fistula on the forearm
- end-of-vein to end-of-artery anastomosis is no longer favoured
- The side-of-vein to side-of-artery anastomotic modification has been excluded from clinical practice due to venous hypertension developing as a result of the blood flow reversal (steal syndrome) in the distal part of the cephalic vein



Indications and contraindications

- **Early occlusion of the arteriovenous fistula:** operator error
Prompt diagnosis enables intraoperative correction.

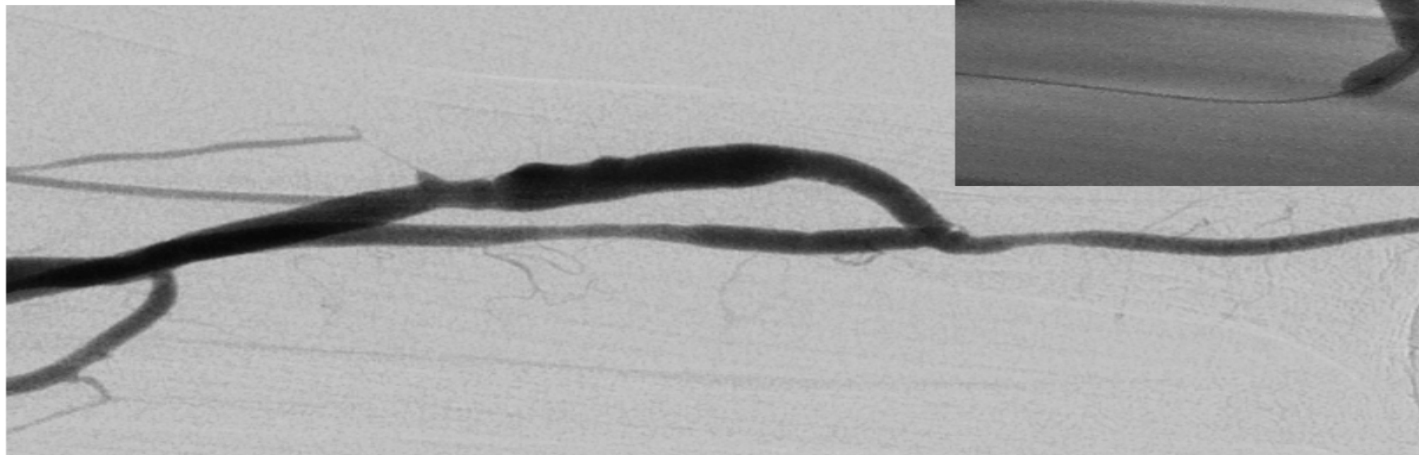
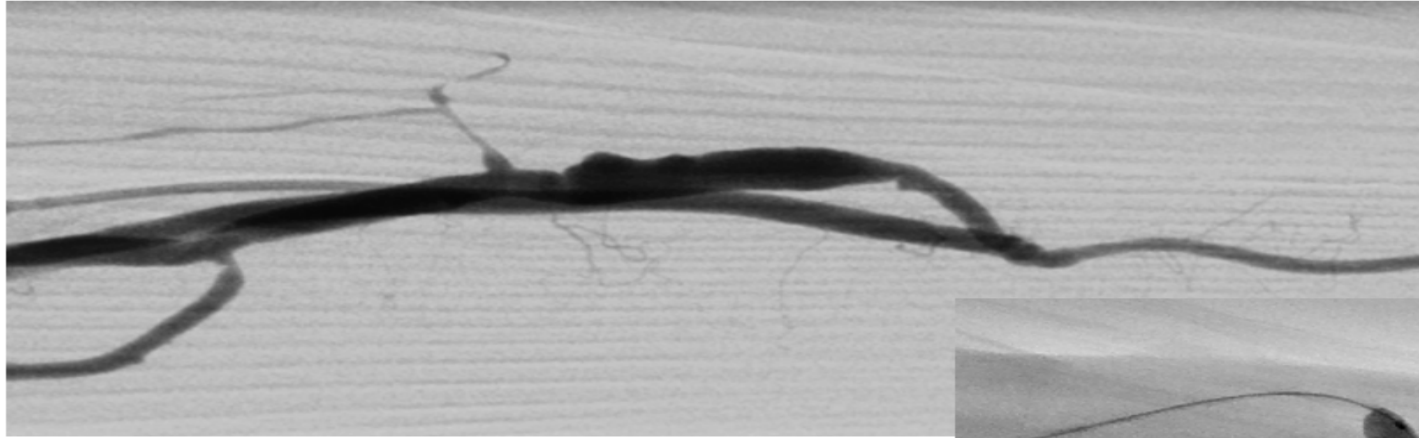
thrombosis due to a drop in blood pressure

compression during sleep.

- **Inadequate maturation**(access exercises after surgery may contribute to the maturation of the fistula)

Balloon-assisted maturation is one of the methods (to reach 6mm diameter)

Balloon-assisted maturation

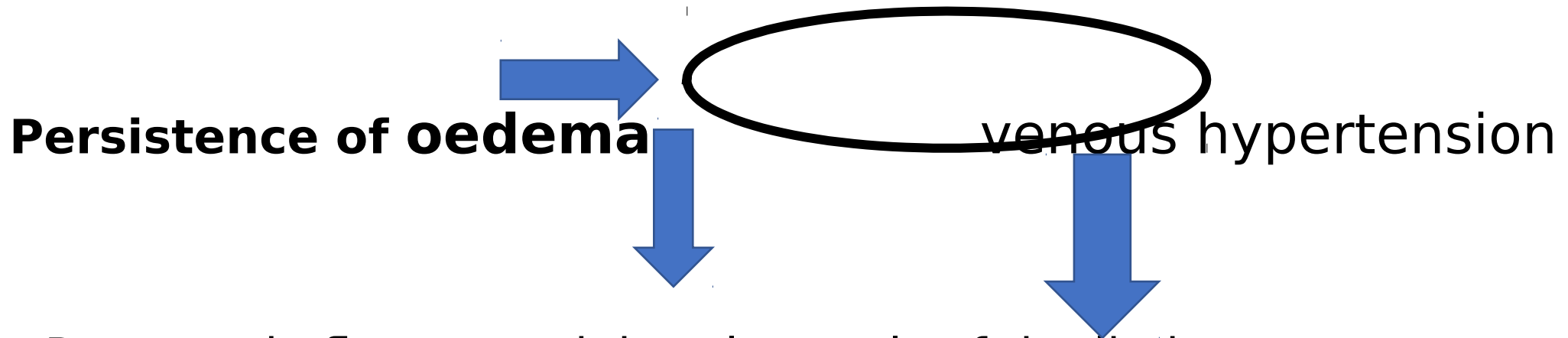


LIMB oedema shortly after haemodialysis access intervention



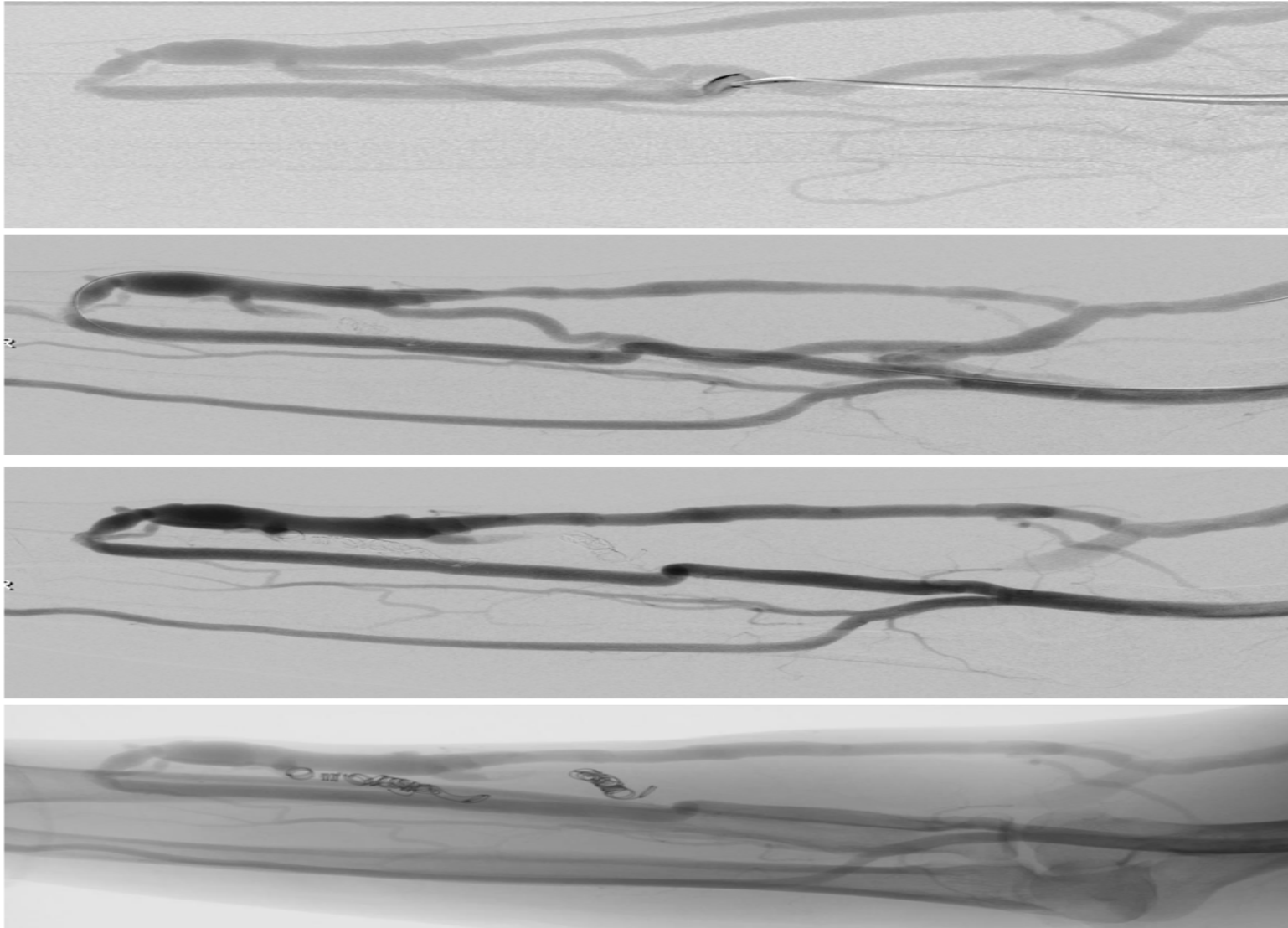
LIMB oedema shortly after haemodialysis access intervention

transient limb oedema can be successfully reduced by elevation of the limb



- Retrograde flow to peripheral vessels of the limb
- Occlusion/stenosis of central veins (previous temporary haemodialysis access)

closing unnecessary branches can be done with percutaneous coil embolization



Occlusion/stenosis of central veins (previous temporary haemodialysis access)



- Patency restoration of the native vessel is not required in asymptomatic narrowings
- Persistent pain and oedema of the face and shoulders serve as strong indications for PTA

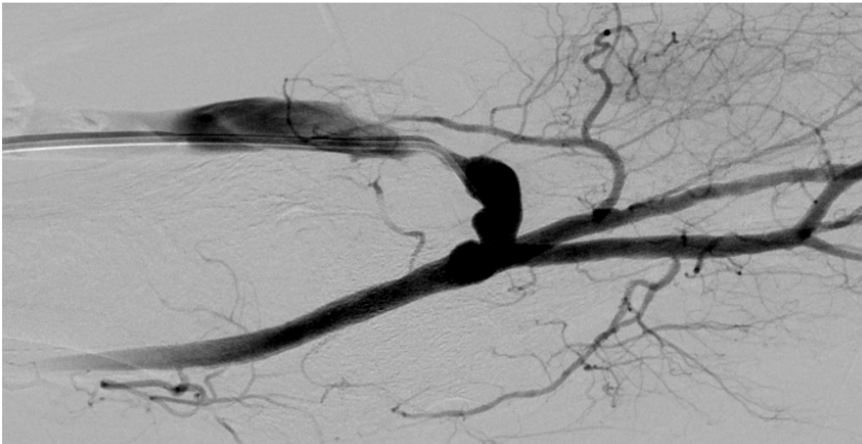
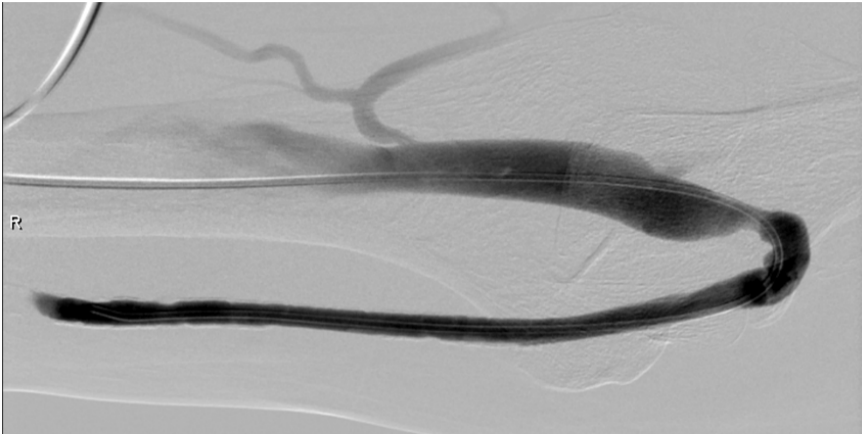
post-operative limb ischaemia following fistula creation

Due to extensive vascular network ischemic manifestations within the upper extremity are less dramatic as compared to the lower limb. From only pain and coldness during dialysis to digital necrosis

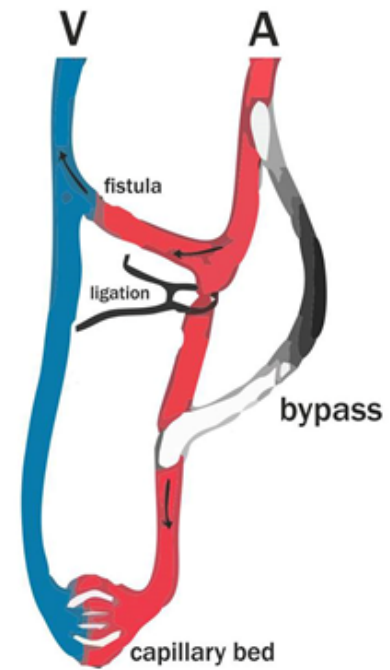
solutions:

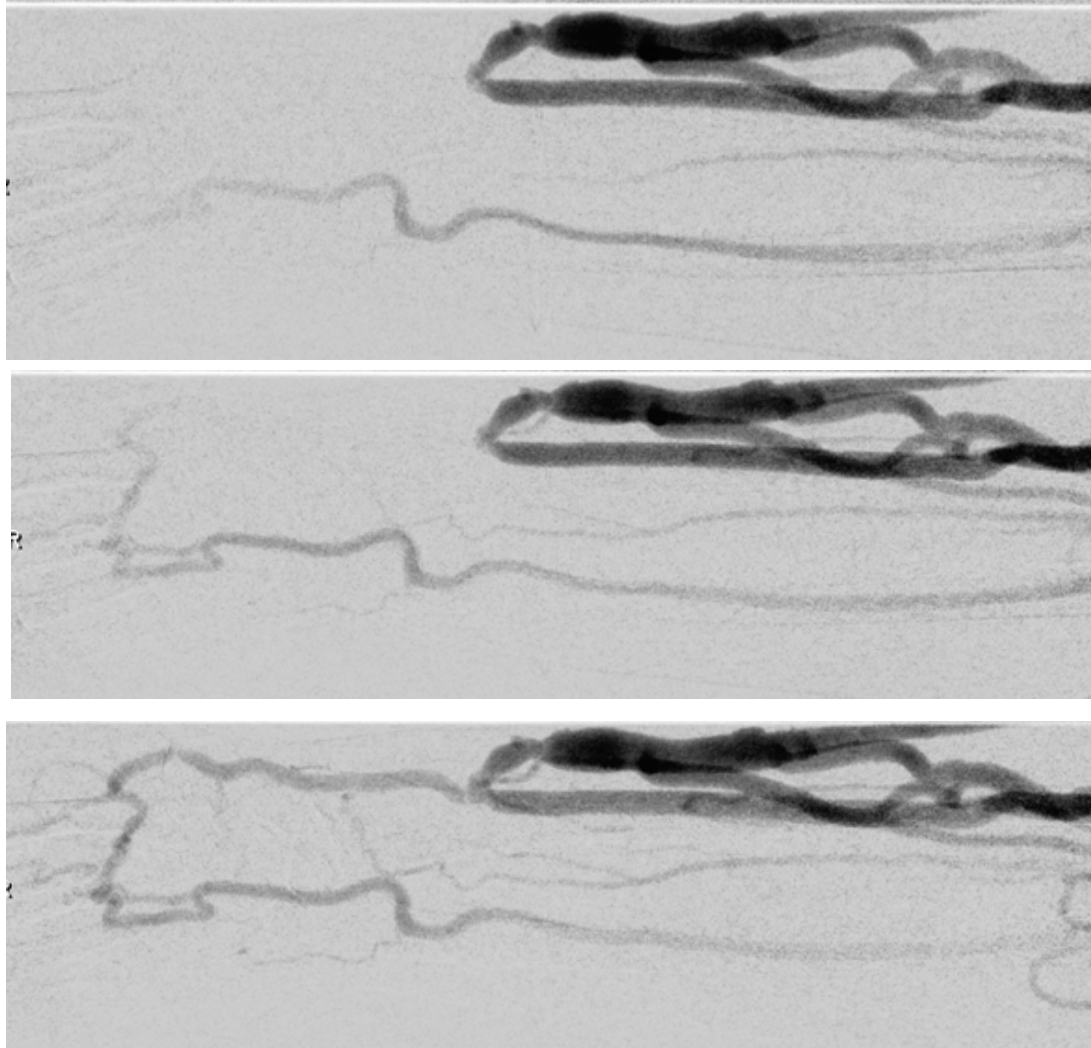
- banding the arterial anastomosis with PTFE prosthesis or placing additional sutures to reduce blood inflow to the fistula
- distal revascularization with interval ligation (DRIL)

Surgical solutions



DRILL BYPASS





Situation might occur in end-of-vein to side-of-artery anastomoses when there *is reversal flow from the ulnar artery.*

Ligation of the distal part of radial artery behind the anastomosis and creating an end-to-end fistula prevents patients from developing steal syndrom

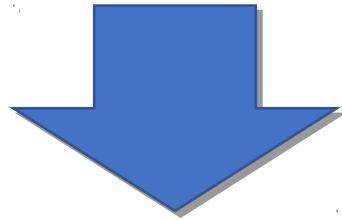
Endovascular solutions

(possible but more expensive than surgical solution)

- Endo vascular reduction(TIPS technique)
- Endovascular “ligation” using micro plug
- PTA for distal arterial stenosis or occlusion

Poorly functioning fistulas(mature fistula)

- Decreased blood flow through the fistula together with a high recirculation rate
- changes in the nature of thrill, pulsation and altered bruit at auscultation

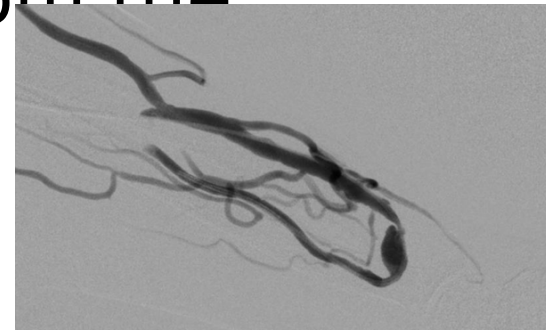


Doppler ultrasound examination and angiography should be performed in the presence of any pathological findings

stenosis are the most frequent direct cause of radiocephalic fistula insufficiency

Proximal stenosis 2 cm or 5 cm from the arteriovenous anastomosis

Distal stenosis > 5cm



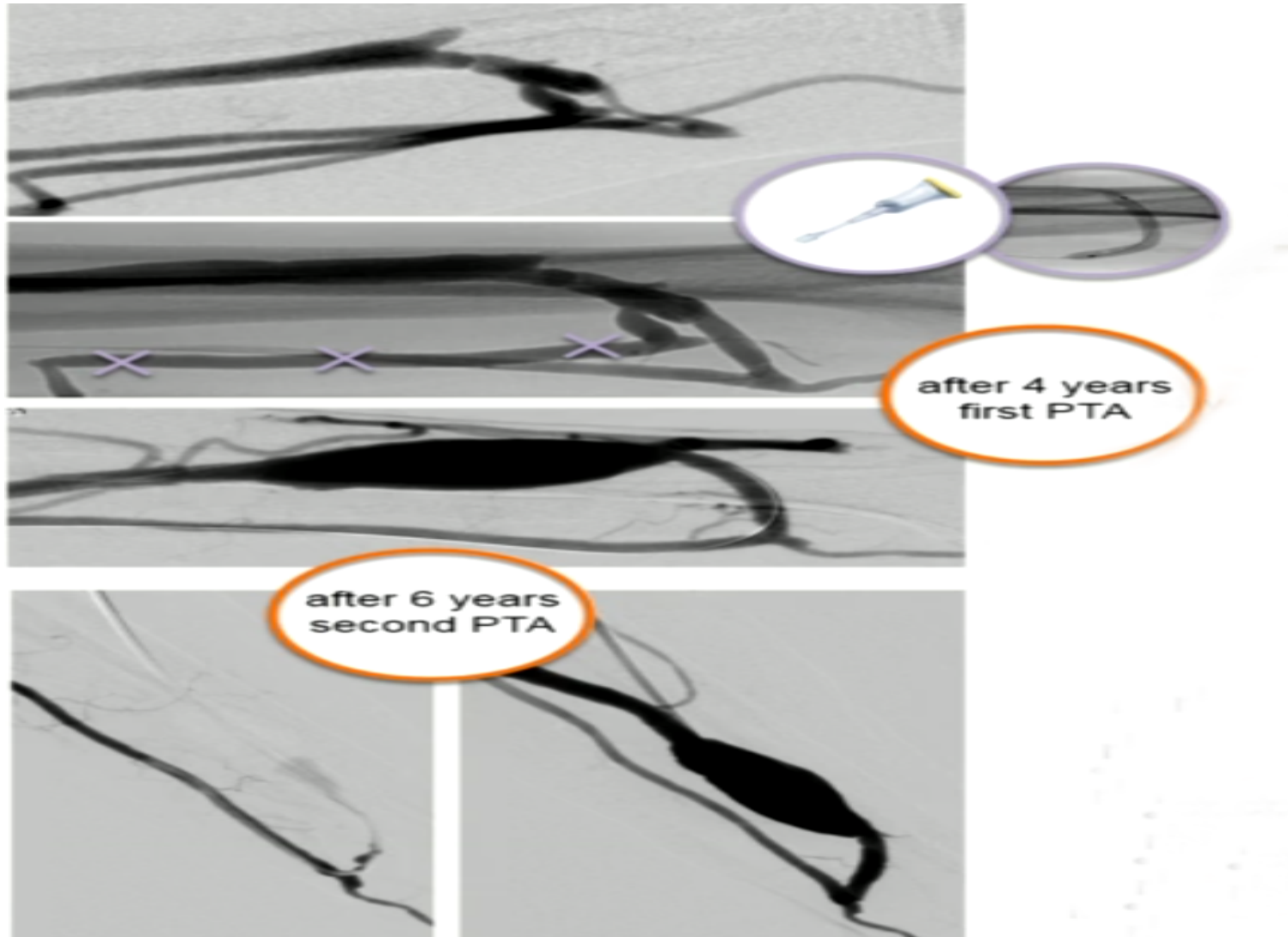
(PTA) is the treatment of choice for the majority of patients

PTA indications

- Absolute contraindications for PTA : infection at either the access or anastomotic site (This is most often the case for arteriovenous fistulas made with prosthetic interpositions)
 - PTA with care:
 - Maturing fistula <4 weeks
 - Recurrent stenosis with short relapse periods
 - Anastomotic junction performed within 1 month following primary surgery (suture rupture, with bleeds difficult to stop)
- VAS guidelines : stenosis >50% & reduction in measured dialysis adequacy

Balloon assisted maturation

Muller et al 122 P maturation was successfully achieved in 118/122



PTA indications

Stenosis > 50% which explain clinical symptoms:


- difficulties in cannulation
- Painful arm oedema
- Prolonged bleeding after removal of the cath.
- Hand ischemia due to arterial inflow or distal arterial stenosis

PTA result and stenting

- According to Rajan et al, the rate of clinical success of PTA intervention (restoring efficiency of haemodialysis) is 98% for radiocephalic fistulas, whereas anatomical success rates (assessed by control angiography during procedure) are 89.4%. The same authors reported primary patency rates (maintaining patency without subsequent interventions) at 3, 6 and 12 months following the procedure at the level of 85%, 75% and 62%, respectively, whereas secondary patency rates (patency restored by surgical/endovascular retreatment) at 3, 6 and 12 months following the procedure were equal to 91%, 88% and 86%, respectively .

Techniques for stenosis treatment

Access site:

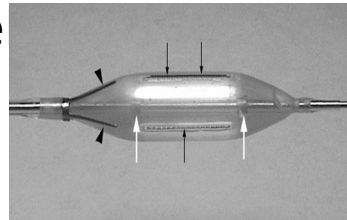
- vein segment easy to puncture by palpation as far away from stenosis as possible
- low flow not easily palpable  sonography guidance

Examination:

fistulography with visualization of anastomosis up to SVC

Treatment and devices :

- Balloon 1-2 mm > than reference vessel
- High pressure balloon.
- Cutting balloon
- Drug eluting balloon



Techniques for stenosis treatment

- Coumadin without **the** same day INR should not have artery cannulation but venous access is possible
- No contraindication for aspirin and clopidogrel
- In case of thrombosed access with potassium > 6mmol/l temporary dialysis
- Venous side access under local anesthesia in the direction of stenosis
- Arterial access in cases of inflow stenosis or ineffective venous side catheterization

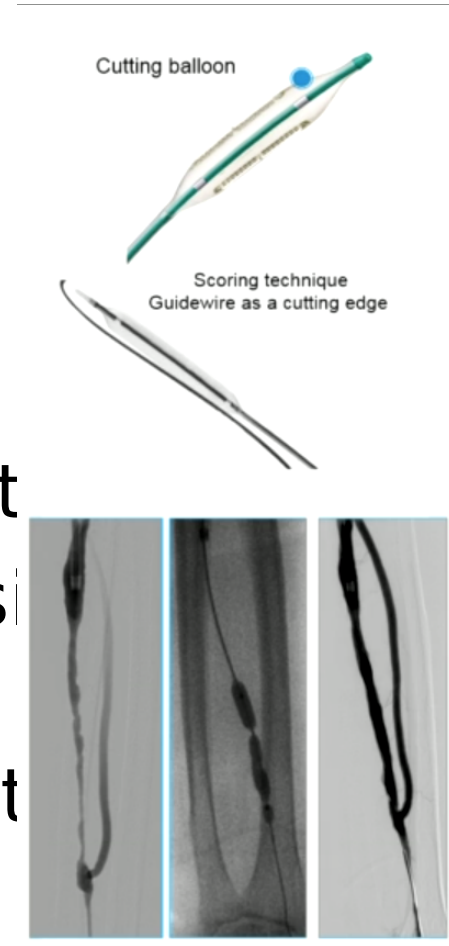
Techniques for stenosis treatment

- 5-7F sheath
- 3000-5000 heparin
- 0,018-0,035 glidewire
- Short 4-5F curved cath.(vert,MP...)
- Proper size of angioplasty cath,4-8mm or more

Techniques for stenosis treatment

- stent implantation is not recommended unless
- is an absolute necessity
- When stenting is indicated stent grafts are more
- than bare metal stents
- Cutting balloon has similar result than stent graft
- DEB can reduce significantly the rate of restenosis there

is no robust argument to support widely use of the new tool (cost/efficacy)




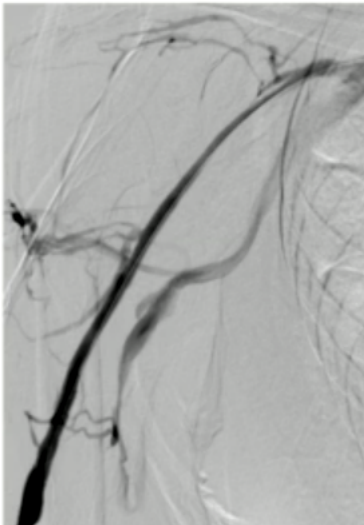
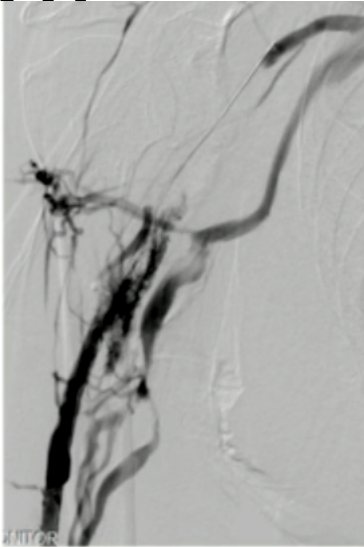
Techniques for stenosis treatment

Vascular rupture: rare but can be the most disastrous

- Balloon tamponade:

2 Atmo. Across the ruptured segment for 3-5min up to
outflow vein has to be flushed via balloon every minute
avoid thrombus formation

- Manual compression of hematoma
- Protamine sulfate if needed
- In cases of failure of recommendation above  above cc
stent



FERJANI, MONGI DIL FIS

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11/11/1952 M

7/18/2019

4:02 PM

Series 11

Run 11 - Frame 10 / 16

Mask 16

18/07/2019

CLINIQUE TAOUFIK

Perf. Phys.: DR HAMZA^KHALIL^{^^}

68kV, 15mAs

Zoom 133%

FERJANI, MONGI DIL FIS

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Run 10 - Frame 10 / 15

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18/07/2019

RESULTAT FINAL

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11/11/1952 M

7/18/2019

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Series 7

Run 7 - Frame 10 / 15

Mask 15

18/07/2019

LAO 4,0°
Cranial 0,3°

LAO 4,0°
Cranial 0,3°

L 512
W 1024

LAO 4,0°
Cranial 0,3°

L 512
W 1024

Cephalic arch stenosis (CAS)

- CAS can cause access dysfunction and may progress to thrombosis of brachiocephalic fistulas
- 6 and 12 M primary angioplasty patency 42% & 23% respectively
- When stenting is indicated covered stents are more durable than bare-metal stents
- Cutting balloon has similar results to covered stent

Cephalic arch stenosis (CAS)



F Oct 26 1963

Nov 18 2014
12:36:34

DR. HAMZA KH

RAD: 0.4 deg
CRA: 1.0 deg
L: 86.2 deg

Central vein stenosis and occlusion

VAS guideline: Asymptomatic

- 75Y old women with ... and prolonged bleed

POLYCLINIQUE TAOUFIK
DR HAMZA . K

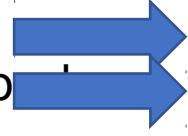


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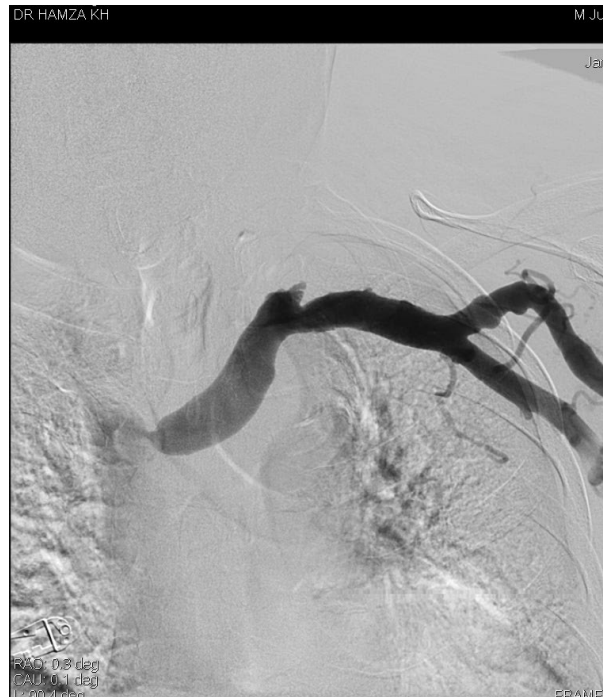
10 months later recurrence of the edema
balloon angioplasty

12 months later recurrence of the o
with SE stent



restenosis does not follow any rules

stenosis recurrence treated with
second recurrence of stenosis treated



Shunt and graft thrombectomy we have to remove 100% of clotts

Techniques of declotting:

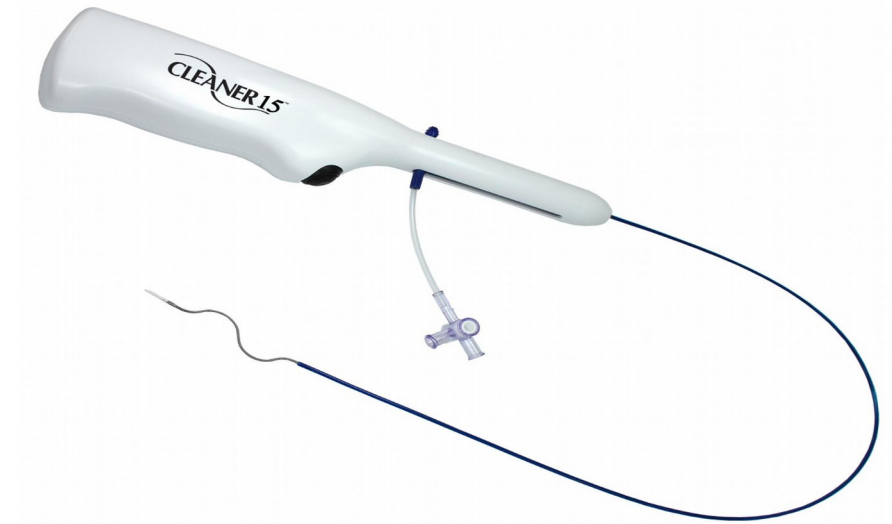
- Lyse and Wait
- Catheter-directed thrombolysis(RTPA,Urokinase)

Mechanical Thrombectomy+++

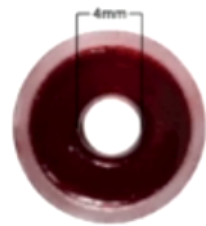
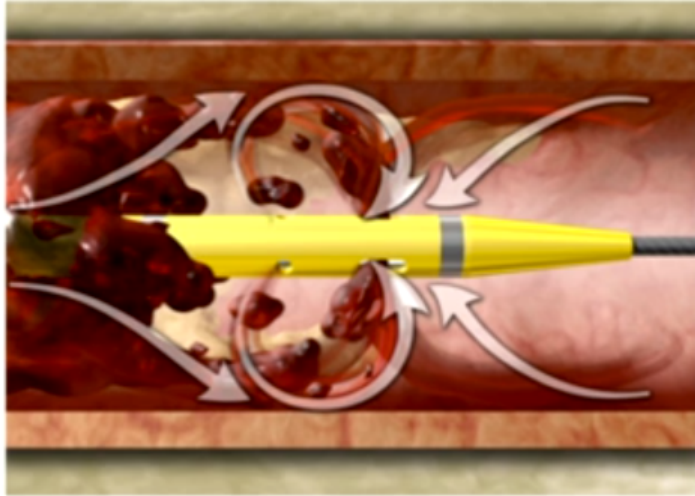
- Aspiration
- Percutaneous “Fogarty-maneuver”
- Venous mechanical instruments

Percutaneous thrombolytic device

- Motor driven nitinol basket
- 7F (OTW)
- Graft and shunt



Hydrodynamic technology



1st generation



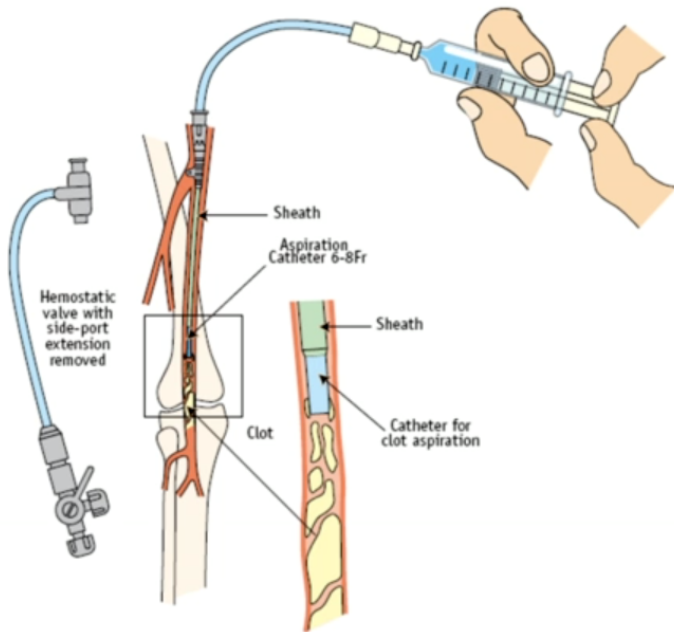
2nd generation



Percutaneous mechanical Thrombectomy

Basic principles(safety rules) :

- sonography and fluoroscopy guidance to explore the graft/fistula
- never inject contrast into the clotted graft or vein for imaging
- first declot venous limb to create free space for arterial side clot to go
- after embolectomy ,always image the arterial anastomosis
via a catheter already placed in the native artery
- never do a retrograde injection -even now!



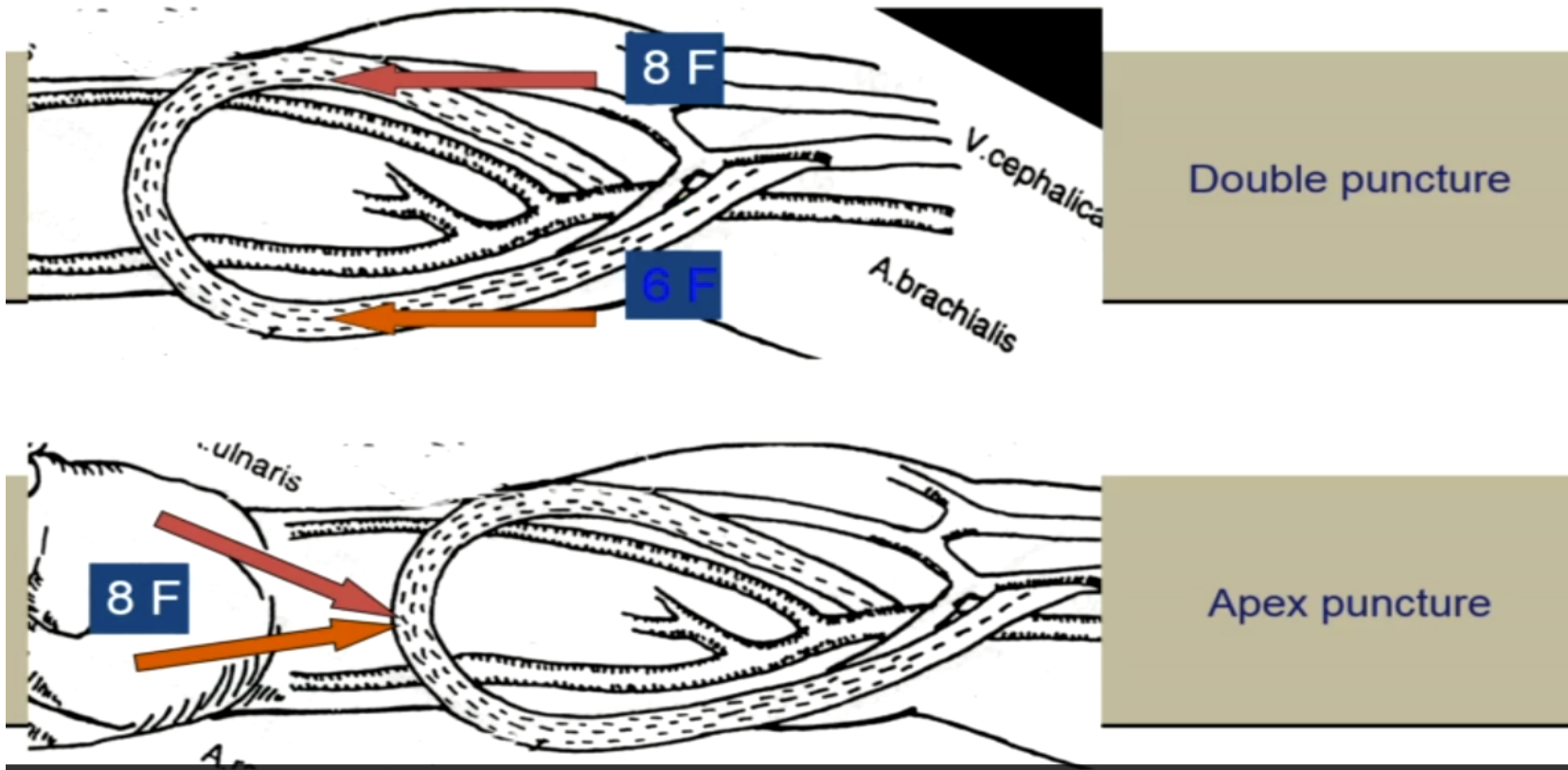
what not to do!



Graft declotting

Graft thrombosis

Implant grafts

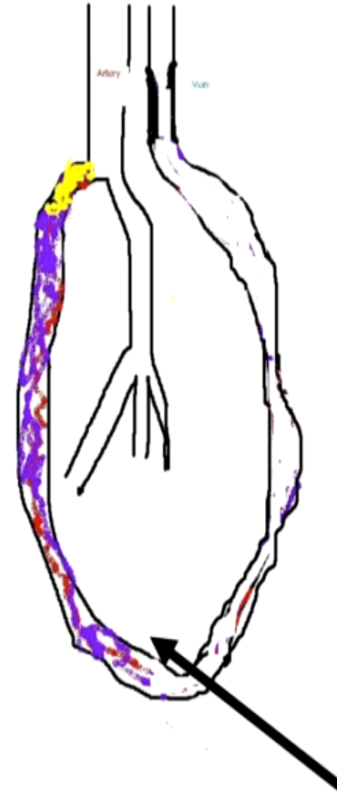


Graft declotting



Step 1.

Apex puncture of the venous limb
and declotting by aspiration and/or
mechanical device



Step 2.

Move sheath into the arterial limb
and declotting by aspiration and/or
mechanical device

But:
Do not touch the anastomosis

Graft declotting



Step 3.

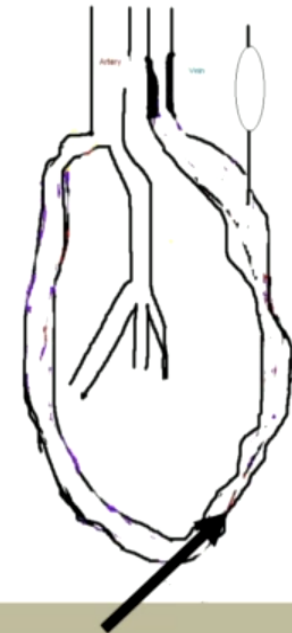
Inflate balloon above arterial plug and pull gently into the graft out of the puncture site

But:
Keep the balloon over a wire!



Step 4. Aspirate the plug

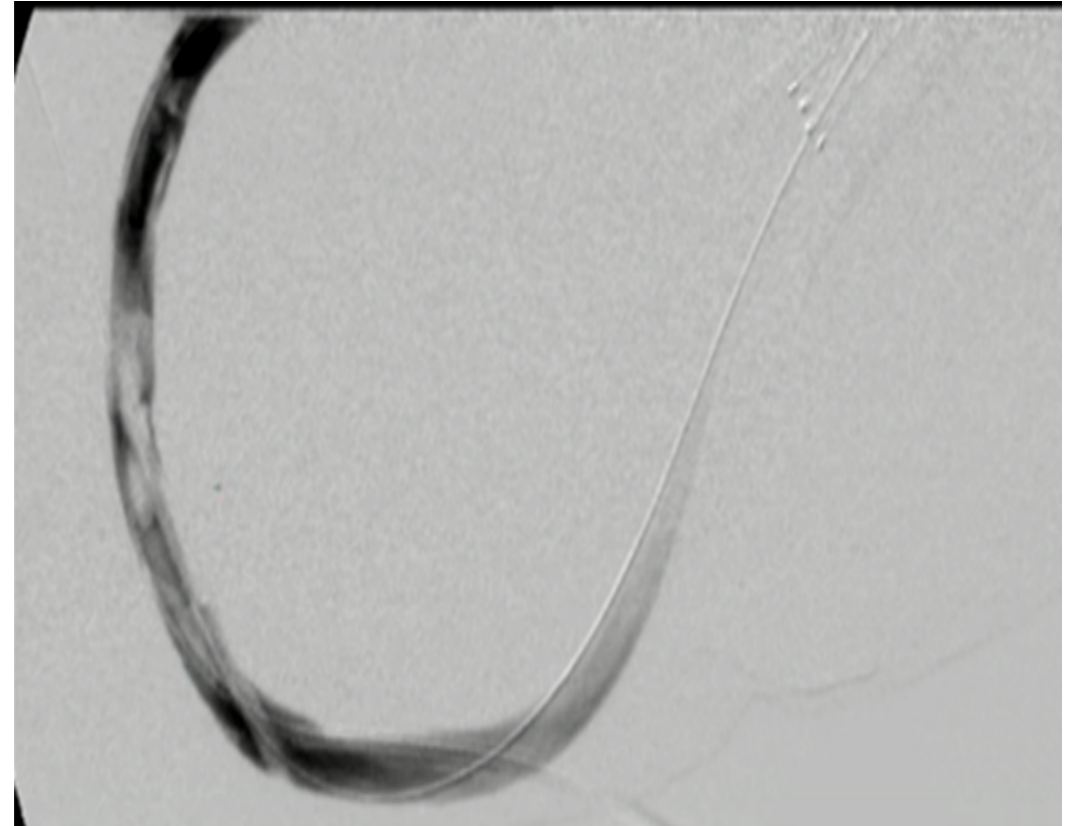
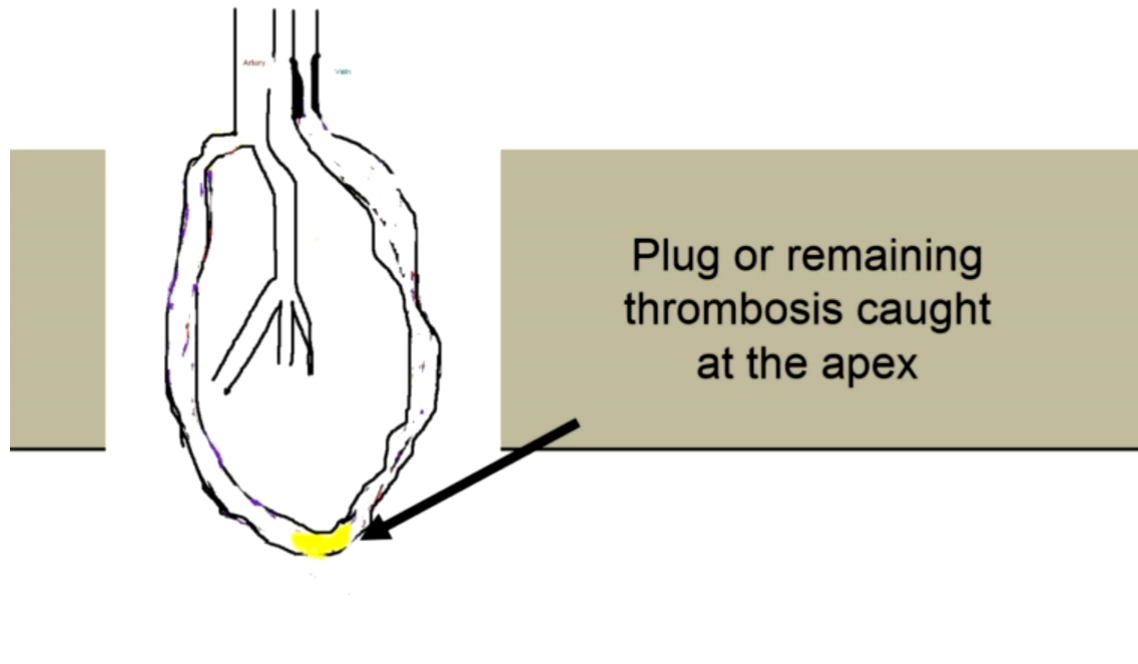
Alternatively:
mechanical device
(PTD, etc.)



Step 5. Dilate venous anastomosis

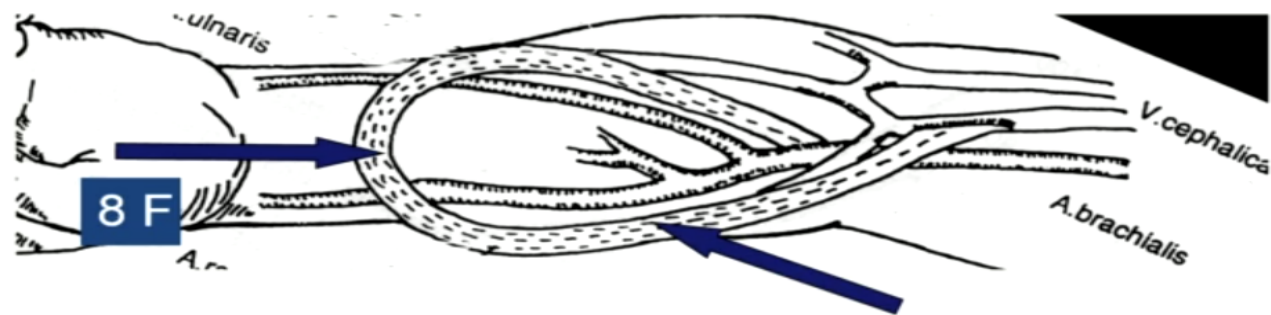
Graft declotting

Problem



Graft declotting

Modified Apex puncture

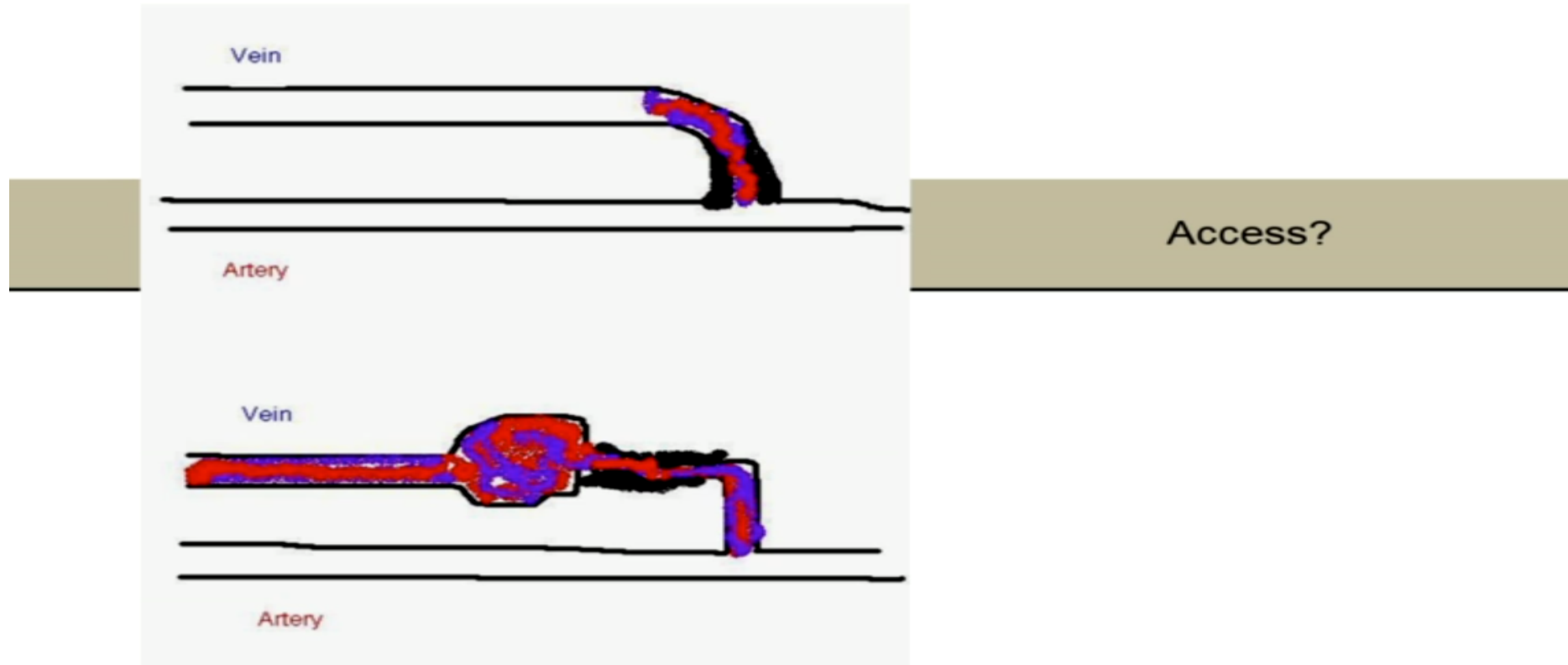


Use 6 mm balloon to further dislodge plug
Into the venous limb (via 6 Fr sheath)

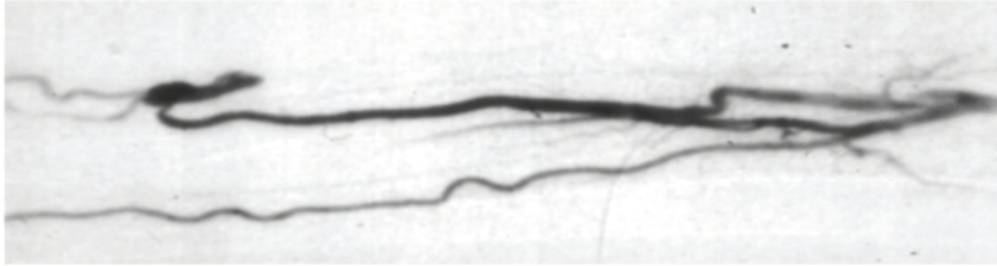
6 Fr



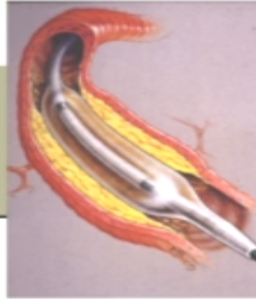
Native fistula



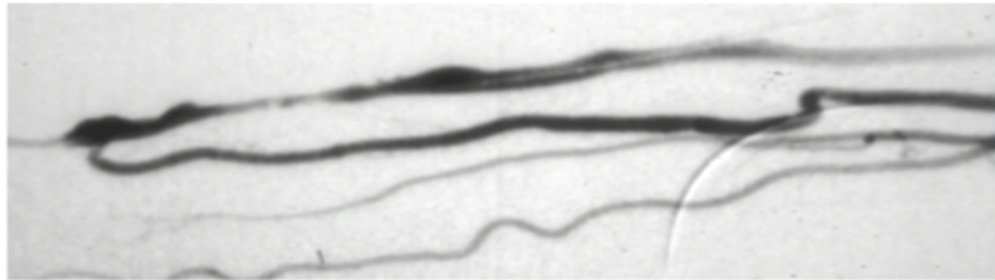
Native fistula



Small Thrombus



PTA



Thrombosed shunt (3 days)



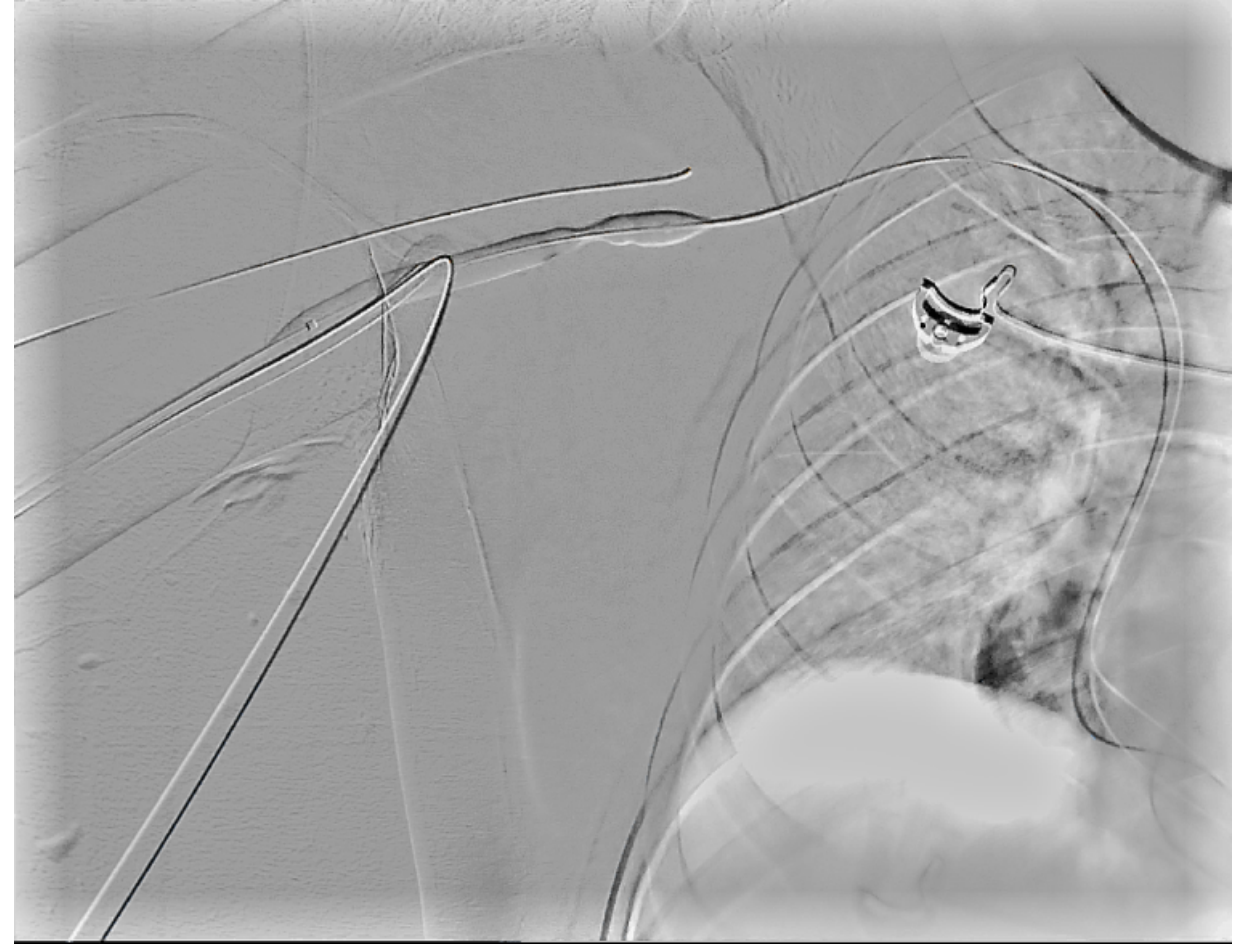
after aspiration of the venous side than the arterial side and balloon angioplasty of the vein obstruction

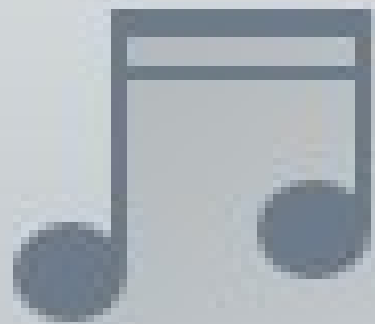


final result



Thrombosed Shunt from 10 days



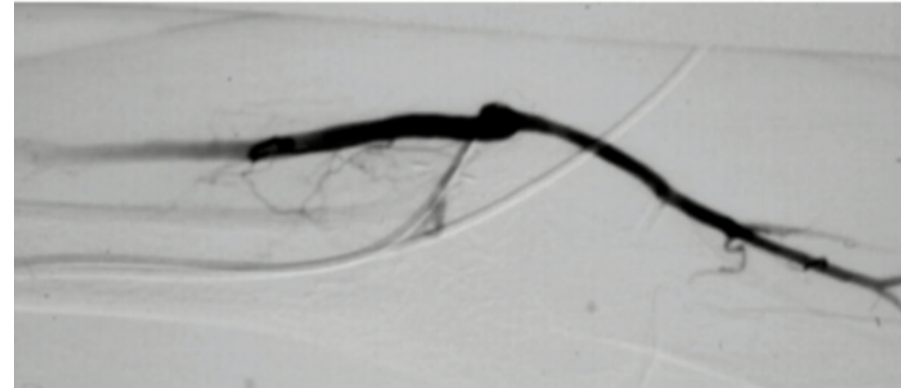
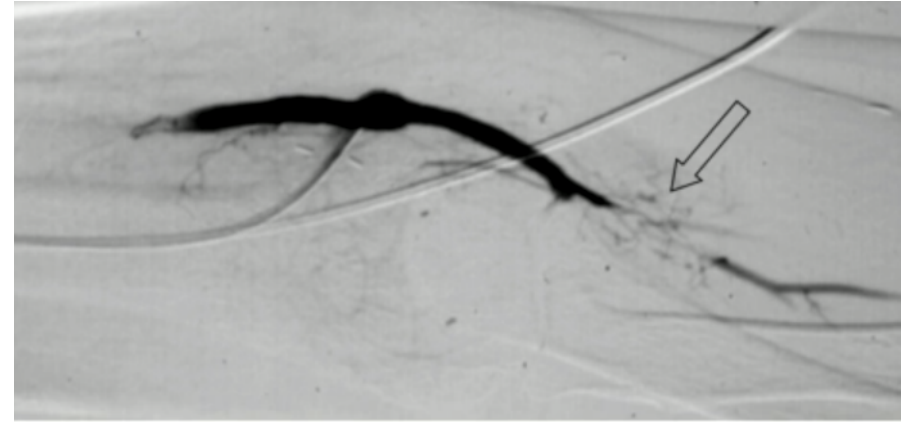


Final result



Complication of shunt thrombosis declotting

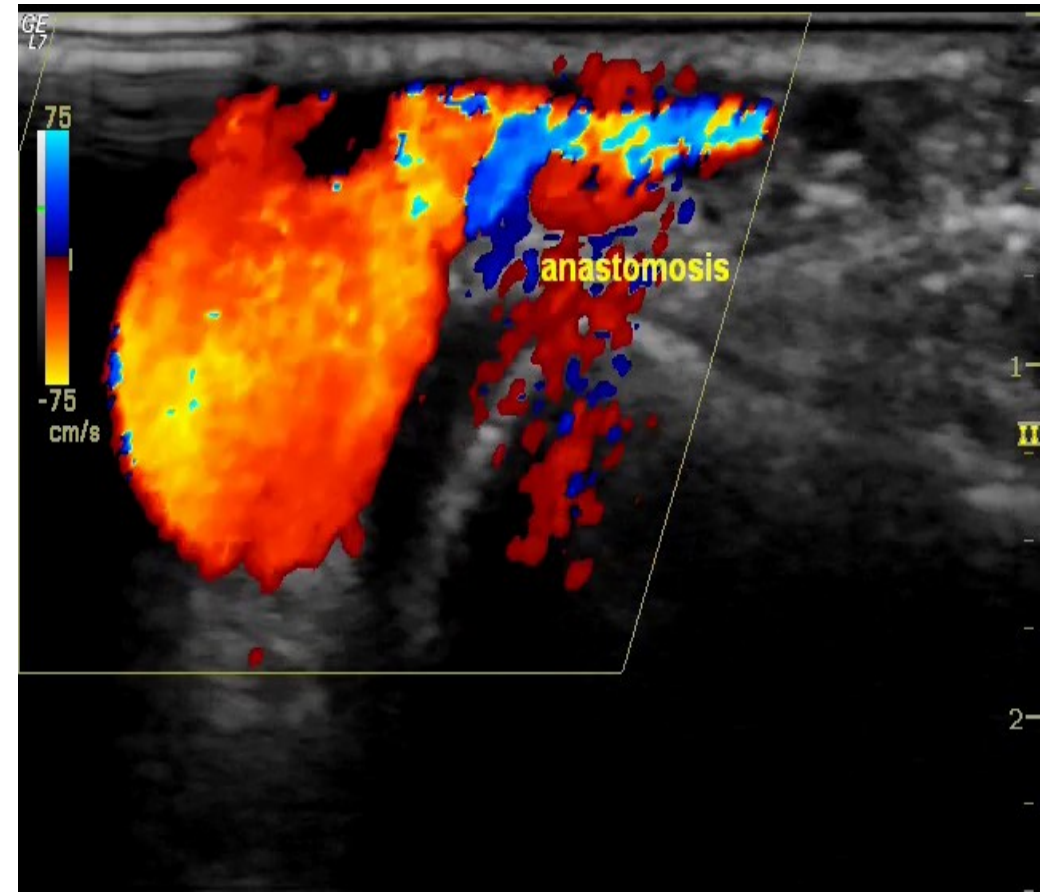
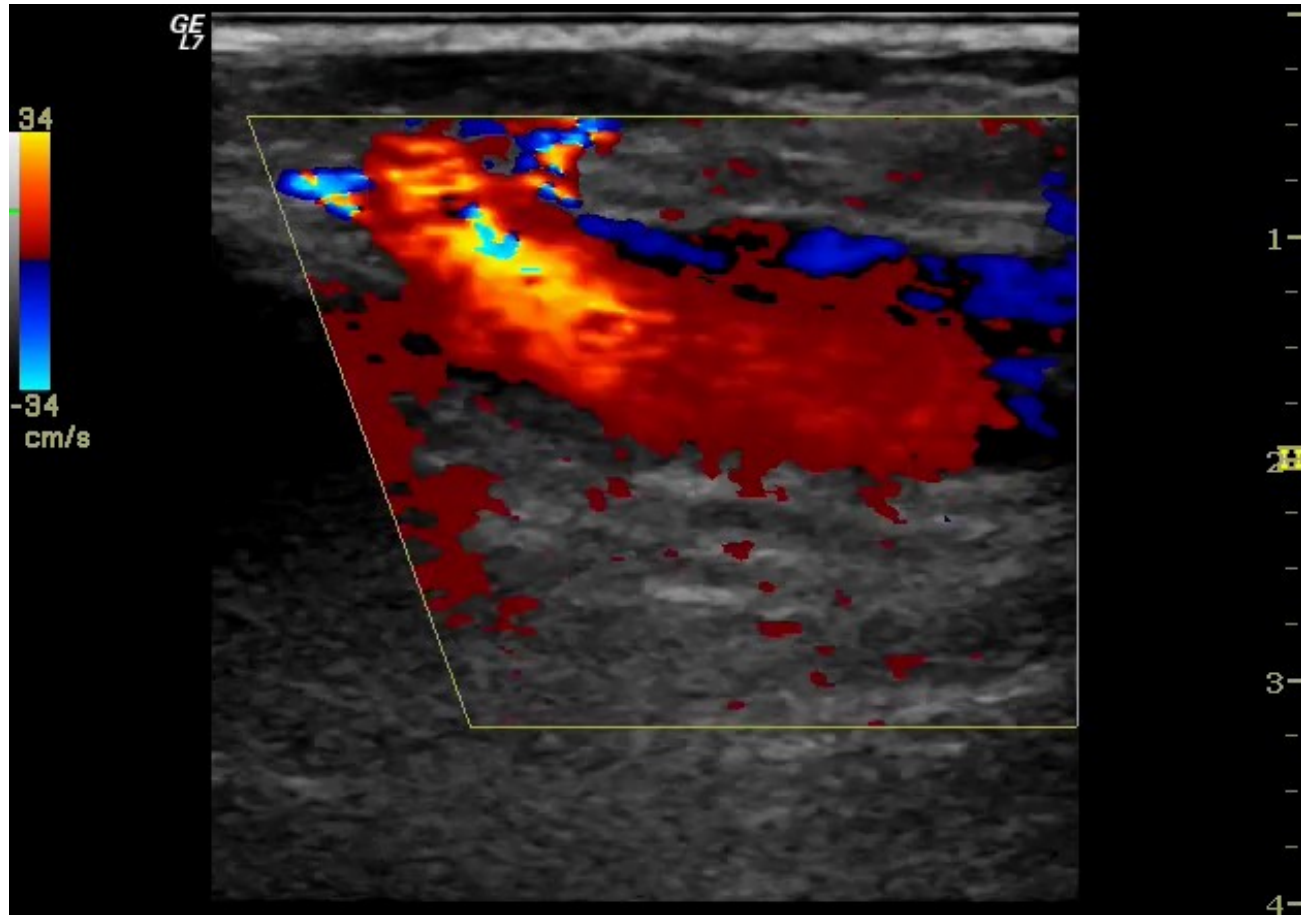
- Arterial emboli
- venous embolization
- Pulmonary embolization
- Subcutaneous hematoma



Post procedural management and follow-up

- NKF KDOQI (National Kidney Foundation's Kidney Disease Outcomes Quality Initiative guidelines) recommendations suggest:
- assessment of flow characteristics at every dialysis session
- direct measurements of static pressure ratios during every 2 weeks, with less-direct measurements made on a weekly basis
- flow measurements performed at a monthly frequency .
- doppler ultrasound is the method of choice in fistula diagnosis. The method allows for immediate identification of both the fistula stenosis (the major

Post procedural management and follow-up



Take home messages(1)

- Vascular Access Society recommends that end-of-vein to side-of-artery anastomosis should be the preferred type of the fistula on the forearm
- The side-of-vein to side-of-artery anastomotic modification has been excluded from clinical practice due to venous hypertension
- If the carpal network does not allow creation of a fistula, the cubital fossa should be the next choice
- In case of lack of native vein, an arteriovenous fistula can be created with the use of prosthetic arteriovenous bypass performed in the forearm, which are straight and loop bypass grafts
- More complications are observed in prosthetic grafts: tendency to anastomotic strictures, graft thrombosis and risk of infection resulting in lower patency rates
- Early occlusion of the arteriovenous fistula is mainly caused by operator error
- Early complications include transient limb oedema and steal syndrome
- Repeated vein puncturing may result in vascular wall thinning and their aneurysmal extension
- Pseudoaneurysms develop as a result of mechanical vessel wall trauma due to venipuncture or damage of the anastomosis itself
- Thrombosis is the most frequent late complication, it results from development of stenosis
- Poorly functioning fistulas are characterised by changes in the nature of thrill, pulsation and altered bruit at auscultation
- Doppler ultrasound examination and angiography should be performed in the presence of any pathological clinical findings.

Take home messages(2)

- Interventional radiology procedures such as percutaneous endoluminal angioplasty and mechanical thrombectomy (declotting) have changed dialysis access treatment
- Balloon angioplasty (PTA) is the treatment of choice for the majority of patients.
- Asymptomatic central vein stenosis should not be treated
- VAS guidelines indicate that stenoses should be treated if the fistula diameter is reduced by >50% and clinically/functionally relevant
- Stenosis resistant to simple PTA (pressure-resistant lesions) may be treated by use of high-pressure or cutting balloons
- Doppler ultrasonography is, alongside clinical examination, the basic method of the assessment of AVF
- None of the currently available studies provide reliable evidence concerning the likelihood of fistula thrombosis or estimated durability of the anastomosis
- In the majority of cases, patency of thrombosed AVFs may be successfully restored by means of endovascular treatment
- Balloon angioplasty is a successful treatment method for stenosis or occlusions accompanied by the presence of small thrombosis
- In the case of more extensive thrombosis, mechanical thrombectomy, thrombus aspiration or thrombolysis should be considered
- Elastic recoils and spasm are common occurrences after angioplasty
- The incidence rate of vessel rupture is equal to 2-4% and can be treated by external compression, prolonged 2- to 3-minute balloon inflation or implantation of covered stent
- Technical success rates of percutaneous recanalisation of thrombosed fistulas are estimated between 70% and 100%
- The published outcomes and patency rates of angioplasty, stenting and thrombectomy are very inhomogeneous and may therefore depend on diligent and meticulous conduct of interventional procedures to a much larger extent than expected at first sight

Conclusion

- patient should be educated about the necessity of daily self-monitoring of the fistula in a home setting so as to immediately report worrying symptoms
- doppler ultrasound is the method of choice in fistula diagnosis despite that preventive angioplasty don't reduce the rate of thrombosis (RCT) Robbin ML, Oser R, Lee J, et. al. (2006)
[Randomized comparison of ultrasound surveillance and clinical monitoring on arteriovenous graft](#) **outcomes**.Kidney Int. Feb;69(4):730-5.
- The exact mechanisms of fistula dysfunction still need to be completely understood
- close cooperation in a multidisciplinary team composed of a nephrologist, vascular surgeon, interventional radiologist and dialysis nurse