FAV PATHOLOGIQUES

INDICATION BILAN US

- **Dysmaturation**

- Variations du thrill
- **Difficultes de cannulation**
- Problème de pompe
- Recirculation

- **Saignement**
- Débit
- Kt/V
- Douleur
- **Ischemie**
- **Oedeme**
- **Thrombose**

BUT DU BILAN US DES FAV

LA CAUSE LA PLUS FREQUENTE DE PERTE DE FAV EST LA THROMBOSE

CAUSES FAVORISANTES :STENOSE ART et VEINEUSE

DIAGNOSTIC CONDUIT à UN TRAITEMENT PREVENTIF

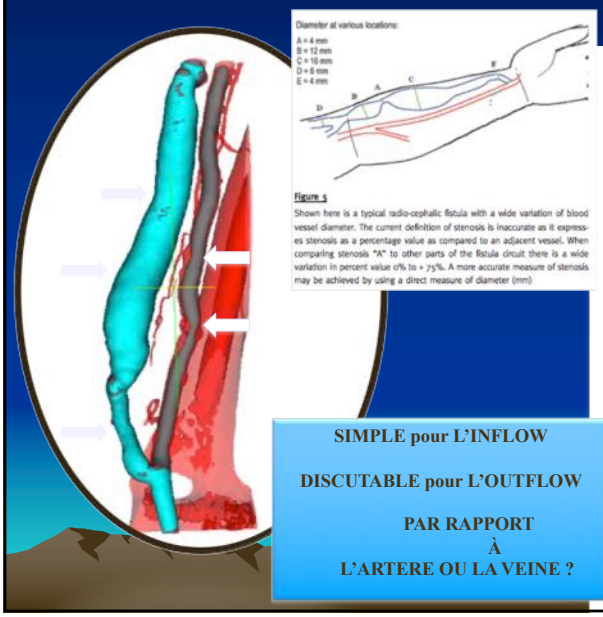
AIDE à la CARACTERISATION DES LESIONS ANGIOGRAPHIQUE
NATURE
SIGNIFICATIVITE DES STENOSES

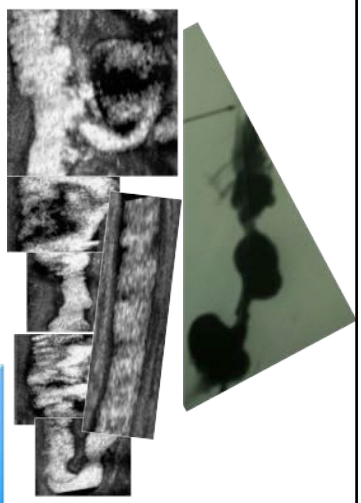
PRECISE LE RAPPORT STENOSE / DEBIT(PB DES HAUTS DEBITS)

STENOSE VEINEUSE

- AUGMENTATION DES PV
- SAIGNEMENT PROLONGE
- HYPODEBIT

DEFINITION DE LA STENOSE



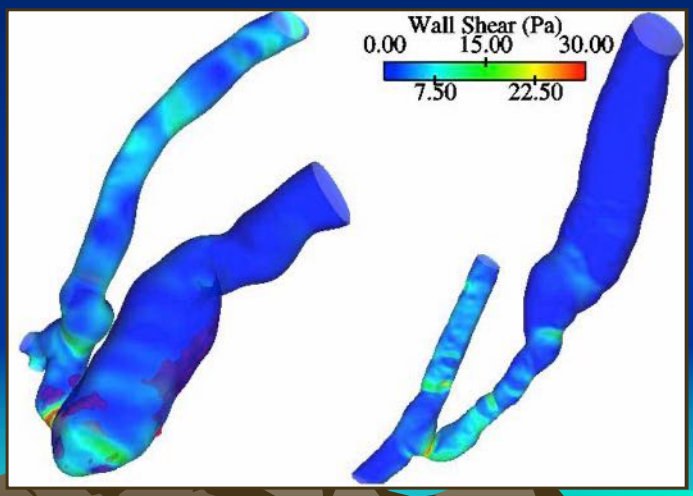


SIMPLE pour L'INFLOW

DISCUTABLE pour L'OUTFLOW

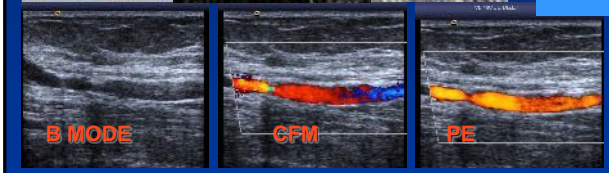
PAR RAPPORT À L'ARTERE OU LA VEINE ?

STENOSIS?
HOW AND WHERE TO QUANTIFY

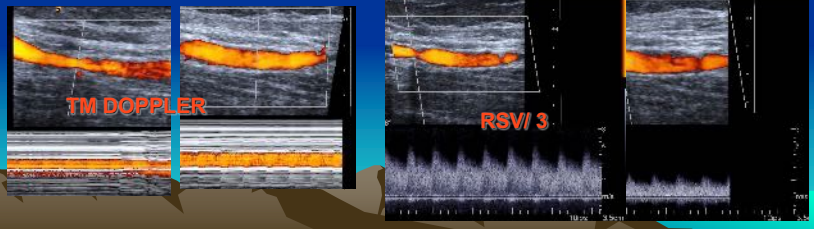


STENOSE
MOYEN DIAGNOSTIC et QUANTIFICATION

CONTINUITY EQUATION:
S1*V1=S2*V2
% of stenosis =1-V1/V2*100
RSV > 3 :significant sténosis >50%

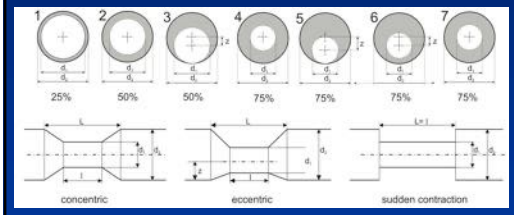


50% STENOSIS

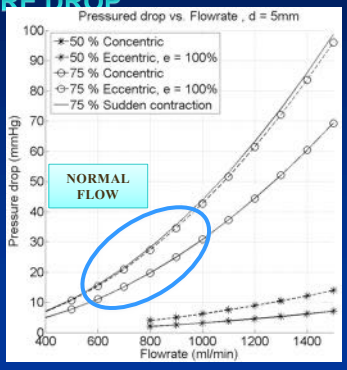


EFFECT OF STENOSIS SEVERITY AND ECCENTRICITY ON THE PRESSURE DROP

50% DIAMETER STENOSIS



Schematic diagram of the cross-sections stenosis used in the in vitro experiments:
1,2,4 concentric stenosis
3,5,6 eccentric stenosis with various degree of contraction and eccentricity
7-concentric stenosis with sudden contraction.



Pressure drop vs. flow rate.
Flow rate Q=400-2000 ml/min, artery diameter d=5 mm.

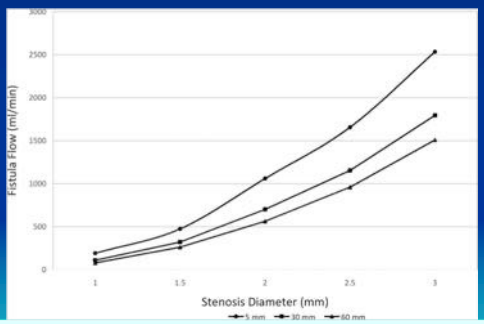
STENOSIS ASYMMETRY IS ASSOCIATED WITH :
MORE PROFOUND PRESSURE DROP
AND
FLOW VOLUME DECREASE

Novakova L et al. Physiol. Res. 2016

FLOW RATE and STENOSIS

AVF under physiologic extremes of mean blood pressures (50-160 mmHg)

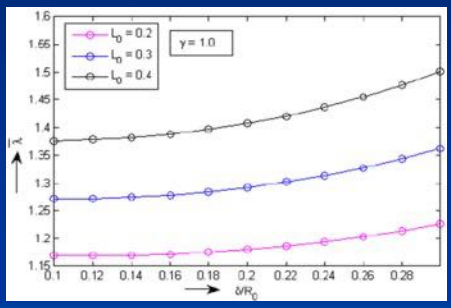
1.5 mm stenosis of 5 mm length is capable of delivering: 301mL/min>flow rate <642 mL/min
2.5 mm stenosis of 5 mm in length is capable of delivering: 1,027mL>flow rate <2,262 mL/min
3 mm stenosis of 6 cm lengh is capable of delivering: 902mL>flow rate <2093 mL/min



Hoganson D M,.Validation of computational fluid dynamics-based analysis to evaluate hemodynamic significance of access stenosis J Vasc Access 2014

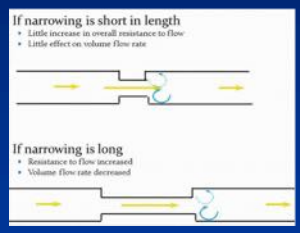
The model clearly suggests that under physiologic extremes of mean pressures, a diameter of 2.5 mm is ample to provide flows over 1,000 mL/min

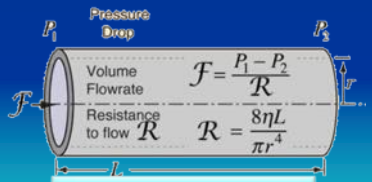
EFFECT OF STENOSIS LENGH



Variation of non-dimensional resistance to flow for different values of stenosis length

Arun Kumar Maiti.
American Journal of Applied Mathematics and Statistics, 2016

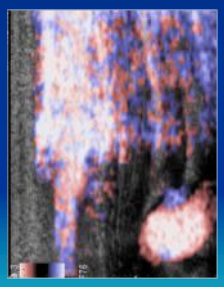


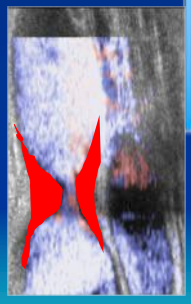


Poiseuille's law

STENOSE DIAGNOSTIC ET QUANTIFICATION

EQUATION de CONTINUITE
EQUATION:
S1*V1=S2*V2
% of stenose =1-V1/V2*100
SVR > 3 :stenose >50%
R1 < 0,7





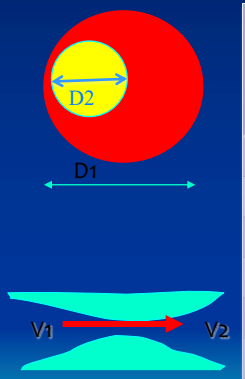
Chute de pression depend :
debit
degre de stenose
$\Delta P = 4\ v^2$ max

Diamètre résiduel 2-3mm
B Mode
TM-Doppler
Color Flow
Power Doppler
E-flow

BLOOMING

% STENOSE / VITESSE / Δ P

V1-V2m/s	Pressure drop mmHg
1	4
2	16
3	36
4	64
5	100
6	144



STENOSIS % SURFACE 1-V1/V2.100	STENOSIS % DIAMETER
50%	30%
66%	4O%
75%	50%
83%	60%
92%	70%
96%	80%

LIMITES

L'équation de Bernoulli simnplifiée est très précise sauf :

- V max d'amont (V1) > 1.5 m/s surestimation de 10 mm de Hg
- Présence de deux sténoses successives
- Longue sténose (effet tunnel)
- Hématocrite élevé (Ht > 60%)
- Bas débit cardiaque
- Très petits orifices

STENOSE SIGNIFICATIVE

CRITERES HABITUELS DE STENOSE

26% de FAV nouvellement crées sont normales
54% sont porteuses de sténose significatives

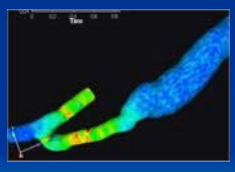
Grogan JJ Vasc Surg.Jun 2005

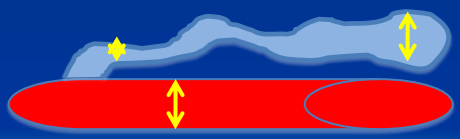
NECESSITE DE SEUIL PRECIS

Strandness DE ,Summer DS.Vasc surg 1989

STENOSES SIGNICATIVE ET FAV

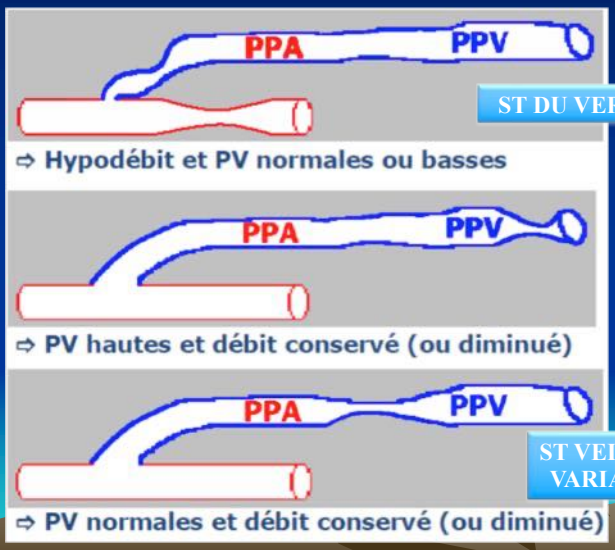
- **La définition du % de sténose par rapport au segment adjacent normal est inadéquate**
- **Sténose significative :diamètre minimal necessaire à assurer le débit de pompe**
- Diamètre résiduel de 2.7 mm est une valeur seuil seuil à retenir





Fahrtash F et al.
Defining a significant stenosis in an autologous radio-cephalic arteriovenous fistula for hemodialysis. *Semin Dial. 2011*

STENOSE VEINEUSE



ST DU VERSANT VEINEUX DE L'AAV

ST PROXIMALE

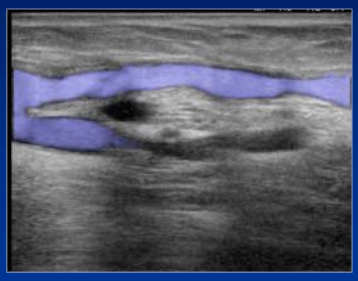
ST VEINEUSE INTERMEDIAIRE VARIABLE /COLLATERALITE

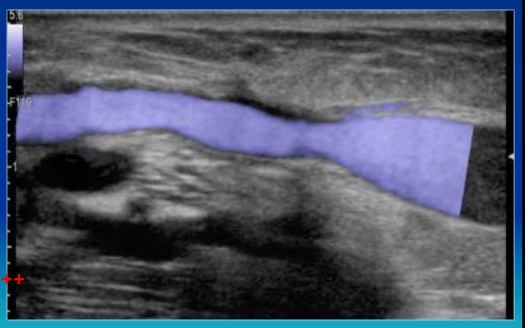
Courtesy Dr O.PICHOT

NATURE DE LA STENOSE VEINEUSE

- HYPERPLASIE MYO –INTIMALE
- COMPRESSION
- VALVULE (Synéchie –Fibrose)
- DISSECTION
- THROMBUS

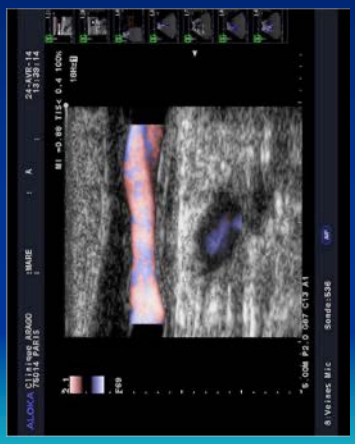
NATURE DE LA STENOSE



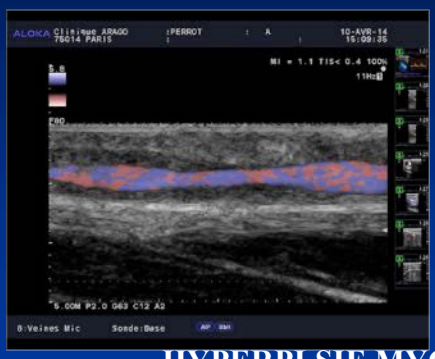


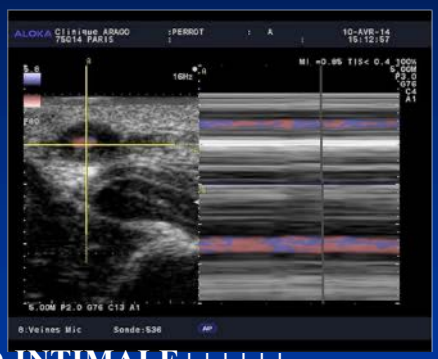
PEU DE FIBROSE
CONTRAINTES EXTRINSEQUES +++++

Hyperplasie fibreuse



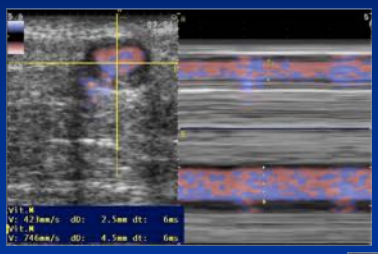
STENOSE INTERMEDIAIRE FAV RC

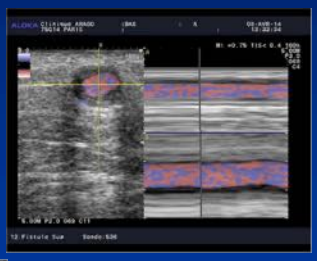


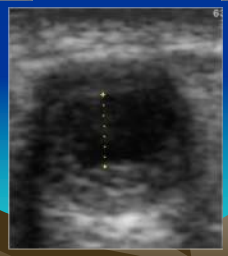


HYPERPLSIE MYO-INTIMALE++++++

DEFINITION EN TM DOPPLER ENERGIE
STENOSE EXENTREE

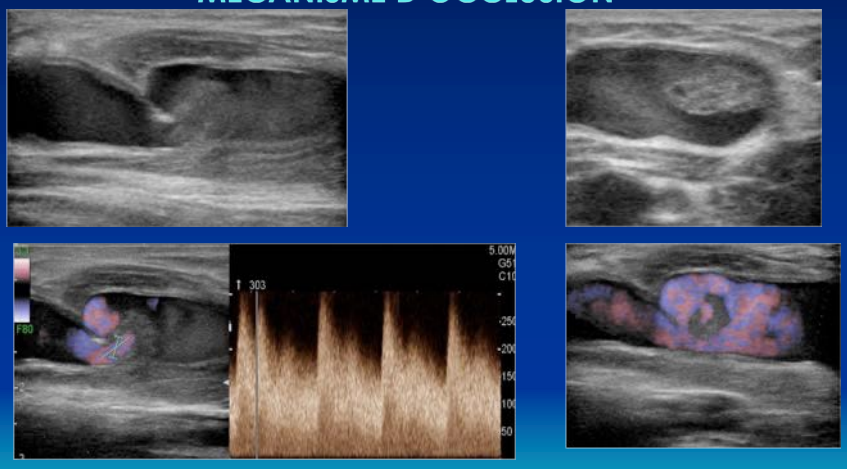






STÉNOSE
Compliance et résistance

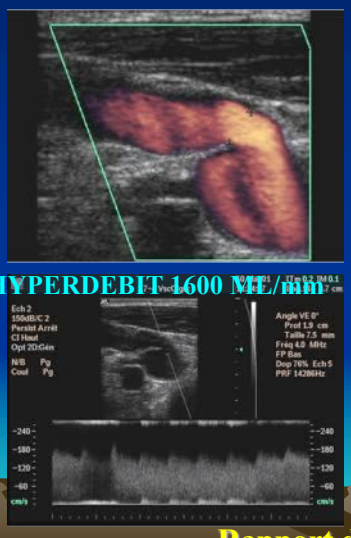
STENOSE VALVULAIRE
MECANISME D'OCCLUSION



THROMBUS POST CANNULATION D'UNE STENOSE

LOCALISATIONS PARTICULIERES

STENOSE RELATIVE CROSSE CEPHALIQUE



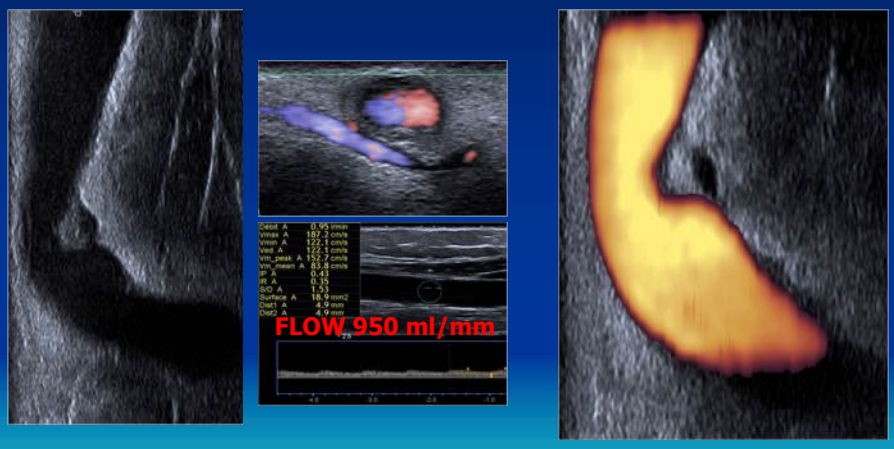
HYPERDEBIT 1600 ML/mn

diametre residuel 4.5 mm

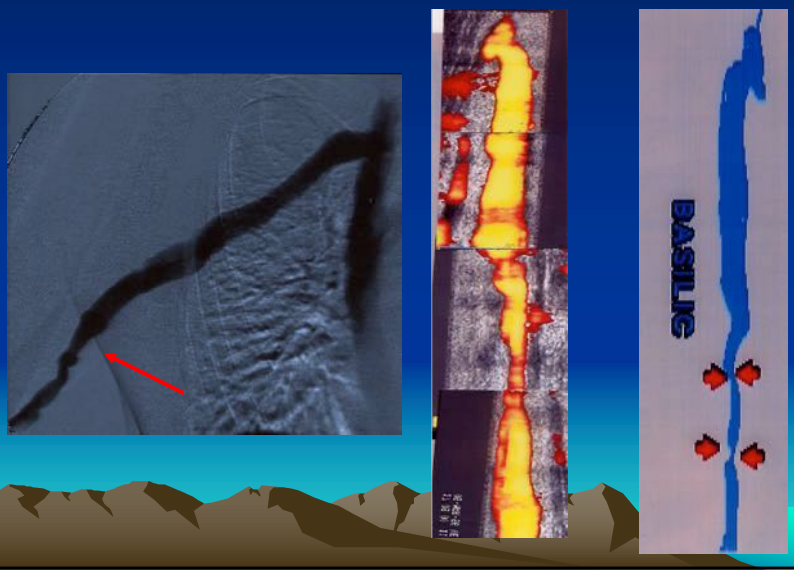
Rapport de vitesse = 3

FAV HUMERO BASILIQUE

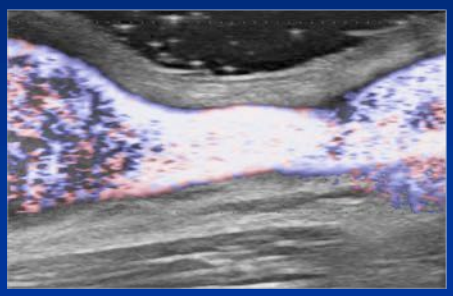
STENOSE MODEREE SUR COMPRESSION EXTRINSEQUE



STENOSE V.BASILIQUE



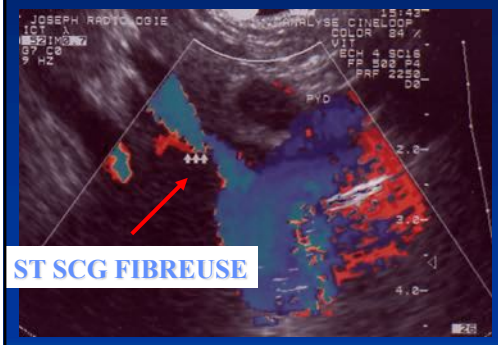
STENOSE V.BASILIQUE



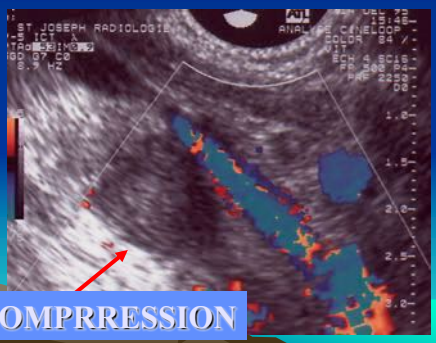
Fibrose mineure et compression extrinsèque /deroutage

NATURE PARTICULIERE

STENOSE des GROS TRONCS VEINEUX

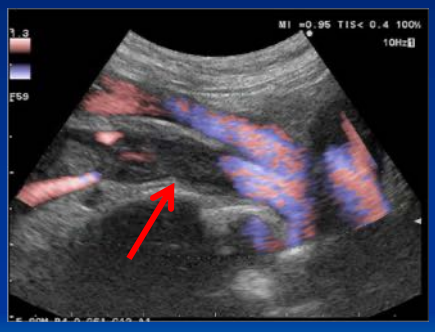


ST SCG FIBREUSE

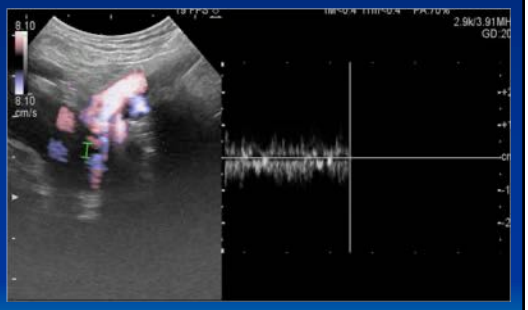


ST VJI COMPRRESSION

STENOSE VSC SUR THROMBUS



OCCLUSION DU TVBC POST KT



REFLUX DANS LA COLLATERALITE

« Stenotic lesions should not be repaired merely because they are present .If such correction is performed then intaprocedural prior and following PTA should be conducted to demostrate functional improvement with a succesfull PTA »

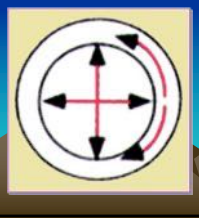
Besarab A,*Blood purification 2006*

PATHOLOGIE ANEVRISMALE

INFECTION
RUPTURE
PONCTION DIFFICILE
ASSOCIATION STENOSE /ANEVRISME
THROMBUS

ANEVRISME VEINEUX

- CONSEQUENCE DE L'ALTERATION DE LA PAROI VEINEUSE PAR LES PONCTIONS (VARIABLE AVEC LE TYPE)
- FACTEUR PREDISPOSANT :DVLP EN ABSENCE DE PONCTION
- HYPERDEBIT
- STENOSE D'AMONT ET SURTOUT D'AVAL
- 3% des COMPLICATIONS de FAV OPEREES



T=P.D/E

Problèmes Cliniques

Manque de place

Souffrance cutané

Nécrose

Hémorragie

INFECTION ?

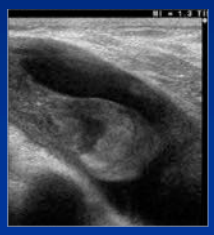
FAUX ANEVRISME VEINEUX

PAS DE THROMBUS

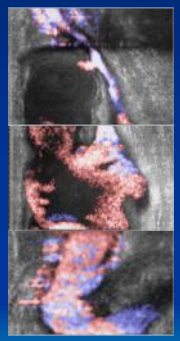
INFLAMMATION OU SEPSIS ?

THROMBUS INTRA ANEVRISMAL
PONCTION DIFFICILE





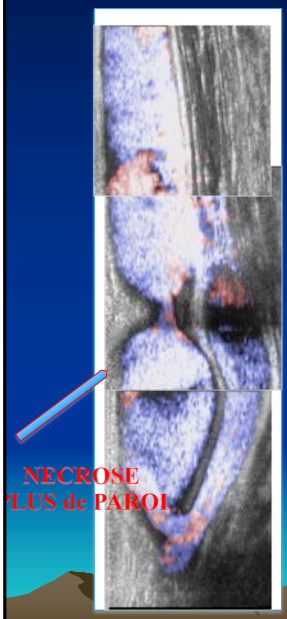
FAUX ANEURYSME SUR PONCTIONS

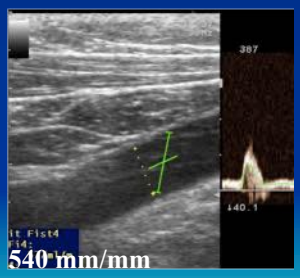



PONCTION TRANSFIXIANTE
DEFAUT DE COMPRESSION
PONCTION DE L'ARTERE

FAV BRACHIO-CEPHALIQUE

ASSOCIATION ANEVRISME/STENOSE
HAUTE PV
ST +++++
PT DE NECROSE
CHUTE DE DEBIT





SUBSTITUT VASCULAIRE

- PTFE
- PROCOL
- GREFFON VEINE PRESERVEE
- STENT
- HERO-GRAFT

LESIONS PROTHETIQUES

PTFE :

- STENOSE DE L' ANASTOMOSE PROTHETO-VEINEUSE(à 80%
- THROMBUS MURAL
- EPAISSISSEMENT DE LA CAPSULE INT
- CALCIFICATION DE LA CAPSULE EXT
- FX ANEVRISME INTRA CAPSULAIRE
- HEMATOME
- SEROME
- REACTION FIBROLASTIQUE

BIO-PROTHESE:

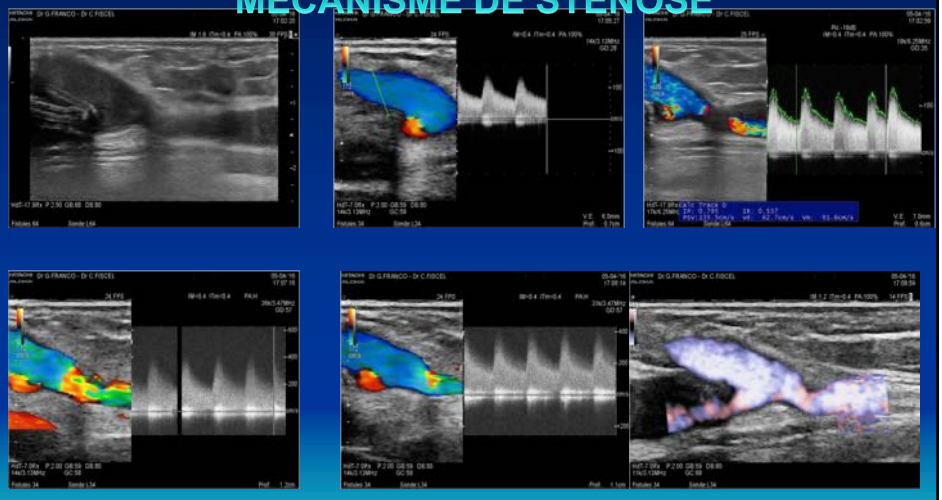
- DEGENERESCENCE/ STENOSE

STENT:

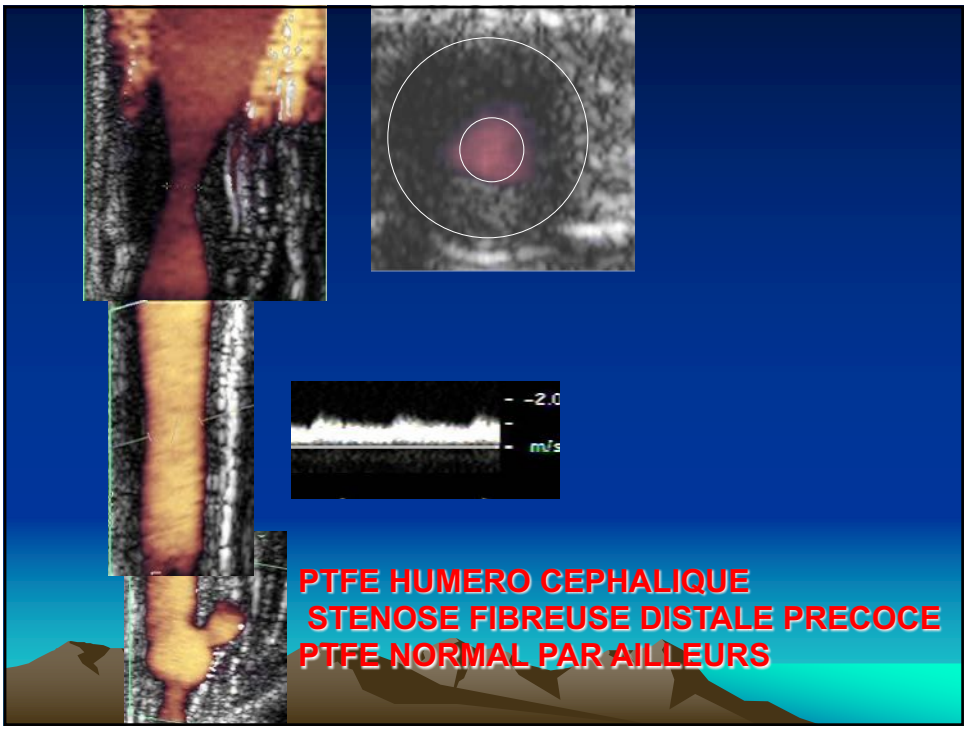
- HYPERPLASIE FIBREUSE
- FRACTURE
- PERFORATION

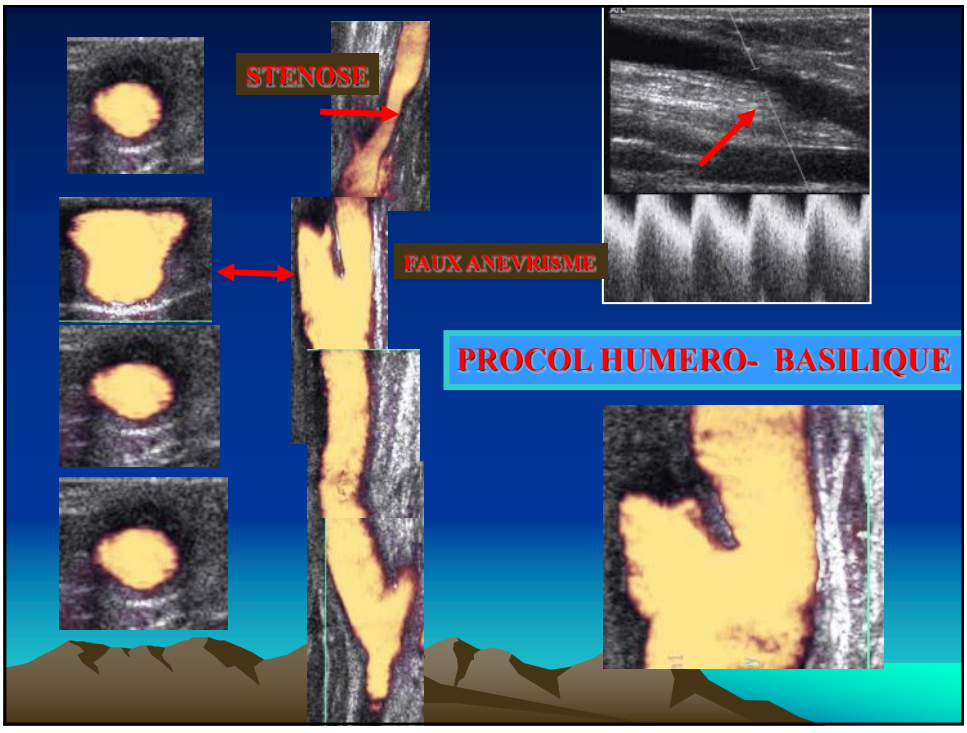
ST PTFE HUMERO AXILLAIRE

MECANISME DE STENOSE



MISTMACH DE COMPLIANCE PTFE /VEINE


PTFE HUMERO CEPHALIQUE
STENOSE FIBREUSE DISTALE PRECOCE
PTFE NORMAL PAR AILLEURS


STENOSE
FAUX ANEVRISME
PROCOL HUMERO- BASILIQUE

CONTRÔLE DES PROCEDURES

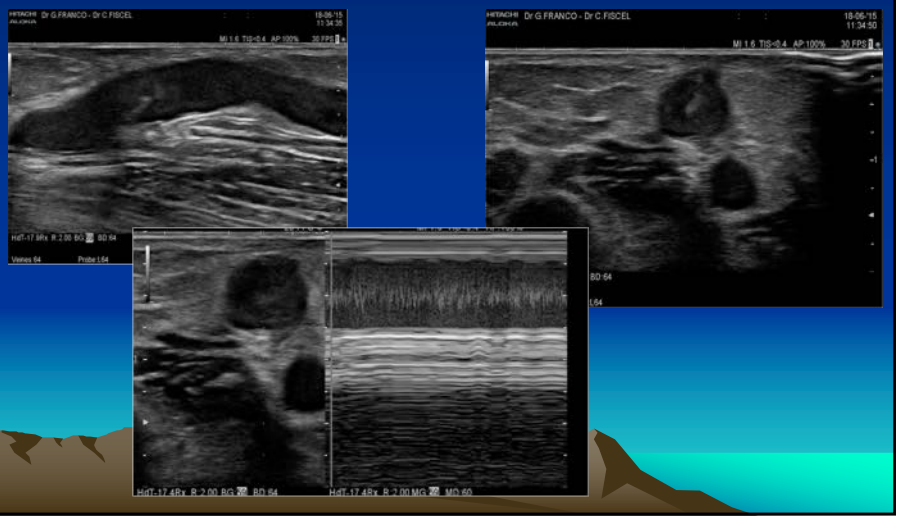
DESOBSTRUCTION

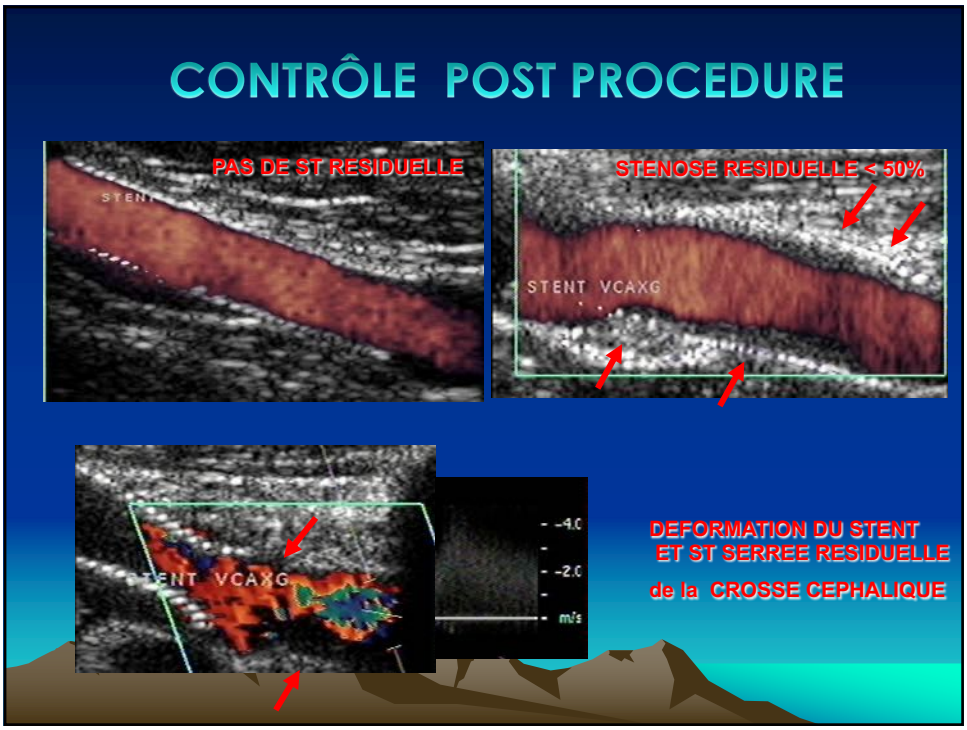
ANGIOPLASTIE +/- STENT

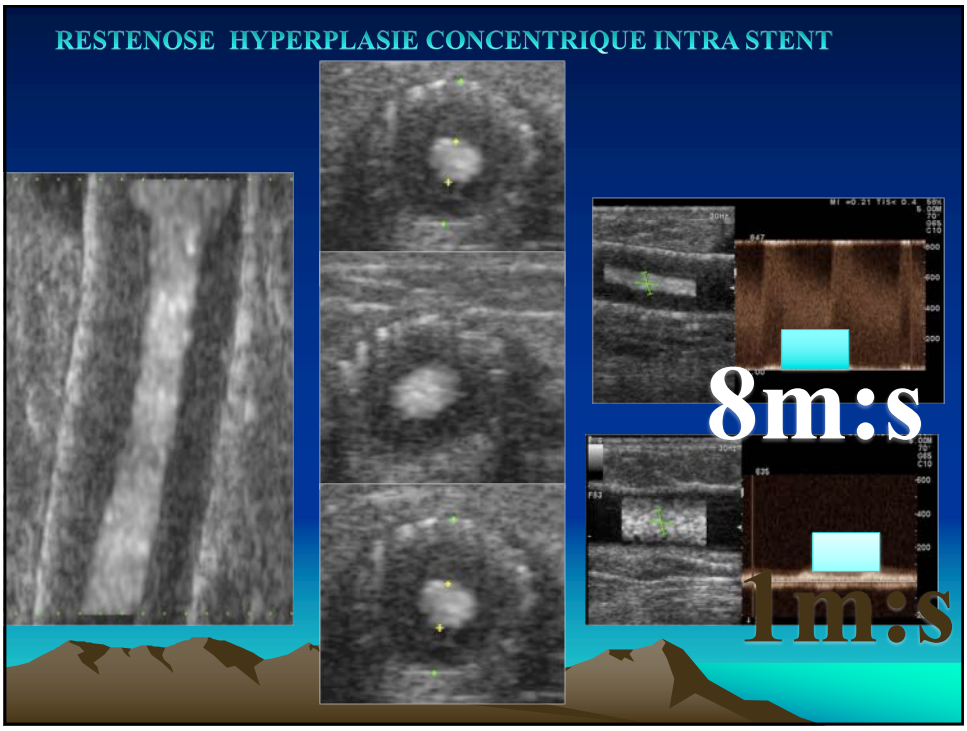
REPRISE DEFAV

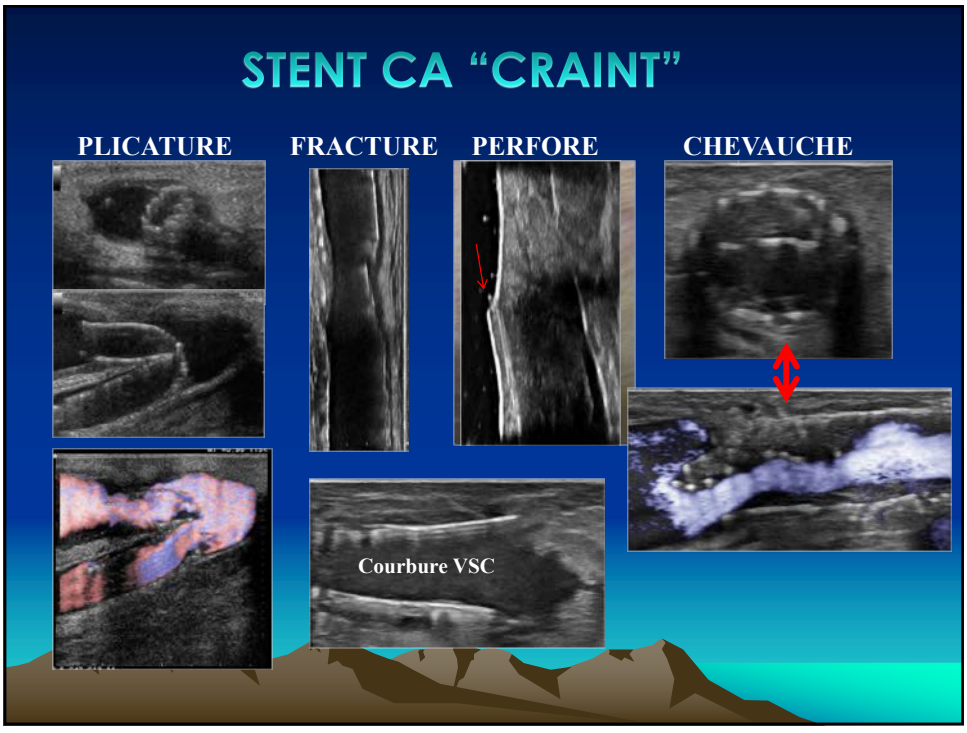
FLAP POST ATL ST VEINEUSE AAV

NON DECRIT à la FISTULOGRAPHIE




CONTRÔLE POST PROCEDURE
PAS DE ST RESIDUELLE
STENT
STENOSE RESIDUELLE < 50%
STENT VCAXG
STENT VCAXG
-4.0
-2.0
m/s
DEFORMATION DU STENT
ET ST SERREE RESIDUELLE
de la CROSSE CEPHALIQUE

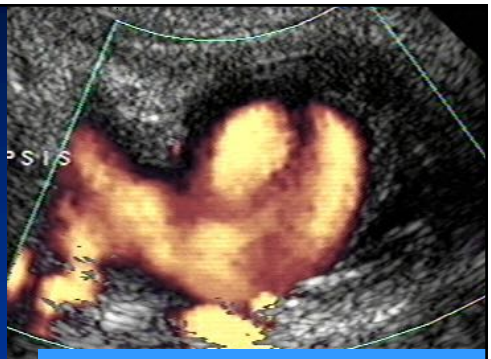

RESTENOSE HYPERPLASIE CONCENTRIQUE INTRA STENT
8m:s
1m:s


STENT CA "CRAINT"
PLICATURE
FRACTURE
PERFORE
CHEVAUCHE
Courbure VSC

ANOMALIES MORPHOLOGIQUESDIVERSES

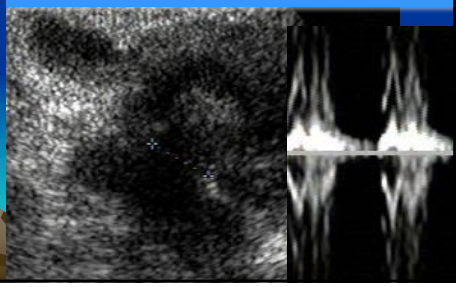
HEMATOME
SEROME
ANEVRISME
FX ANEVRISME
SEPSIS
LYMPHOCELE

FX ANEVRISME POST DILAT

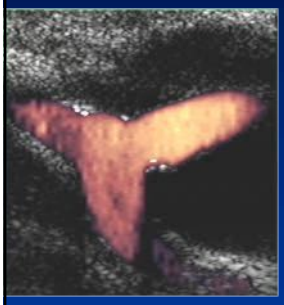


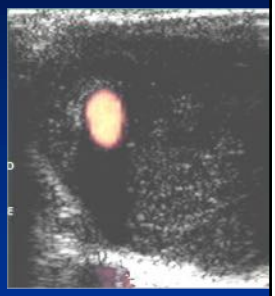
FX ANEVRISME PTFE INTRA CAPS

Faux anevrisme septique
fav fermee

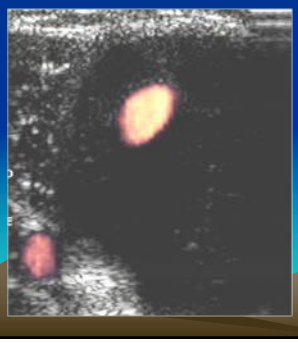


SEROME PERIPROTHETIQUE





PTFE



DIAGNOSTIC DIFFERENTIEL
fx anévrisme
sepsis
lymphocèle

HEMATOME POST PONCTION PROTHESE

GOUTTIERE BICIPITALE

CONCLUSION

« On ne trouve que ce que l'on cherche

On ne cherche que ce que l'on connaît »