

Caractériser les sténoses veineuses par écho-Doppler

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Sténose veineuse fistule AV ≠ Sténose artérielle

■ Carotide (ex.)



Difference between NASCET and ECST in measurement of internal carotid artery stenosis

External carotid artery	Internal carotid artery	NASCET	ECST
30	65		
40	70		
50	75		
60	80		
70	85		
80	91		
90	97		

Approximate equivalent degrees of internal carotid artery stenosis used in NASCET and ECST according to recent direct comparisons

NASCET	A-B/A	ECST	C-B/C
0-29	<10	0-29	<10
30-49	10-19	30-49	10-19
50-59	20-29	50-59	20-29
60-69	30-39	60-69	30-39
70-79	40-49	70-79	40-49
80-89	50-59	80-89	50-59
90-99	60-69	90-99	60-69
100	70-79	100	70-79

Stenosis	ICA PSV (cm/s)	ICA EDV (cm/s)	CCA/ICA PSV Ratio
0-29	<100	<40	<3.2
30-49	110-130	<40	<3.2
50-59	>130	<40	<3.2
60-69	>130	40-110	3.2 to <4.0
70-79	>210	120-140	≤4.0
80-95	>210	>140	≤4.0
96-99	String flow	String flow	String flow
100	Occluded	Occluded	Occluded

Note:—CCA indicates common carotid artery; EDV, end diastolic velocity.

■ FAV



Problématique clinique

- **Pouvoir dialyser de façon efficace**

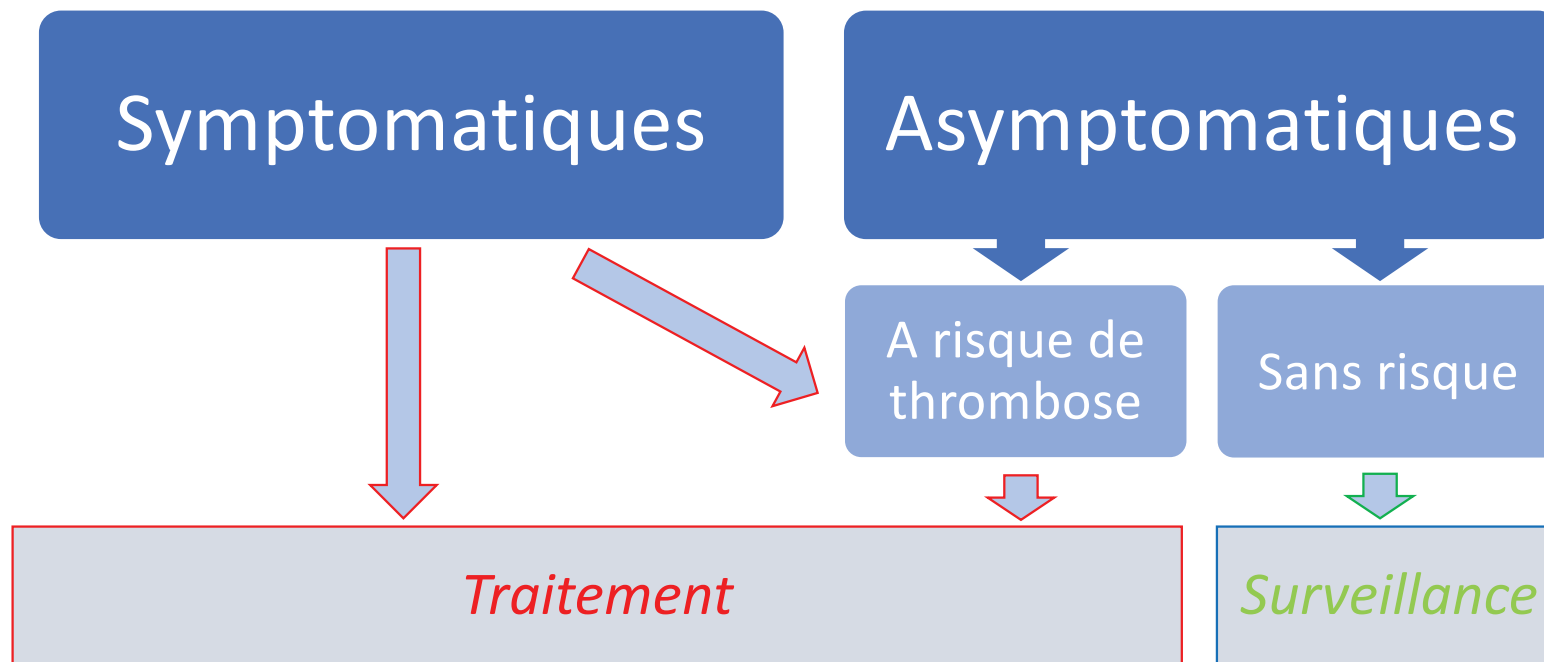
- Ponctionner... à deux aiguilles
- Débit suffisant
- Constantes acceptables
 - PV
 - PA
- $Kt/V > 1.4$



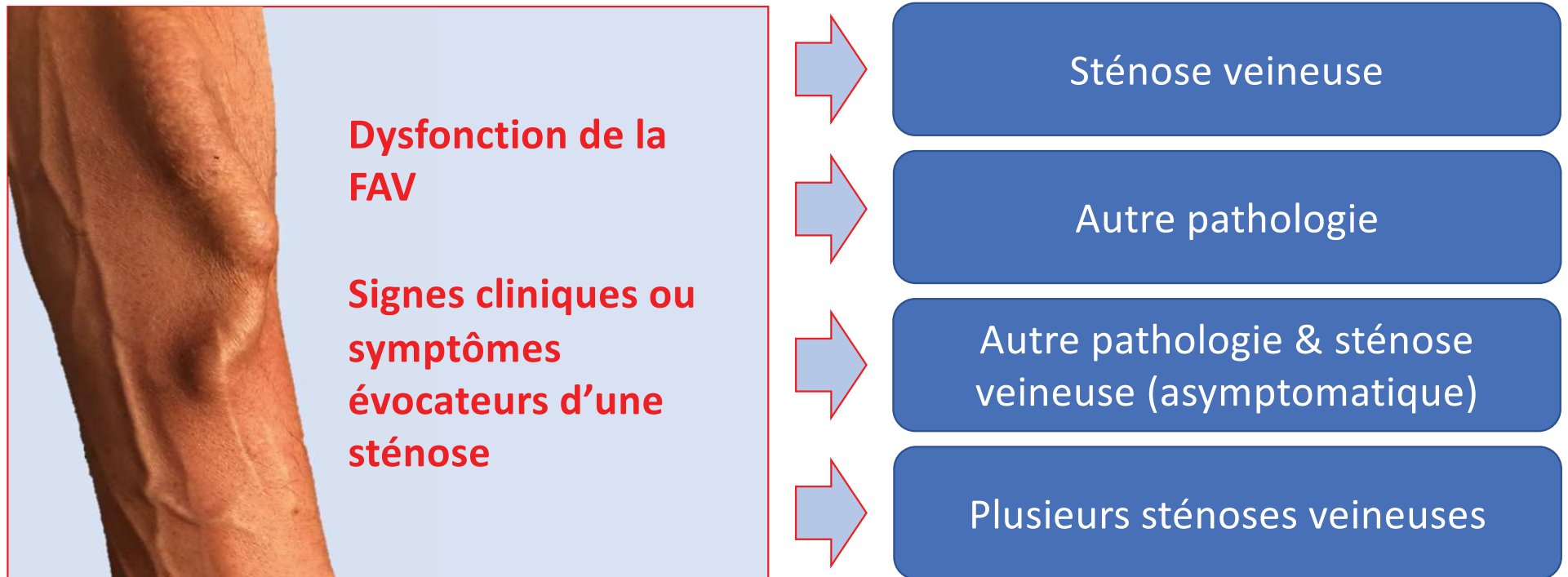
- **Eviter la survenue d'une thrombose**



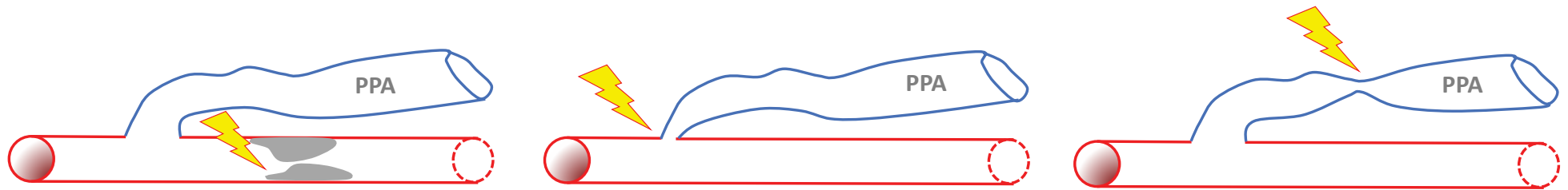
Classification des sténoses veineuses



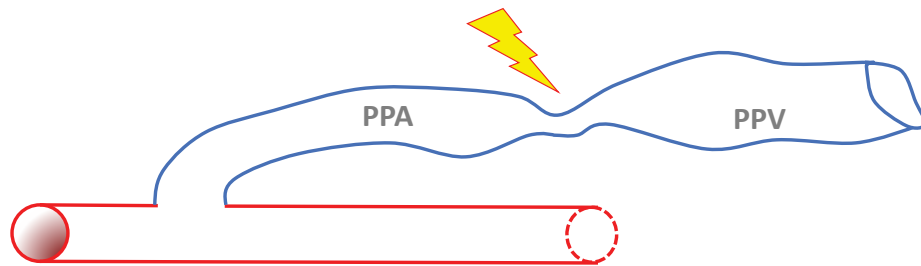
Imputabilité des sténoses veineuses



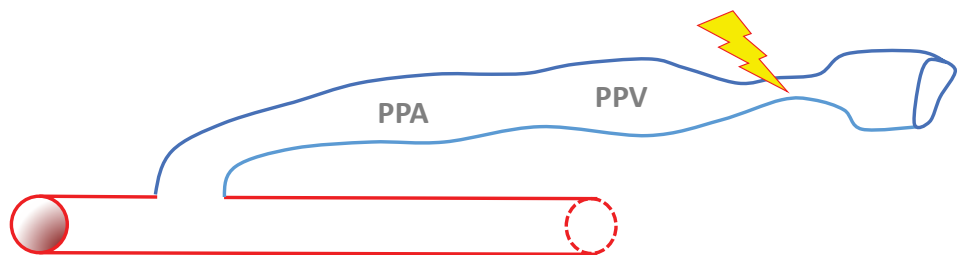
Conséquences de la localisation de la sténose



☞ **Hypo débit**



☞ **Dialyse normale**

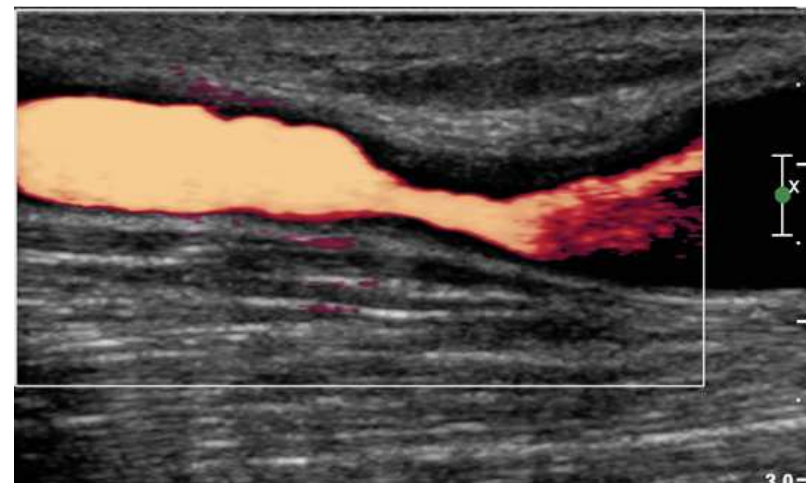
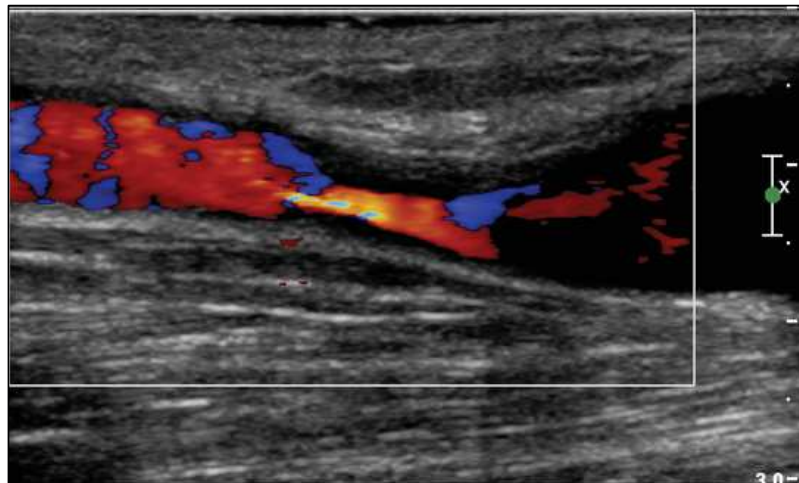
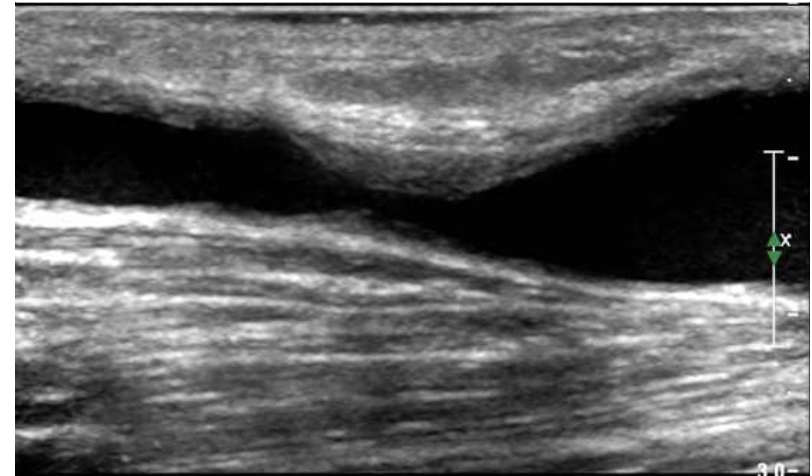


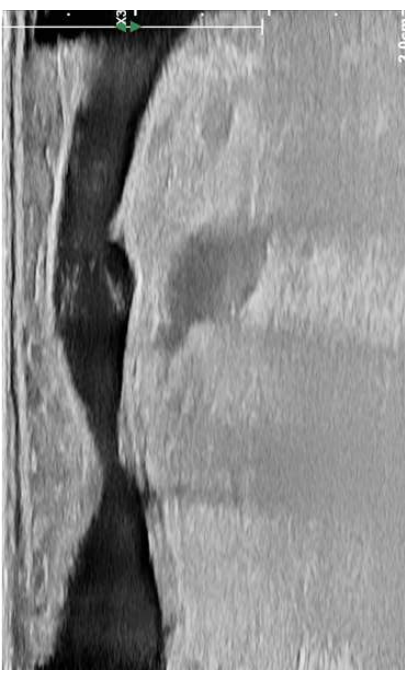
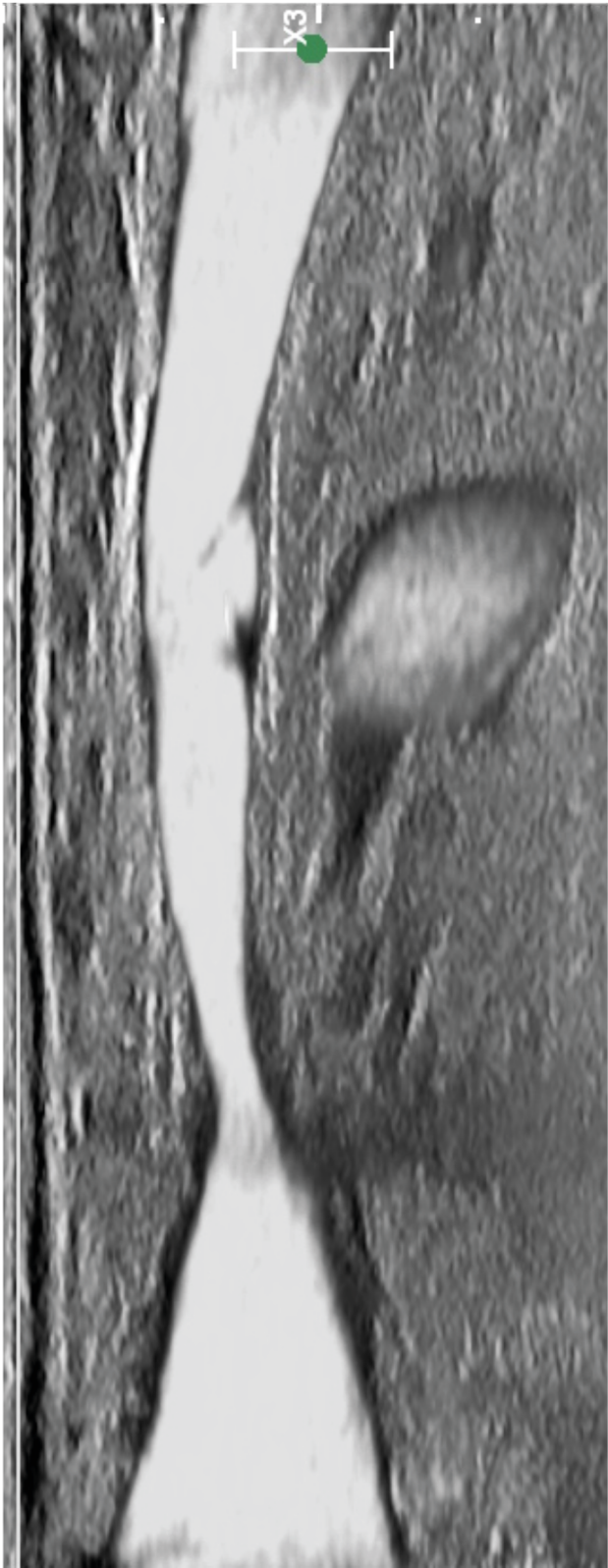
☞ ↗ **Pression veineuse**

Diagnostic des sténoses

■ Dépistage:

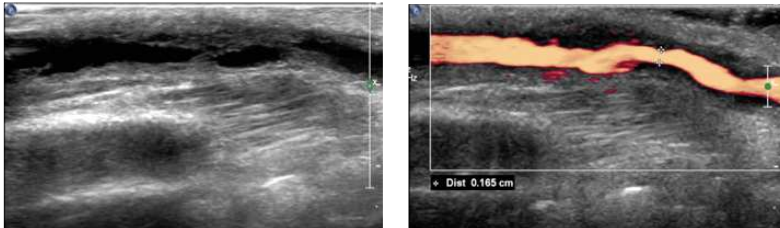
- Anatomique mode B
- Hémodynamique
 - Mode couleur
 - Mode énergie



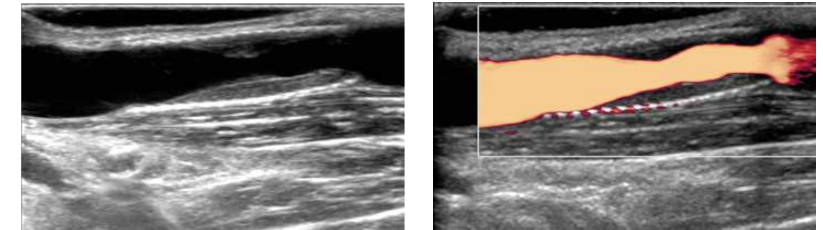


■ Caractérisation du type anatomique

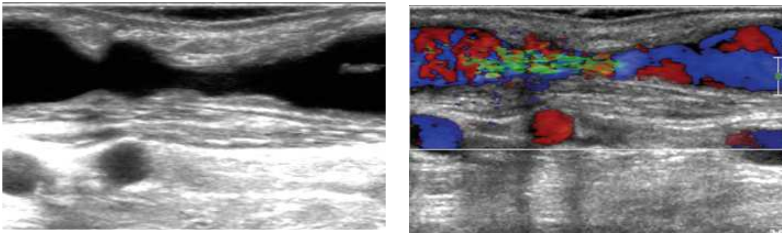
Hyperplasie
intimale



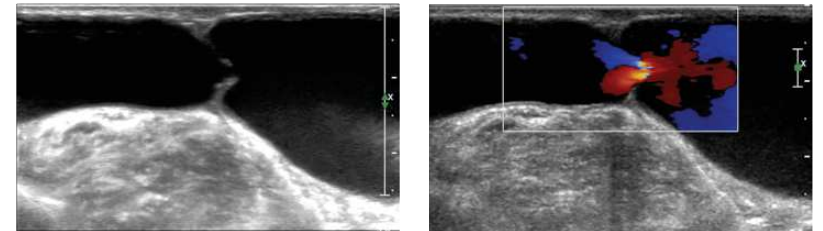
Hyperplasie
intimale
(sténose
endo stent)



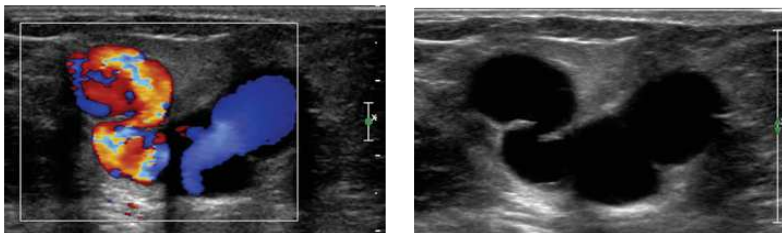
Fibrose
pariétale



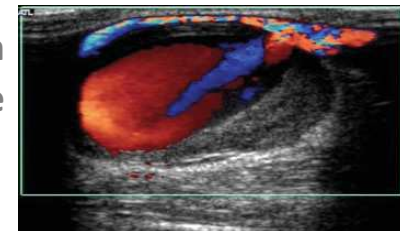
Fibrose
valvulaire



Plicature

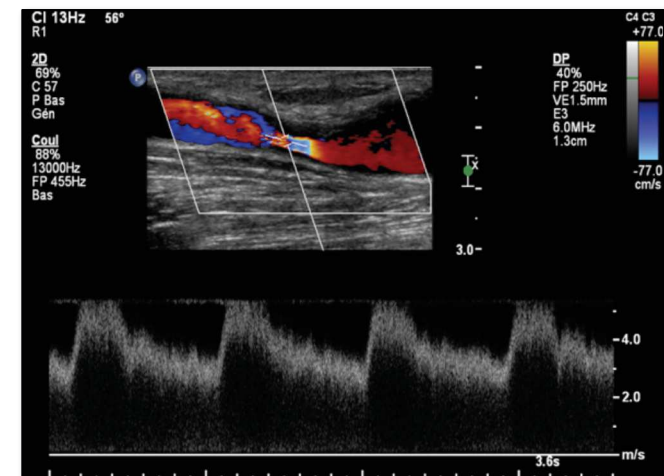


Compression
extrinsèque



■ Paramètres de quantification:

- Diamètre de la lumière veineuse
- % de sténose
- Pic de vitesse systolique max
- Ratio de vitesse



ED versus phlébographie

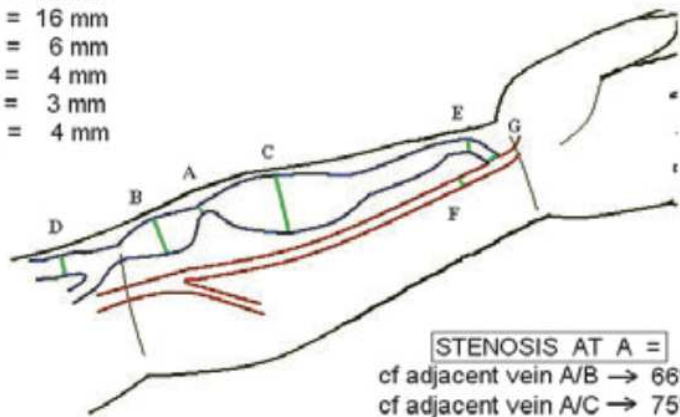
	Degrés sténose	Patients AAV (n=)	Diam. (mm)	PVS (cm/s)	Ratio	Sens. (%)	Spé. (%)	Agré-ment
Chandra Nephrology 2010	N 50-75 % > 75 %	93 patients	> 3 3- 1.5 < 1.5					85 - 96
Grogan JVS 2005	> 50%	54 patients			> 2	93	94	
Raju Ann Vasc Dis 2013	> 50 %	51 patients			> 2	95.5	57.1	
Steven Ann V Surg 2016	> 50%	40 patients 50 AAV		400 500	2.2 3	60 52	86 91	
Wo Ann V Surg 2017	> 50%	780 AAV		500	NA	89		

Limites de la quantification

■ Quantification en % de sténose

A = 4 mm
B = 12 mm
C = 16 mm
D = 6 mm
E = 4 mm
F = 3 mm
G = 4 mm

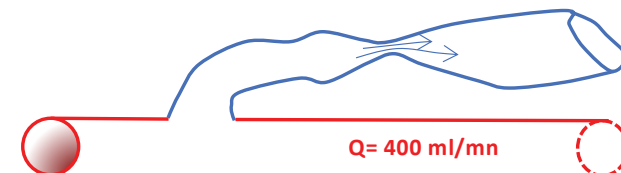
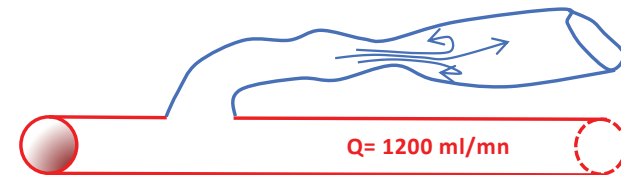
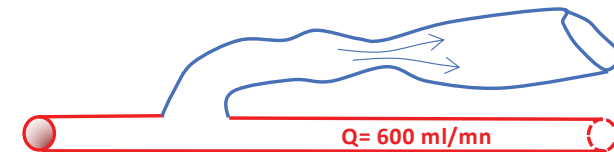
STENOSIS AT A = -25% to +75%



STENOSIS AT A =

cf adjacent vein A/B → 66%
cf adjacent vein A/C → 75%
cf outflow vein A/D → 30%
cf inflow vein A/E → 0%
cf inflow artery A/F → -25%

■ Quantification hémodynamique

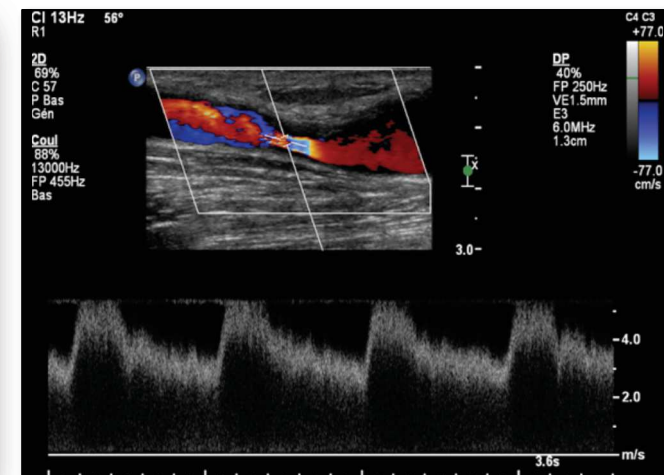
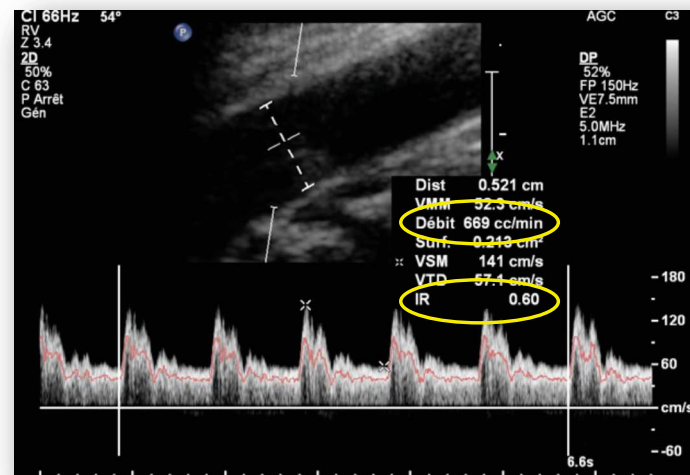


Fahrtash F et al. Defining a Significant Stenosis in an Autologous Radio-Cephalic Arteriovenous Fistula for Hemodialysis. Seminars in Dialysis 2011

Diagnostic des sténoses

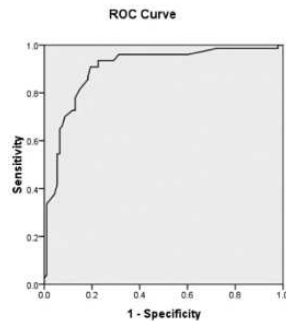
■ Paramètres de quantification:

- Diamètre de la lumière veineuse
- % de sténose
- Pic de vitesse systolique max
- Ratio de vitesse
- Débit FAV
- IR



Critères ED des sténoses symptomatiques

	Dysfonction FAV	FAV normale	p
n =	93	77	
Ancienneté dialyse (mois)	32.4 ± 24.8	60.9 ± 50.9	0.001
Diamètre minimal (mm)	2.19 ± 1.41	4.71 ± 2.83	0.001



- **Valeur seuil: 2.7 mm**
- Valeur prédictive positive: 92%
- Valeur prédictive négative: 80%

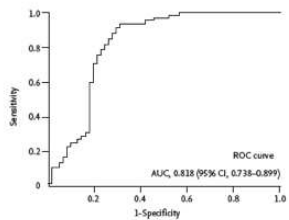
Fahrtash F et al. Defining a Significant Stenosis in an Autologous Radio-Cephalic Arteriovenous Fistula for Hemodialysis. Seminars in Dialysis 2011

Critères ED des sténoses symptomatiques

- Etude rétrospective 127 patient (65 PTA vs 62 non PTA)

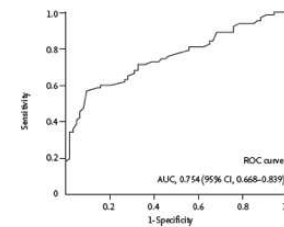
Table 1. Background data of patients

Variable	PTA (n = 65) ^a	Non-PTA (n = 62) ^b	p value
Age, yr	63.5 ± 11.2	63.8 ± 14.8	NS
Female sex	31 (47.7)	29 (46.8)	NS
Diabetes mellitus	36 (55.4)	18 (29.0)	0.004
AVF vintage, mon	14.6 ± 36.6	36.7 ± 40.8	0.000
Follow-up, mon	27.0 ± 15.9	27.0 ± 17.1	NS
Maturing AVF ^c	6 (9.2)	4 (6.5)	NS
Upper arm fistula	27 (41.5)	22 (35.5)	NS
Brachial artery FV, mL/min	653.0 ± 501.6	1134.8 ± 508.8	0.000
Brachial artery RI	0.62 ± 0.14	0.50 ± 0.10	0.000



Cut-off value, mL/min	1-Specificity	Sensitivity	Likelihood ratio
612.9	0.062	0.694	11.27

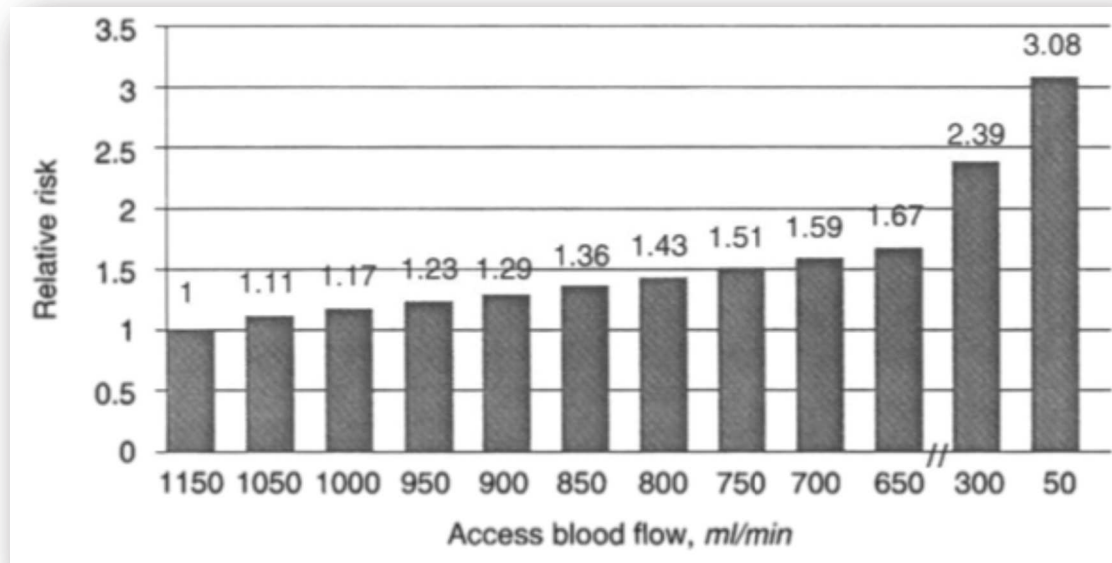
- **Débit: 612,9 ml/mn**
AUC: 0.818



Cut-off value	1-Specificity	Sensitivity	Likelihood ratio
0.63	0.062	0.435	19.10

- **IR: 0,63**
AUC: 0.754

Critères ED des sténoses à risque de thrombose ?



May RE et al. Predictive measures of vascular access thrombosis: a prospective study. *Kidney Int*, 1997

4.4 When to refer for evaluation (diagnosis) and treatment:

- 4.4.1 One should not respond to a single isolated abnormal value. With all techniques, prospective trend analysis of the test parameter has greater power to detect dysfunction than isolated values alone. (A)
- 4.4.2 Persistent abnormalities in any of the monitoring or surveillance parameters should prompt referral for access imaging. (A)
- 4.4.3 An access flow rate less than 600 mL/min in grafts and less than 400 to 500 mL/min in fistulae. (A)
- 4.4.4 A venous segment static pressure (mean pressures) ratio greater than 0.5 in grafts or fistulae. (A)

National Kidney Foundation: KDOQI. Vascular Access 2006 Work group. Clinical practice guidelines for vascular access. *Am J Kidney Dis*. 2006

KDOQI 2019



Surveillance to Facilitate Patency

13.4 There is inadequate evidence for KDOQI to make a recommendation on routine AVF surveillance by measuring access blood flow, pressure monitoring, or imaging for stenosis, that is additional to routine clinical monitoring, to improve access patency.

Note: In other words, monitoring of vascular access is primary, while surveillance findings are supplementary, and action should not be based solely on surveillance findings.

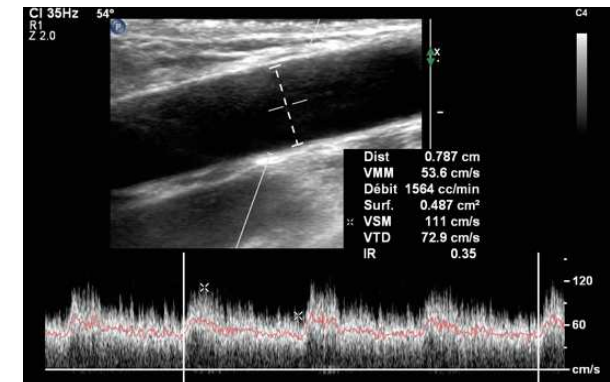
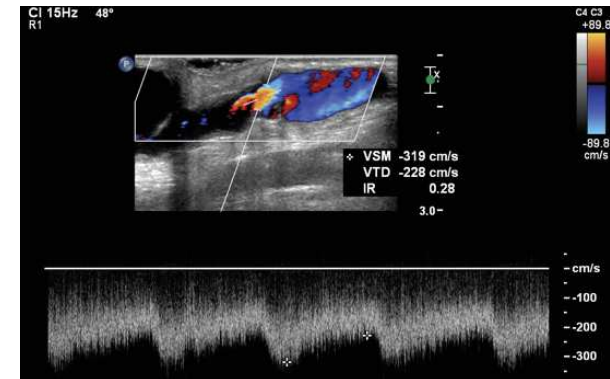
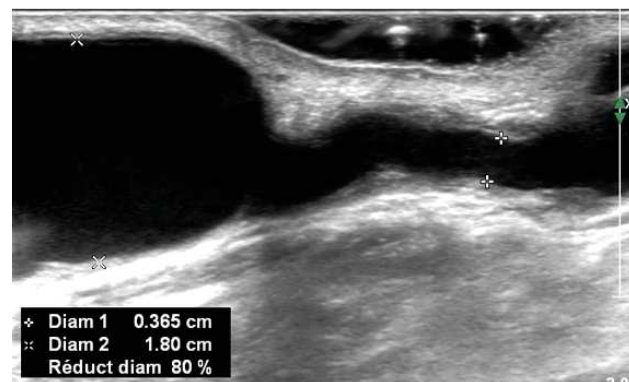
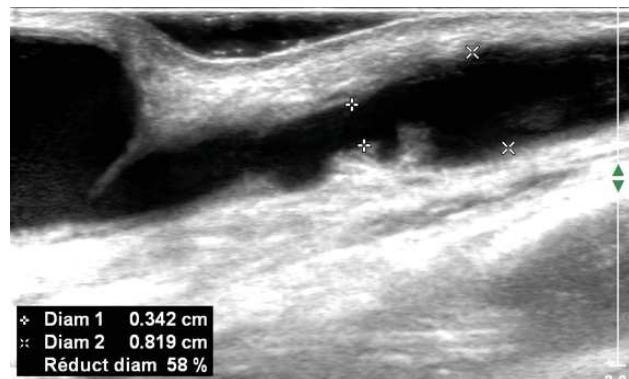
Endovascular Intervention to Improve Patency

13.6 KDOQI does not recommend pre-emptive angioplasty of AVFs with stenosis, not associated with clinical indicators, to improve access patency. (Conditional Recommendation, Moderate Quality of Evidence)

13.7 KDOQI does not recommend pre-emptive angioplasty of AVGs with stenosis, not associated with clinical indicators, to improve access patency. (Conditional Recommendation, Moderate Quality of Evidence)

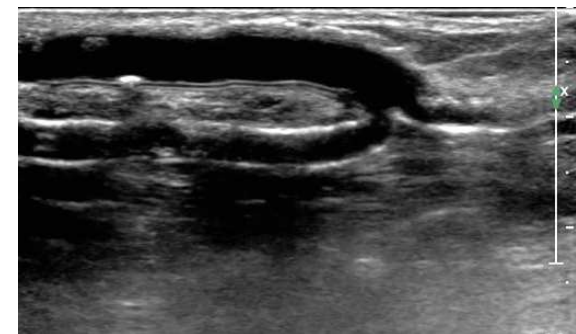
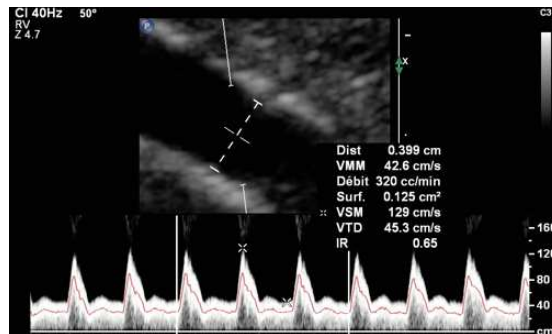
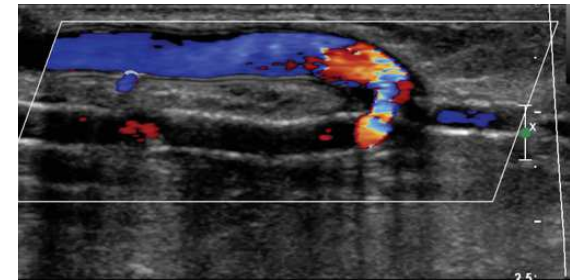
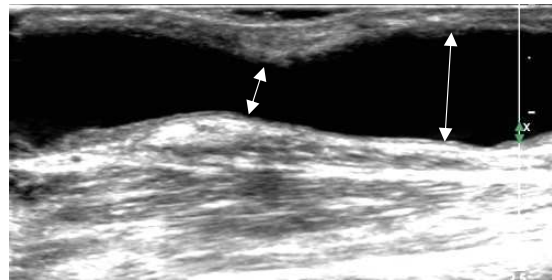
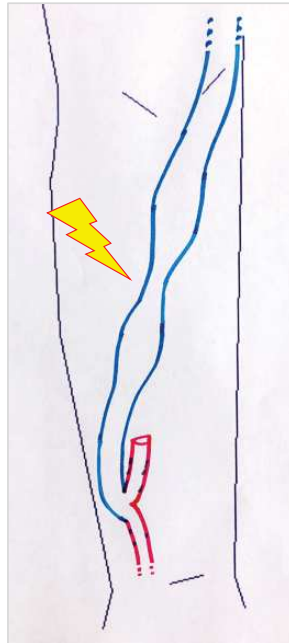
Patient asymptomatique - FAV fonctionnelle

■ Sténose 58-80 %



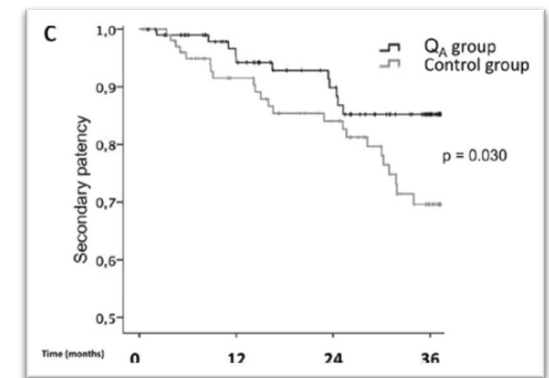
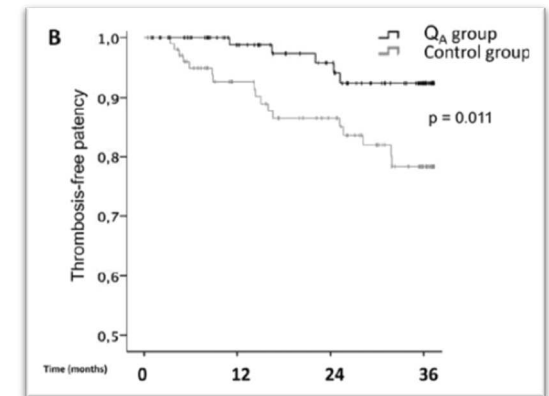
Patient asymptomatique - FAV fonctionnelle

- $Q < 400$ ml/n



Critères combinés: Sténose + hypodébit

- Surveillance clinique seule (104) versus surveillance clinique & ED & Transonic (103)
- **Critères d'intervention:**
 - Débit < 500 ml/mn ou diminution $\geq 25\%$
 - et/ou sténose > 50%
 - avec PSV > 400 cm/s ou ratio >3
- **Taux de thrombose:**
 - Contrôle : 0.086 /patient /an
 - Surveillance: 0.025 /patient /an



Aragoncillo I et al. Adding access blood flow surveillance reduces thrombosis and improves arteriovenous fistula patency: a randomized controlled trial. J Vasc Access 2017

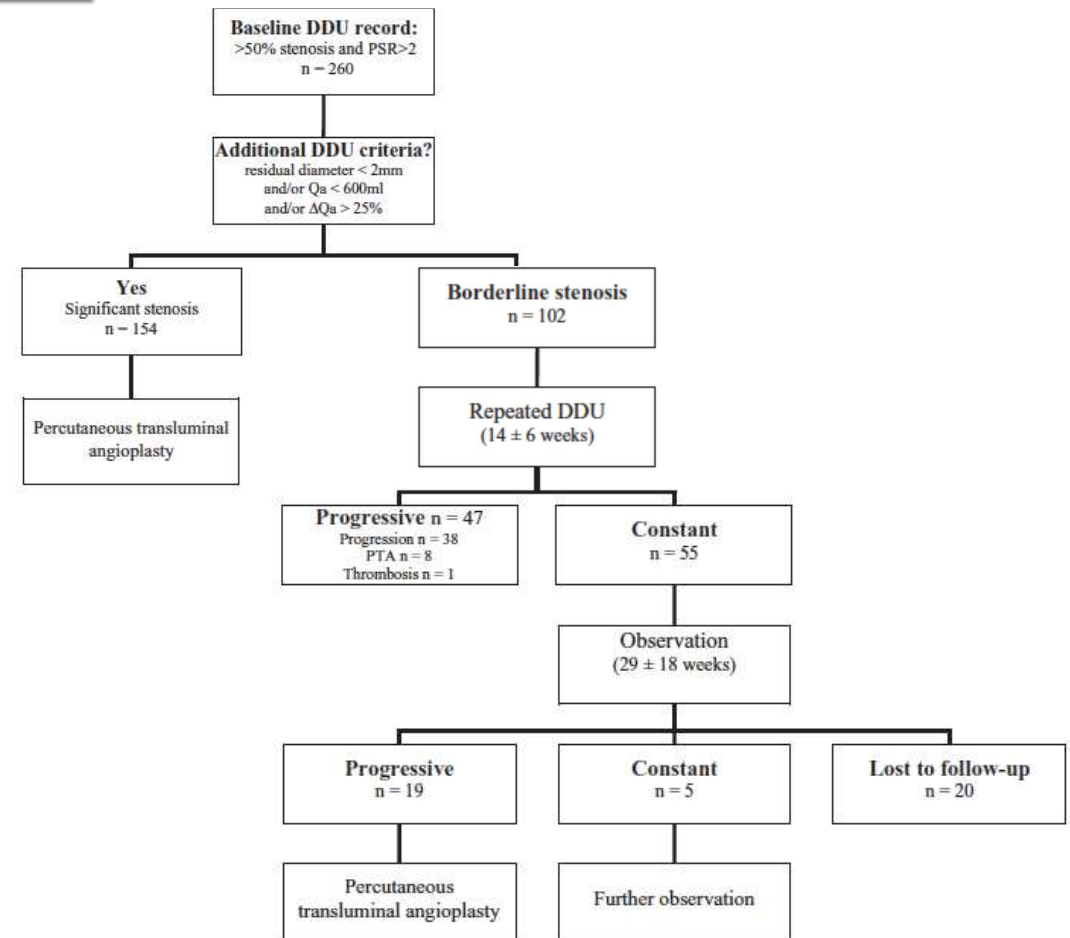
Sous groupes de sténoses

■ Sténoses « borderline »

- >50%
- Ratio de vitesse > 2

■ Sténoses « à risque »

- >50%
- Ratio de vitesse >2
- Débit:
 - < 600 ml/mn
 - Et/ou diminution $\geq 25\%$
- Diamètre résiduel < 2mm



ESVS Guidelines 2018

Recommendation 9	Class	Level	Refs
Duplex ultrasound is recommended as the first line imaging modality in suspected vascular access dysfunction.	I	B	120,123

Recommendation 45	Class	Level	Refs.
It is recommended that vascular access surveillance is performed by flow measurement of arteriovenous grafts monthly and arteriovenous fistulas every 3 months.	I	B	405,428,429

Recommendation 49	Class	Level	Refs.
Surveillance of arteriovenous fistulas with duplex ultrasound at regular intervals and pre-emptive balloon angioplasty should be considered to reduce the risk of arteriovenous fistula thrombosis.	Ila	A	385

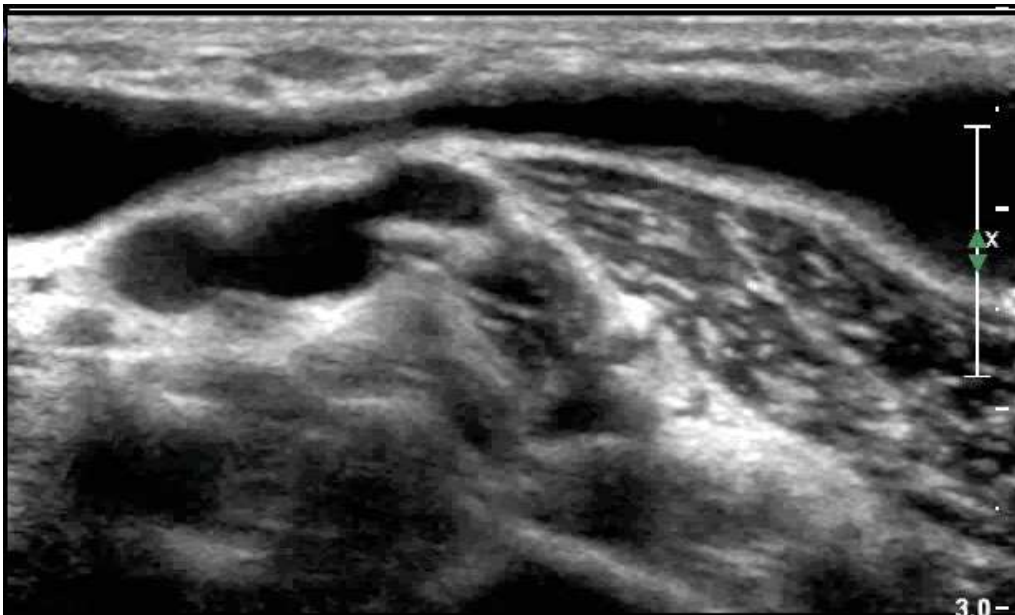
Schmidli J, Widmer MK, Basile C, de Donato G, Gallieni M, Gibbons CP et al. Editor's Choice - Vascular Access: 2018 Clinical Practice Guidelines of the European Society for Vascular Surgery (ESVS). *Eur J Vasc Endovasc Surg* 2018

KDOQI 2019

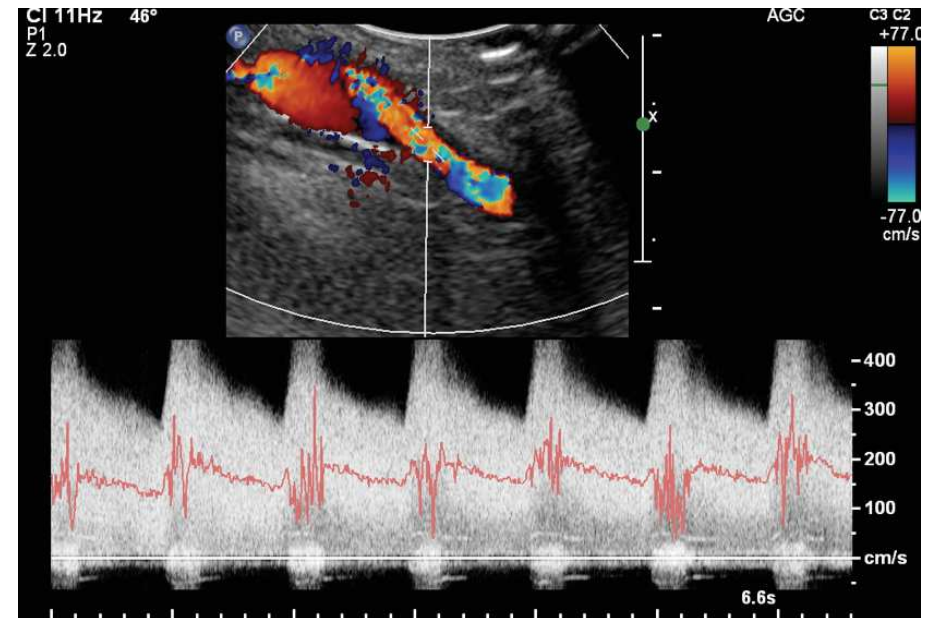
The Work Group recognizes that duplex ultrasound is valuable and has different characteristics than specific surveillance techniques for intra-access flow; however, the ERT evidence was limited. The Work Group encourages further research in all monitoring and surveillance techniques and strategies (see Future Research in this section).

Autres critères de sévérité des sténoses

- Effet Venturi

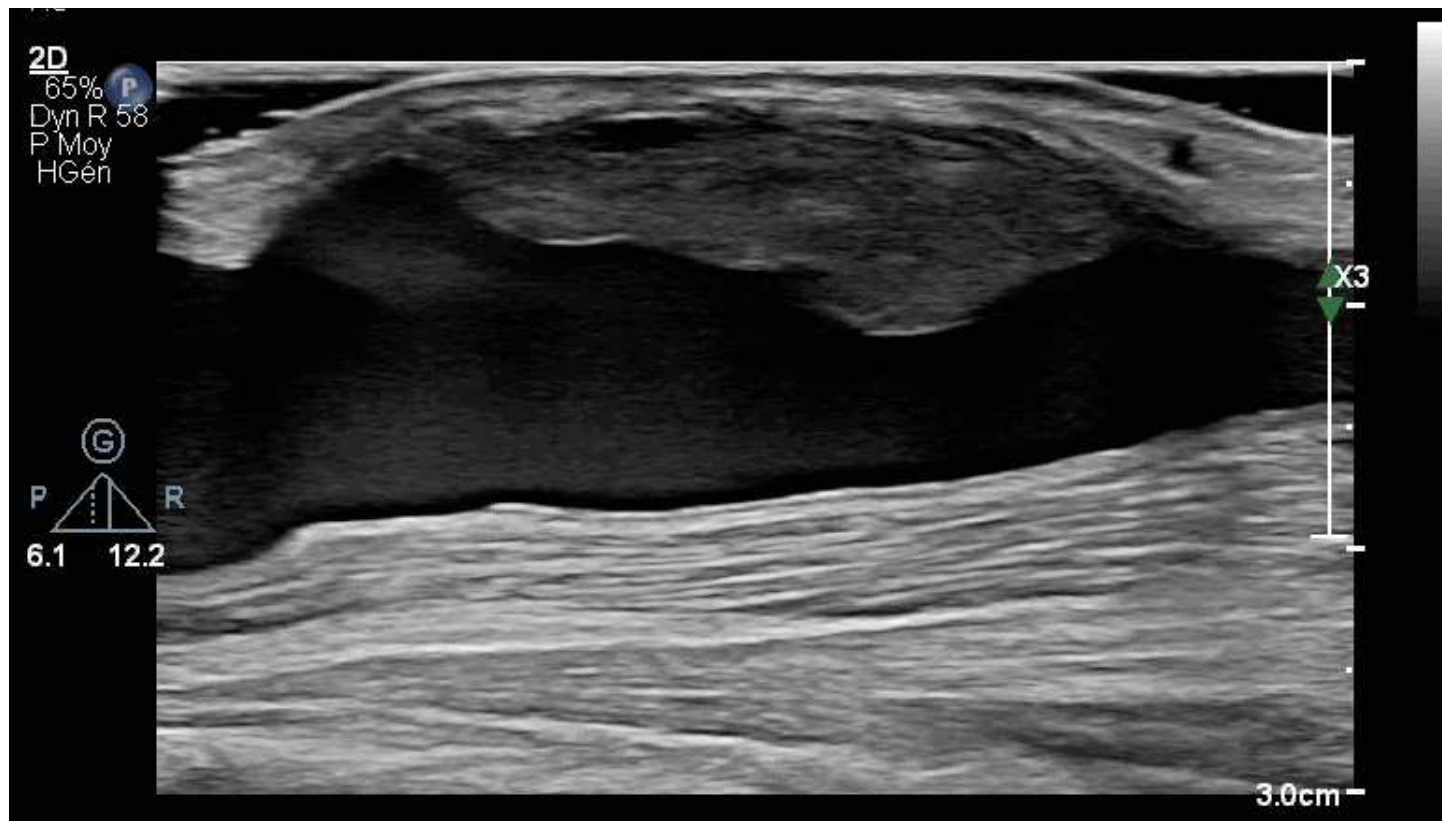


- Signal doppler « piaulant »



Autres critères de sévérité des sténoses

- Stase en aval de la sténose

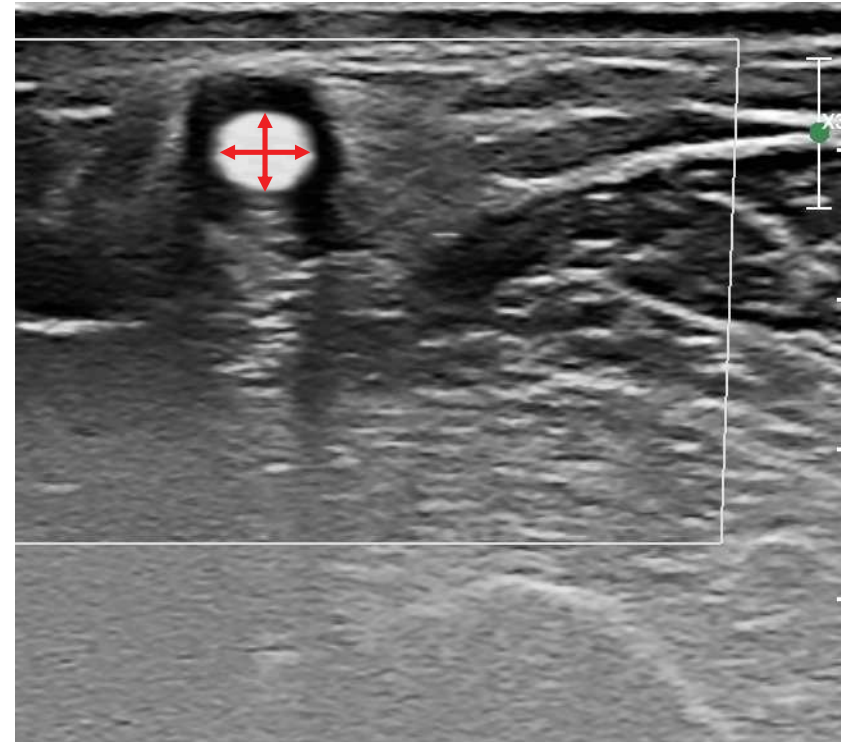
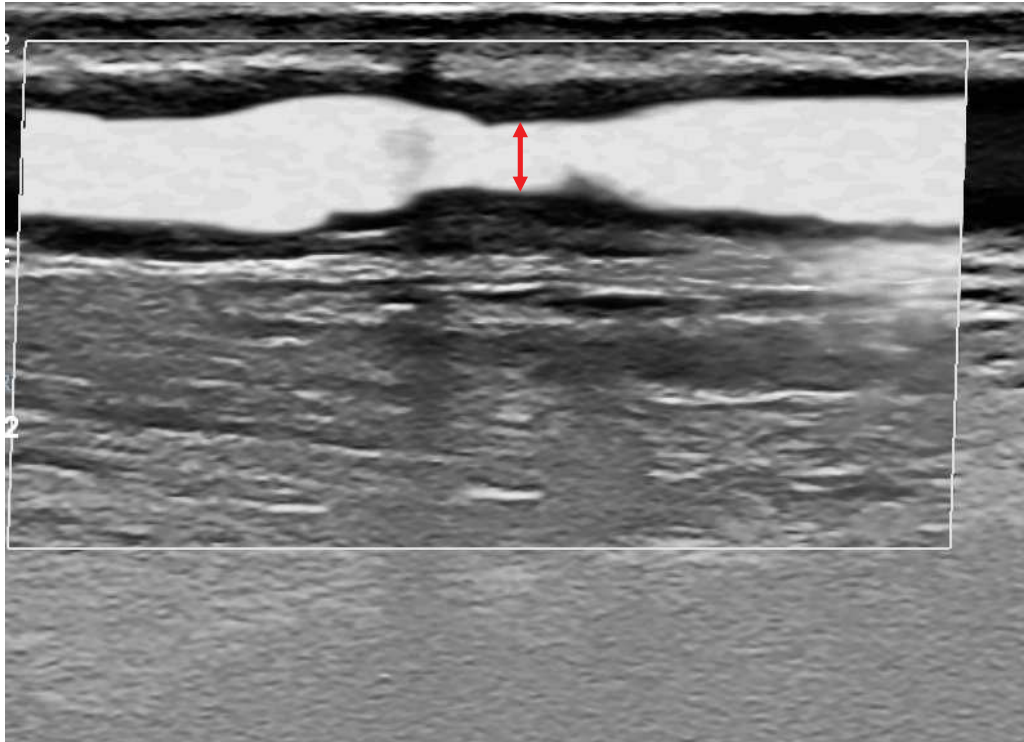


Pièges de la mesure du diamètre résiduel

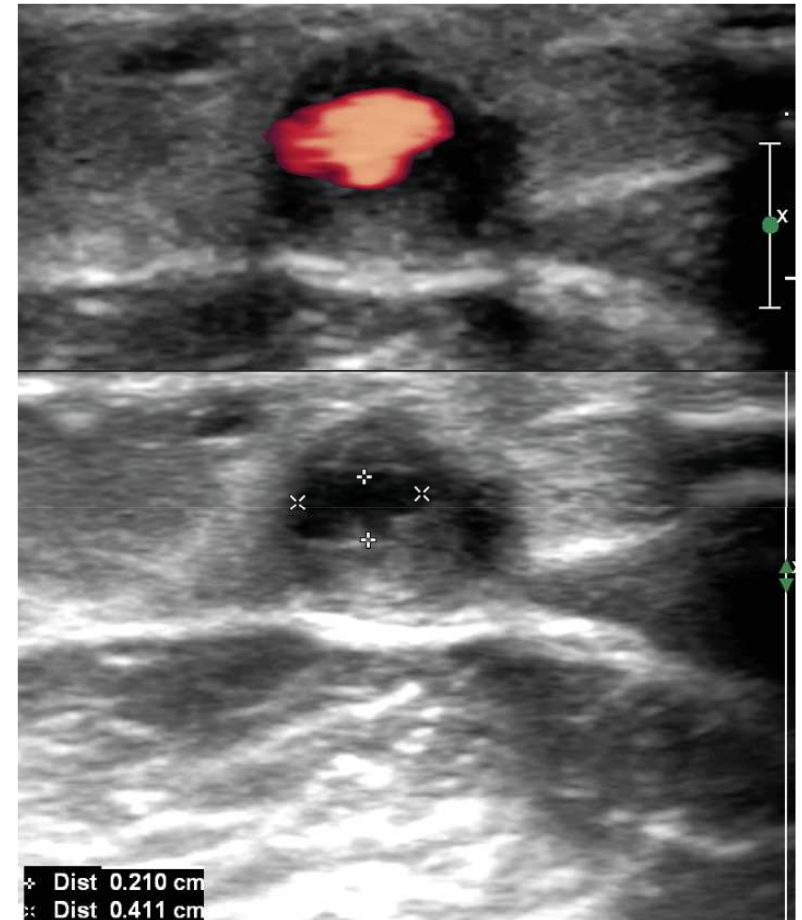
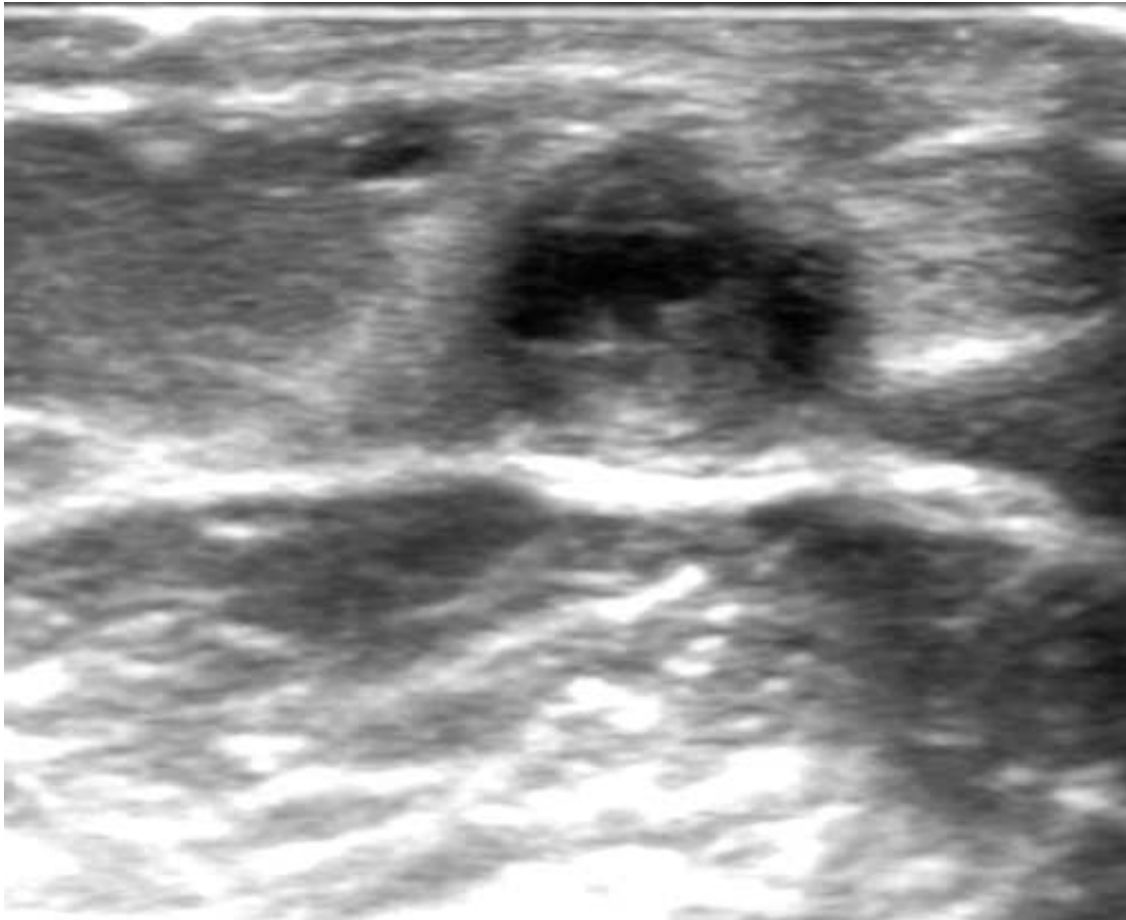
- Hyperplasie intimale



- **Hyperplasie intimale**

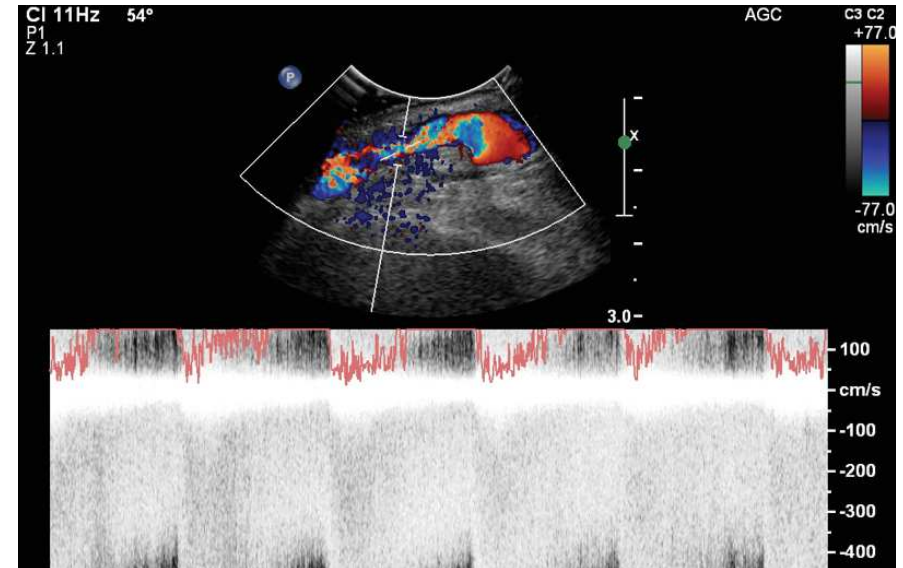
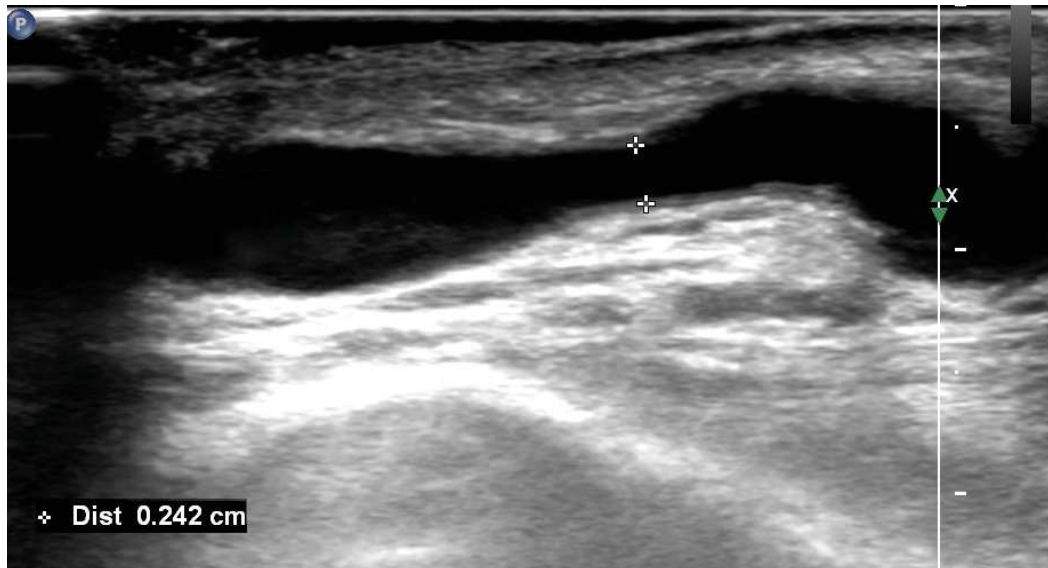


■ Hyperplasie intimale



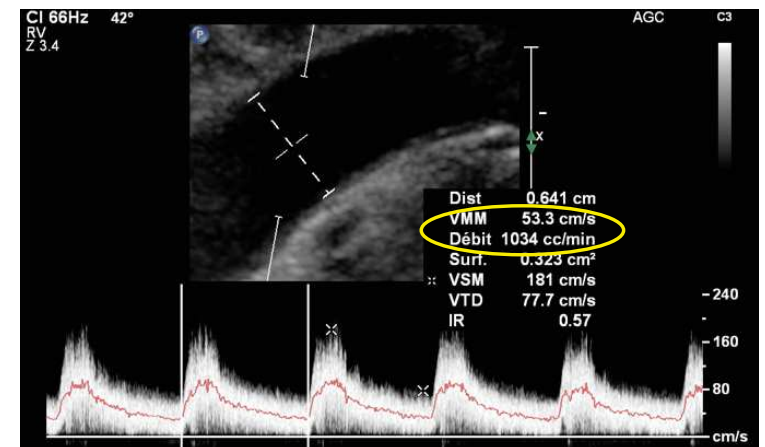
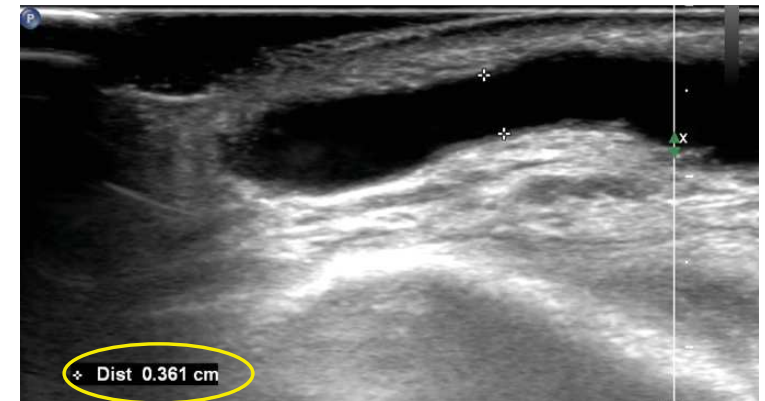
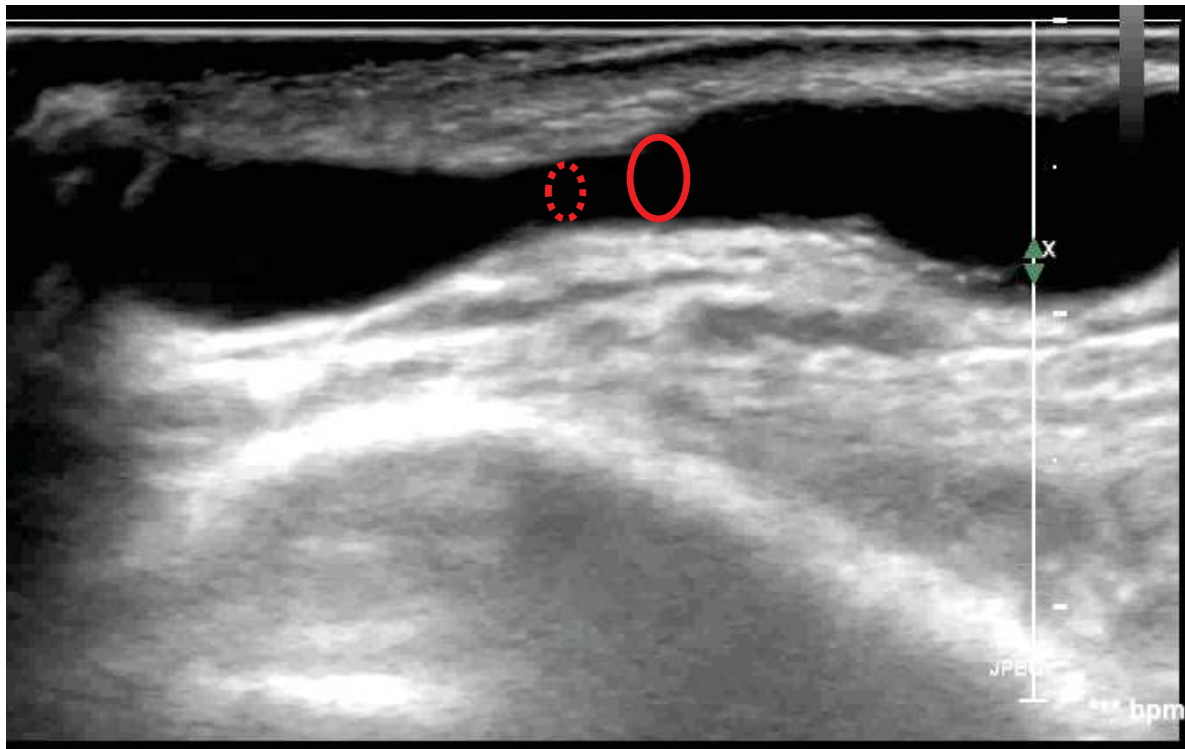
Pièges de la mesure du diamètre résiduel

- Sténoses « élastiques »

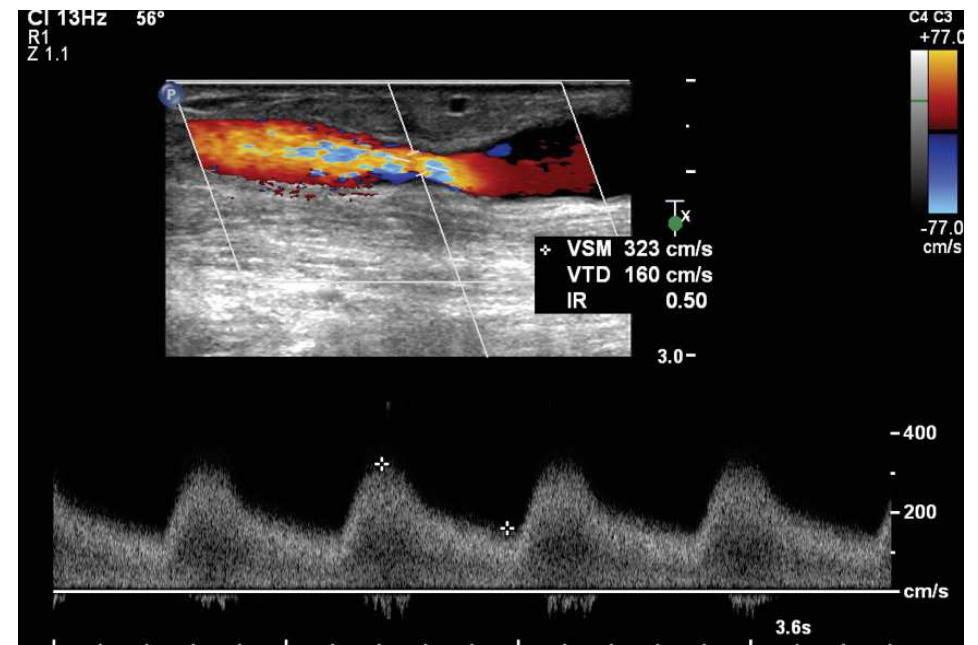
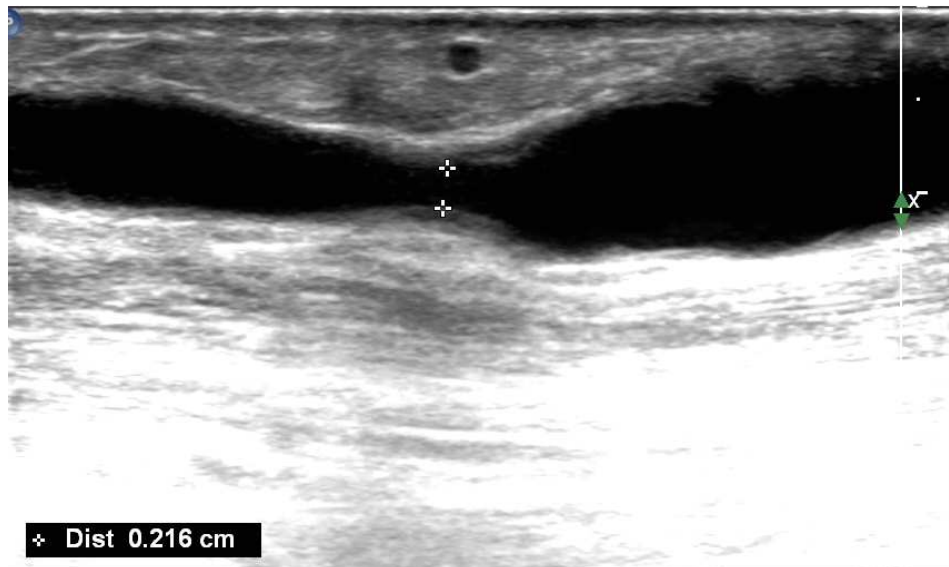


Pièges de la mesure du diamètre résiduel

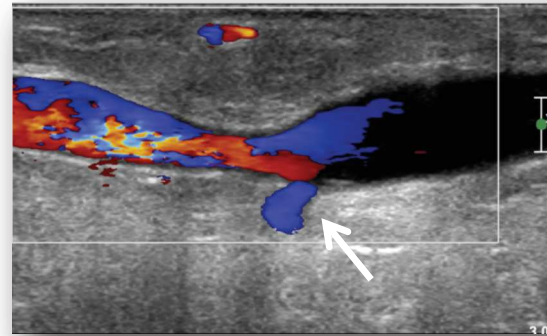
- Sténoses « élastiques »



Discordances diamètre résiduel & VSM

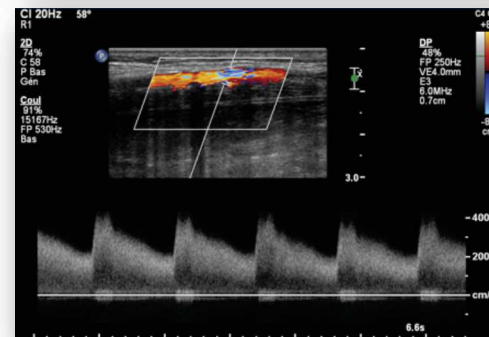


- Veine collatérale



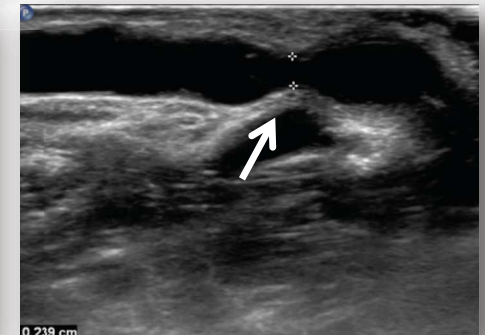
- Sténose proximale associée:

- Artère donneuse
- Anastomose



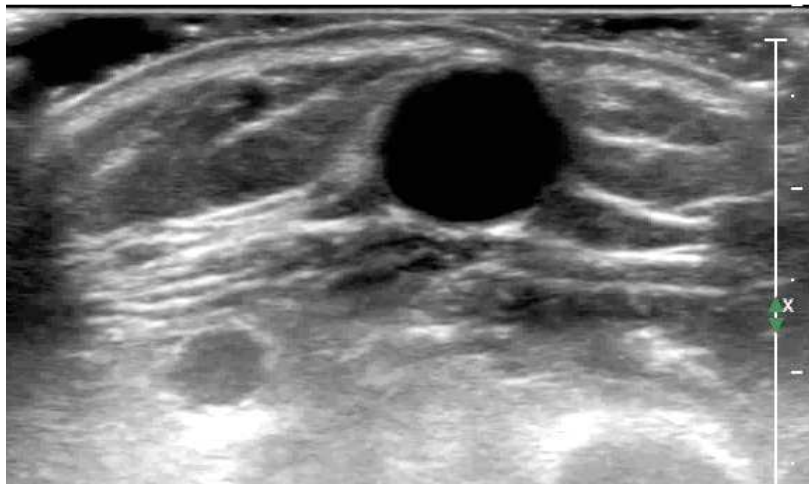
- Sténose veineuse distale:

- Veine périphérique
- Veines centrales



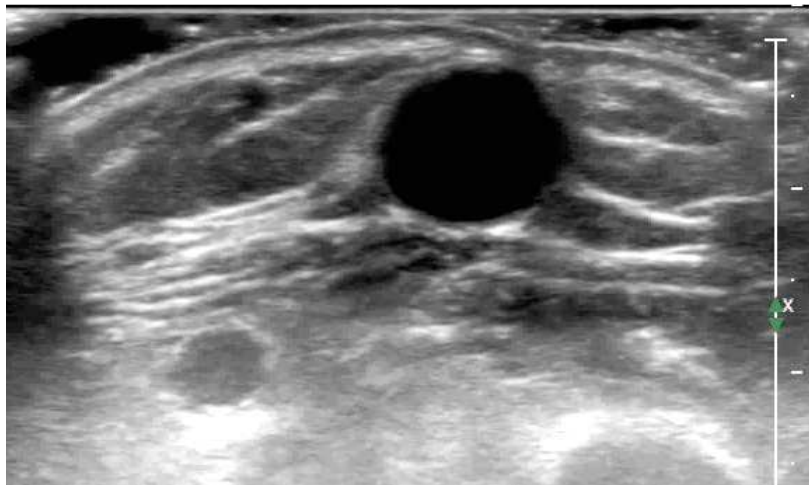
Manœuvre de compression: ED

- Pas de sténose en aval

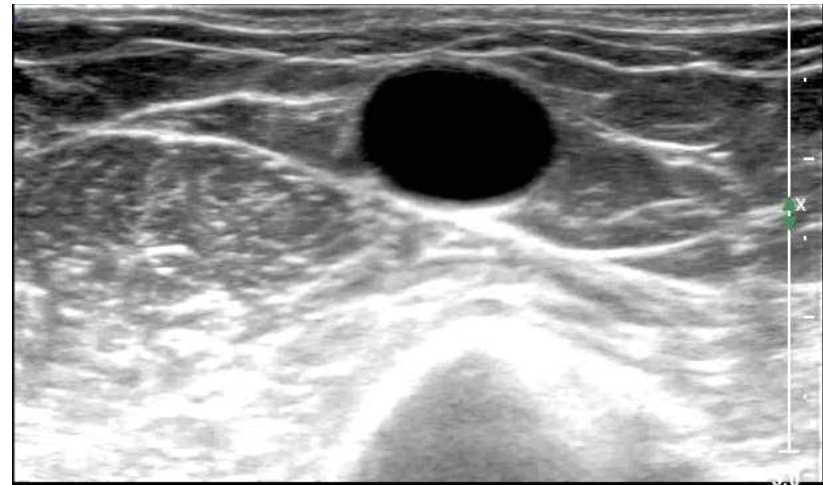


Manœuvre de compression: ED

- Pas de sténose en aval



- Sténose en aval



A retenir

- **Examen clinique +++**
- **Caractérisation multifactorielle des sténoses**
 - Débit
 - Diamètre lumière résiduelle (sous compression)
 - Vitesse max
- **Pathologies associées**
 - Plusieurs sténoses
 - Sténose + autres facteurs
- **Tenir compte**
 - Contexte néphrologique
 - Caractéristiques « basales » de la FAV
- **Cartographie**

