Αντιμετώπιση δυσλειτουργίας των αγγειακών προσβάσεων αιμοκάθαρσης: η πλευρά του επεμβατικού ακτινολόγου

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Αν. Καθηγητής Επεμβατικής Ακτινολογίας
Β’ Εργαστήριο Ακτινολογίας, Πανεπιστήμιο Αθηνών
“ΑΤΤΙΚΟΝ” Πανεπιστημιακό Γενικό Νοσοκομείο

Disclosure

- None

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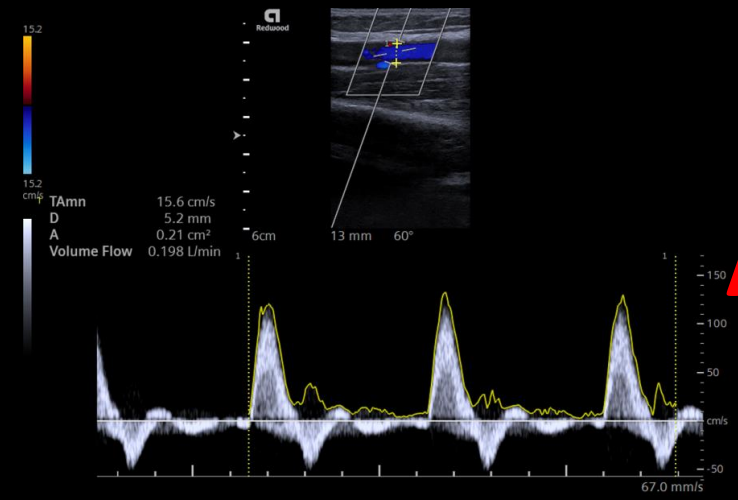
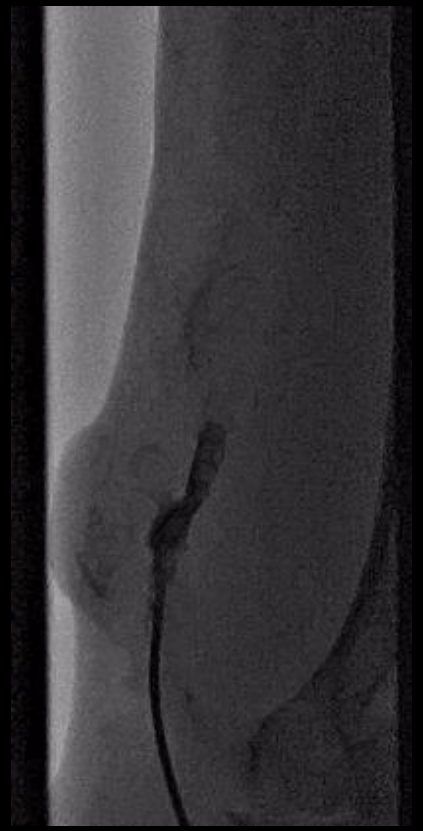
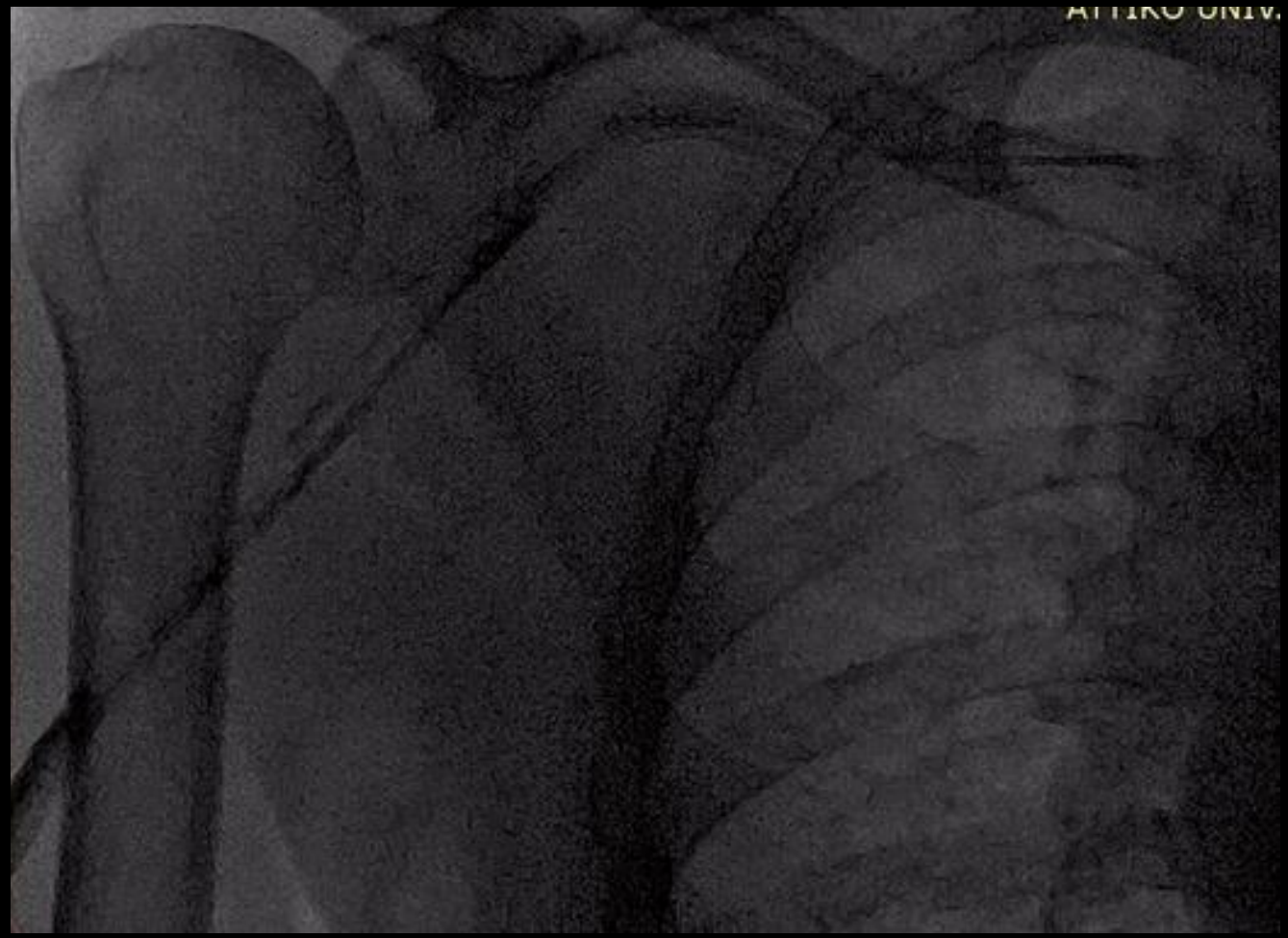
ΑΠΟΘΡΟΜΒΩΣΗ AV FISTULA

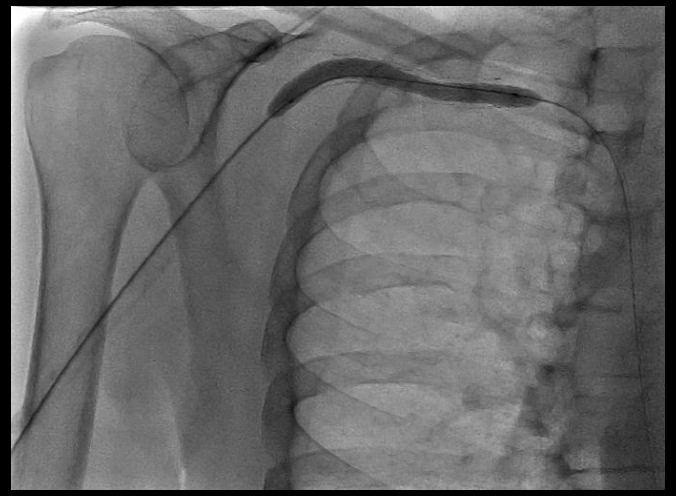


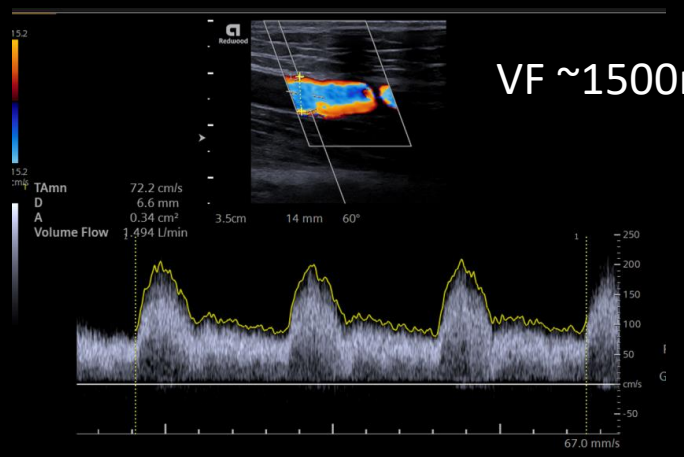




ΑΠΟΘΡΟΜΒΩΣΗ AVF

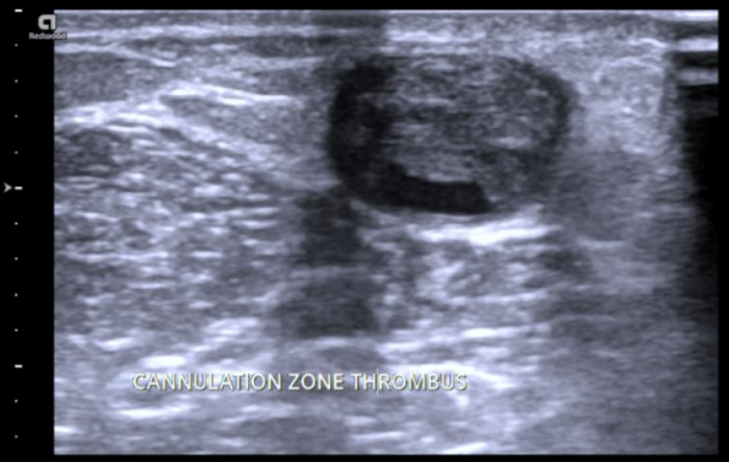
Χωρίς ημερήσια νοσηλεία



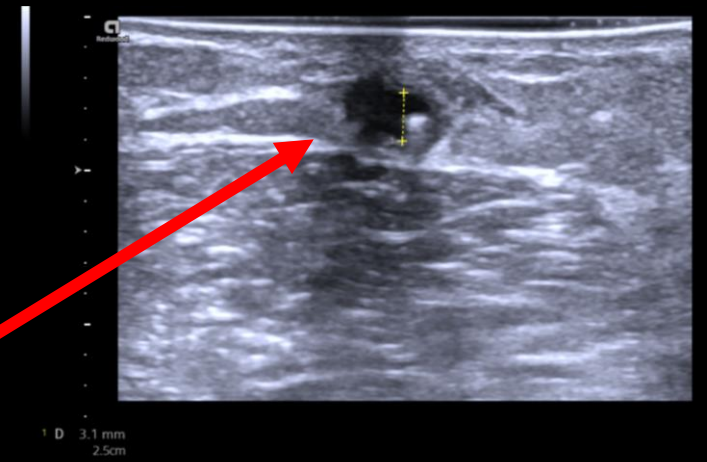


VF ~1500ml/min

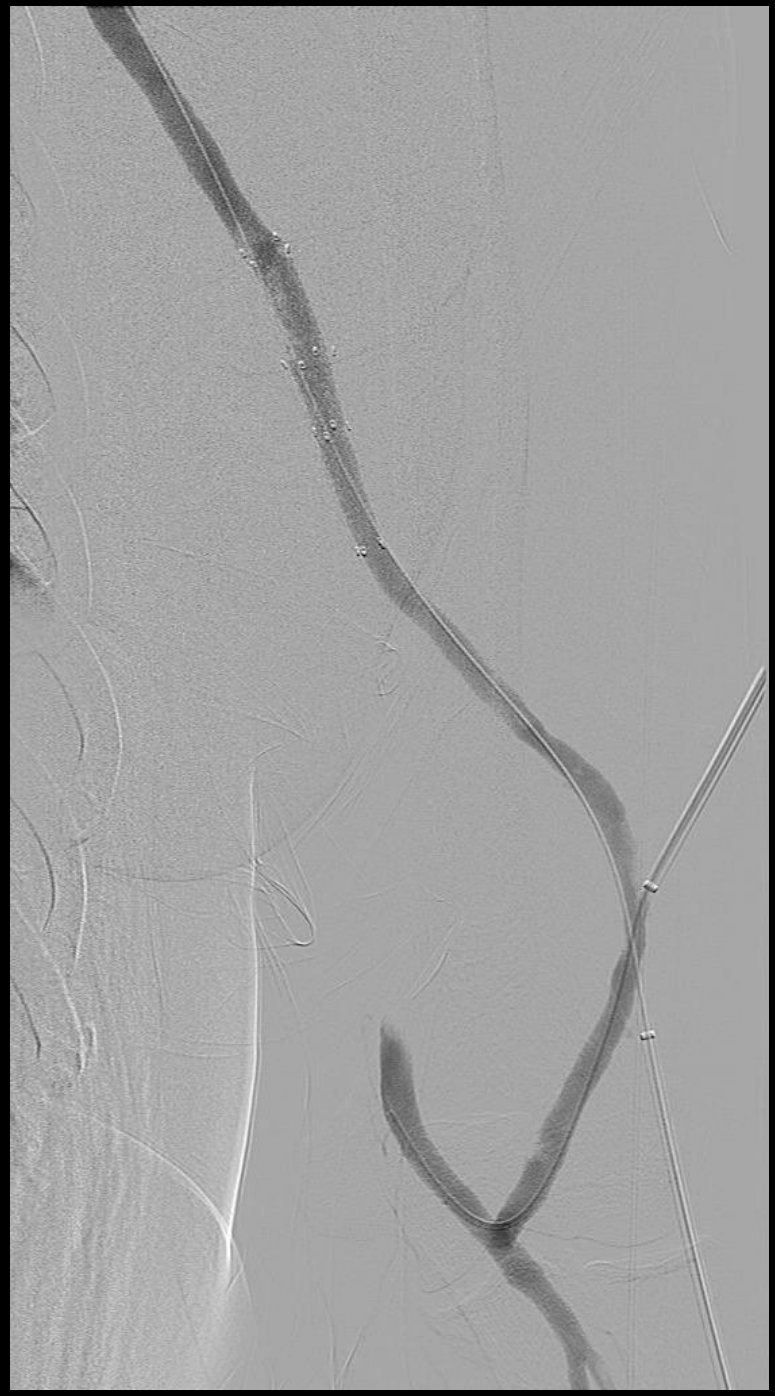

Post


CANNULATION ZONE THROMBUS
2.5cm

PI 1.88
RI 0.75
S/D 4.00
PS 247.2 cm/s
ED 61.8 cm/s
TAmx 98.6 cm/s
TAmn 54.7 cm/s
TAmn 55.8 cm/s
D 5.3 mm
A 0.22 cm²
Volume Flow 0.737 L/min


D 3.1 mm
2.5cm

ΑΠΟΘΡΟΜΒΩΣΗ ΜΟΣΧΕΥΜΑΤΟΣ



Αποτελέσματα διαδερμικής αντιμετώπισης

Στενώσεις χωρίς θρόμβωση:

- Κλινική επιτυχία: 92%- 100%
- PP: μέση τιμή 50% έτος

Αποθρόμβωση

- Κλινική επιτυχία: 62%-96%
- PP: μέση τιμή 41.6% έτος

Review

A survival guide for endovascular declotting in dialysis access: procedures, devices, and a statistical analysis of 3,000 cases

Panagiotis M. Kitrou, Konstantinos Katsanos, Panagiotis Papadimatos, Stavros Spiliopoulos & Dimitris Karnabatidis

Pages 283-291 | Received 06 Nov 2017, Accepted 15 Mar 2018, Published online: 21 Mar 2018

Cite this article https://doi.org/10.1080/17434440.2018.1454311 Check for updates

- Maeda K, et al. Percutaneous transluminal angioplasty for Brescia-Cimino hemodialysis fistula dysfunction:
- technical success rate, patency rate and factors that influence the results. Eur J Radiol. 2005;54(3):426-30

Επιπλοκές

- Μαζική πνευμονική εμβολή-Θάνατος
- Αρτηριακή εμβολή (0.4 - 7%)
- Ρήξη/Αιμορραγία
- Διαχωρισμός
- Ψευδανερύσματα
- Σημαντικά αιματώματα που χρήζουν χειρ/κης αντιμετώπισης
- Άμεση επαναθρόμβωση

Review

A survival guide for endovascular declotting in dialysis access: procedures, devices, and a statistical analysis of 3,000 cases

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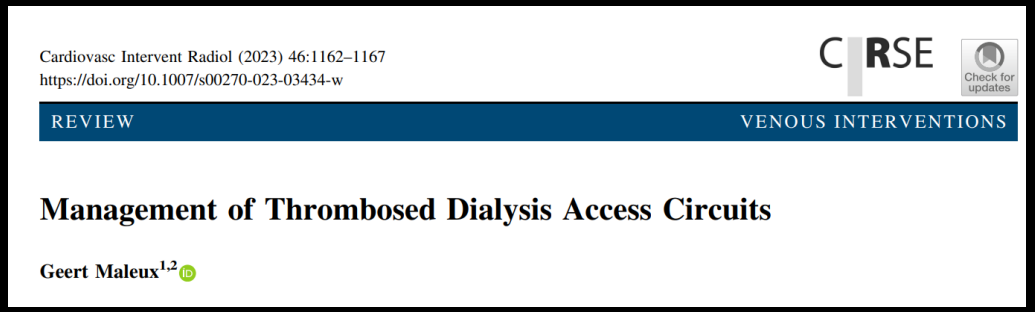


Cardiovasc Intervent Radiol (2023) 46:1162–1167
https://doi.org/10.1007/s00270-023-03434-w

CIRSE Check for updates

REVIEW VENOUS INTERVENTIONS

Management of Thrombosed Dialysis Access Circuits

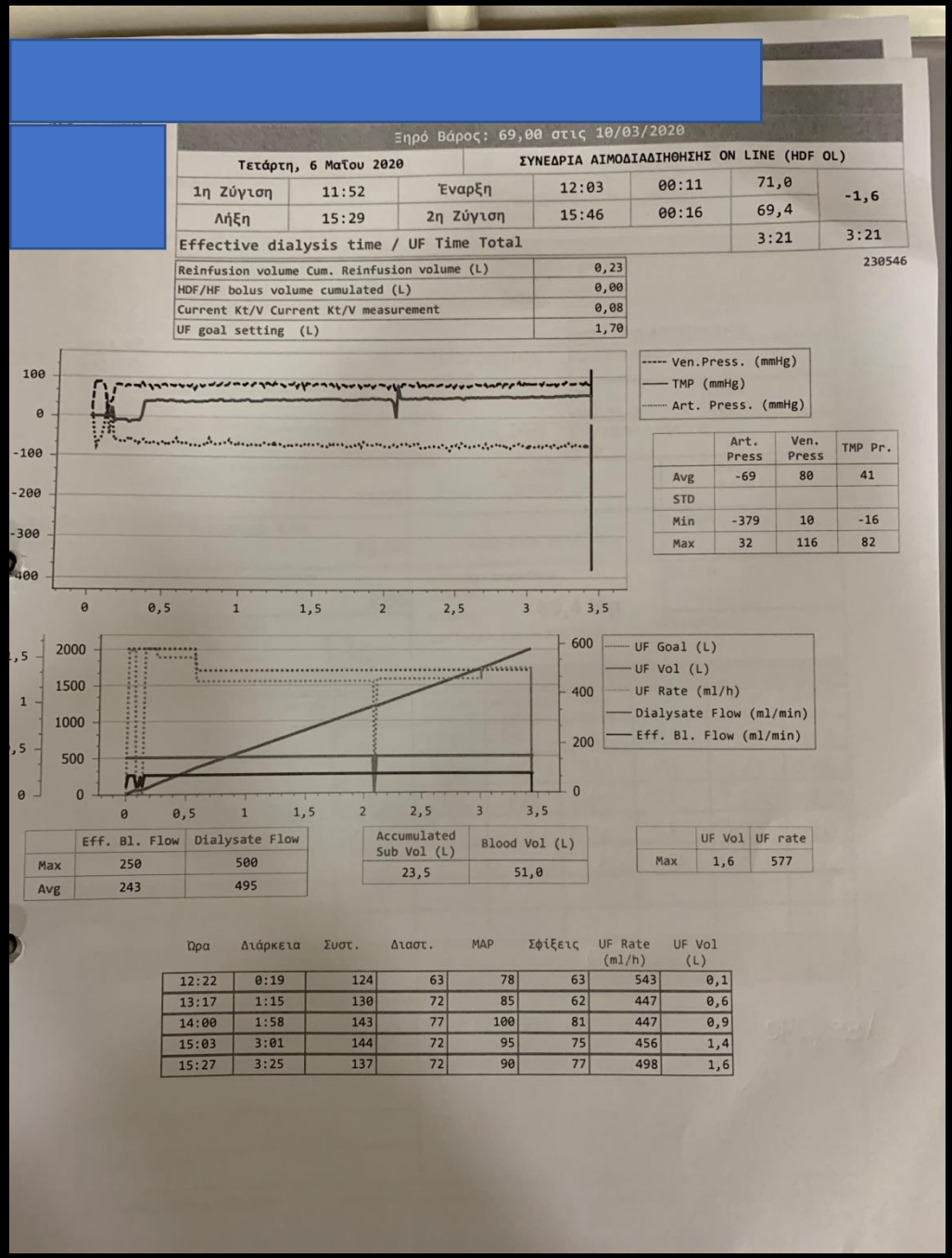
Geert Maleux[1,2]

Αντιμετώπιση θρόμβωσης:

1. **Αυξημένος βαθμός δυσκολίας**
2. **Αυξημένος κίνδυνος επιπλοκών**
3. **Το συντομότερο (διαθεσιμότητα?)**
4. **Μειωμένη βατότητα**

Φυσιολογικοί παράμετροι κάθαρσης
Κανένα κλινικλο σημείο δυσλειτουργίας
Διακριτός ροίζος (ελάττωση?)

Revised radiocephalic
Baseline VF 650ml/min
Αγγειοπλαστική 9/9/2019
Αποθρόμβωση 6/3/20



Ξηρό Βάρος: 69,00 στις 10/03/2020

Τετάρτη, 6 Μαΐου 2020		ΣΥΝΕΔΡΙΑ ΑΙΜΟΔΙΑΔΙΗΘΗΣΗΣ ON LINE (HDF OL)				
1η Ζύγιση	11:52	Έναρξη	12:03	00:11	71,0	-1,6
Λήξη	15:29	2η Ζύγιση	15:46	00:16	69,4	
Effective dialysis time / UF Time Total					3:21	3:21

230546

Reinfusion volume Cum. Reinfusion volume (L)	0,23
HDF/HF bolus volume cumulated (L)	0,00
Current Kt/V Current Kt/V measurement	0,08
UF goal setting (L)	1,70

Ven.Press. (mmHg)
TMP (mmHg)
Art. Press. (mmHg)

	Art. Press	Ven. Press	TMP Pr.
Avg	-69	80	41
STD			
Min	-379	10	-16
Max	32	116	82

UF Goal (L)
UF Vol (L)
UF Rate (ml/h)
Dialysate Flow (ml/min)
Eff. Bl. Flow (ml/min)

	Eff. Bl. Flow	Dialysate Flow
Max	250	500
Avg	243	495

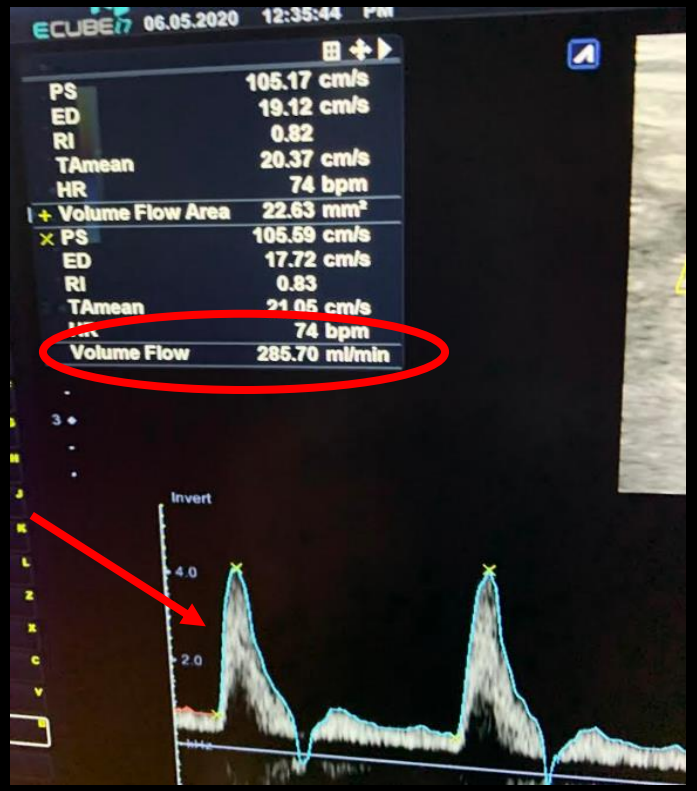
Accumulated Sub Vol (L)	Blood Vol (L)
23,5	51,0

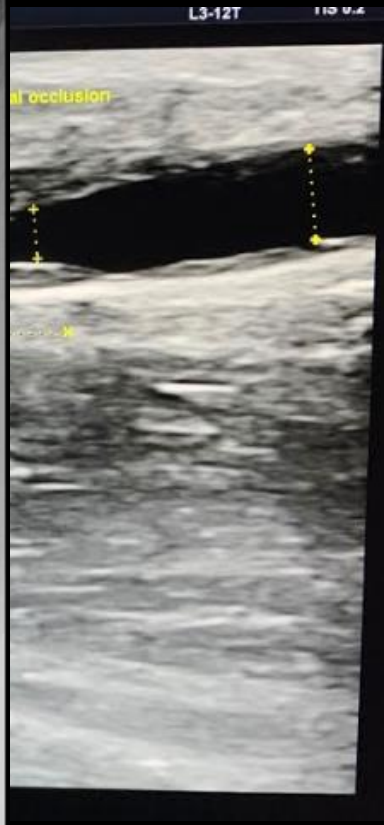
	UF Vol	UF rate
Max	1,6	577

Ώρα	Διάρκεια	Συστ.	Διαστ.	MAP	Σφίξεις	UF Rate (ml/h)	UF Vol (L)
12:22	0:19	124	63	78	63	543	0,1
13:17	1:15	130	72	85	62	447	0,6
14:00	1:58	143	77	100	81	447	0,9
15:03	3:01	144	72	95	75	456	1,4
15:27	3:25	137	72	90	77	498	1,6

Surveillance

Μείωση VF σε 286 ml/min
Υφολική απόφραξη της κεφαλικής φλέβας





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Ενδαγγειακές συσκευές

- Αεροθάλαμοι υψηλών πιέσεων (high pressure balloons)
- Αεροθάλαμοι με μικρολεπίδες (Cutting balloons)
- Καλυμμένες μεταλλικές ενδοπροθέσεις (Stent grafts)

? Αεροθάλαμοι που εκλύουν φαρμακευτική ουσία (Drug-coated balloons- paclitaxel or sirolimus)

? Μεταλλικές ενδοπροθέσεις που εκλύουν φαρμακευτική ουσία (Drug-eluting stents)

X Απλές μεταλλικές ενδοπροθέσεις (bare stents)

X Αγγειοπλαστική με απλό αεροθάλαμο

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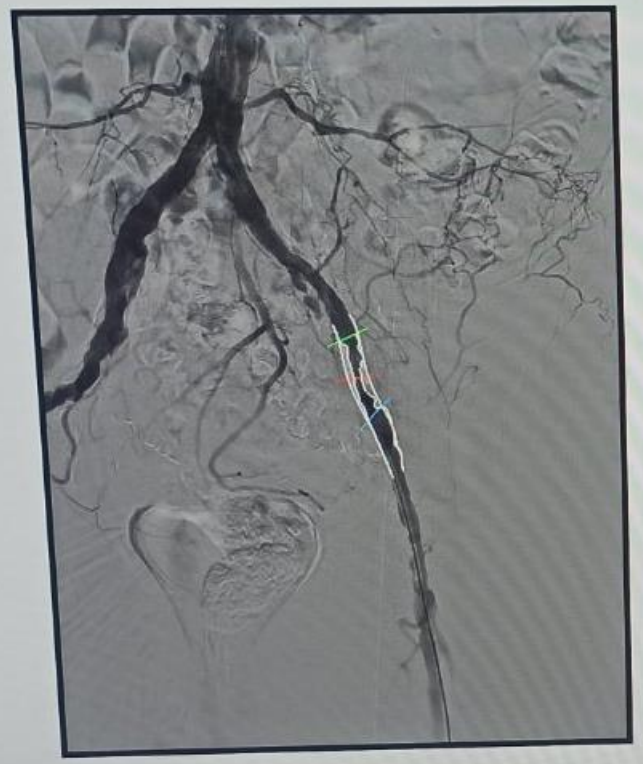
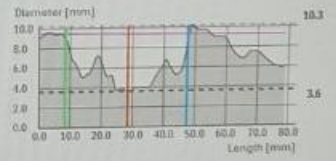
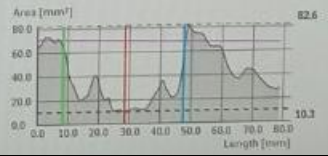
Quantitative Vascular Analysis

⚠ REPORT NOT SAVED

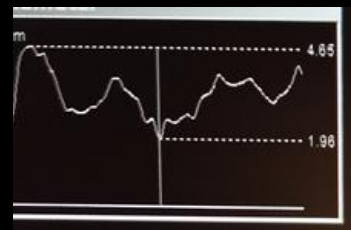


Stenosis Length	39.10 mm
% Stenosis Diameter	61.50 %
Minimum Lesion Diameter (MLD)	3.62 mm
User Defined MLD	3.62 mm
Proximal Diameter	9.00 mm
Distal Diameter	8.71 mm
Expected Diameter	9.40 mm
Maximum Diameter	10.25 mm
Stenosis Area	10.31 mm²
% Stenosis Area	85.20 %
Plaque Area	144.60 mm²
Stenosis Symmetry	0.89
Contour correction	None
Calibration object	Catheter 5 Fr
Calibration factor	0.178 mm/px
Series	4
Image	13





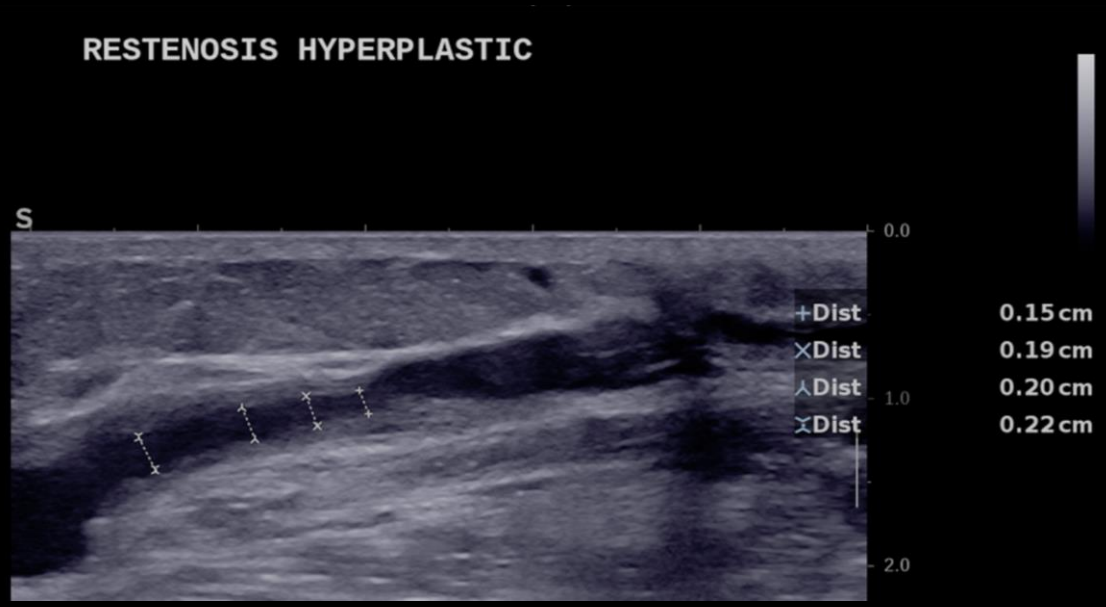
⚠ Catheters less than 6 French might give inaccurate calibration factor. Error can be 20% or more.

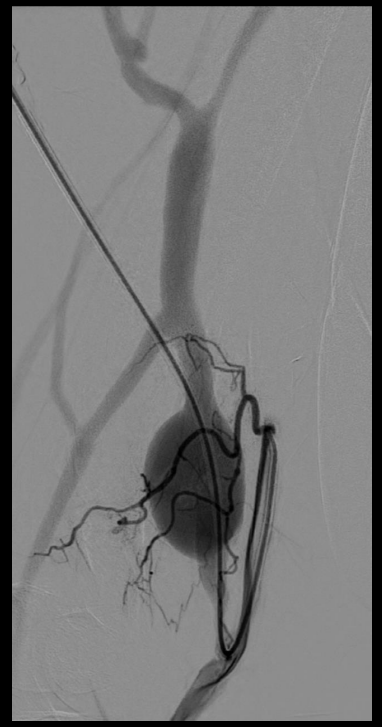


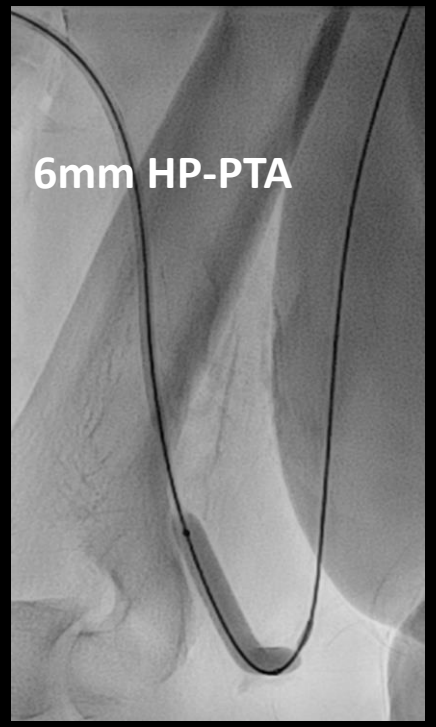
QVA

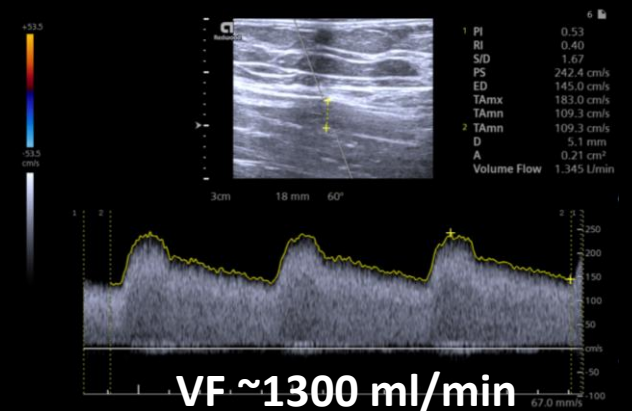
Length	58.53 mm
Min D.	1.96 mm
Max D.	4.65 mm

- Dysfunctional B-C AVF
- Difficulty in needling
- Ruptures/hematomas for 2 weeks
- Poor dialysis parameters
- VF ~600 ml/min

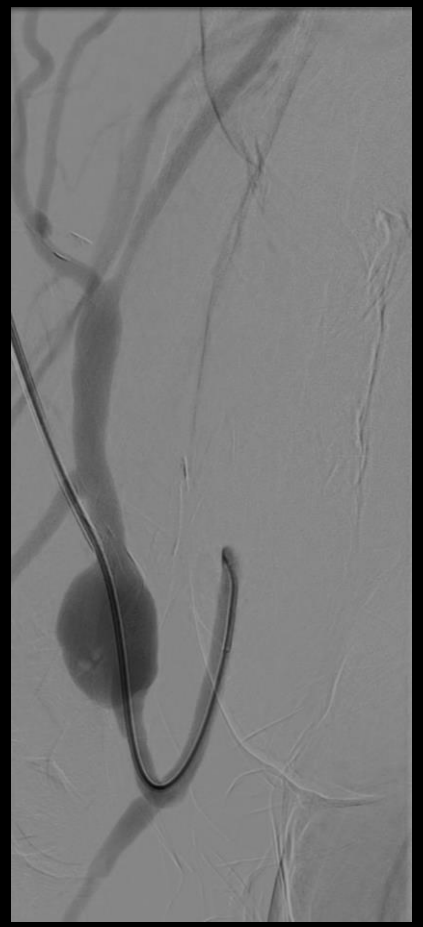








VF ~1300 ml/min (baseline)



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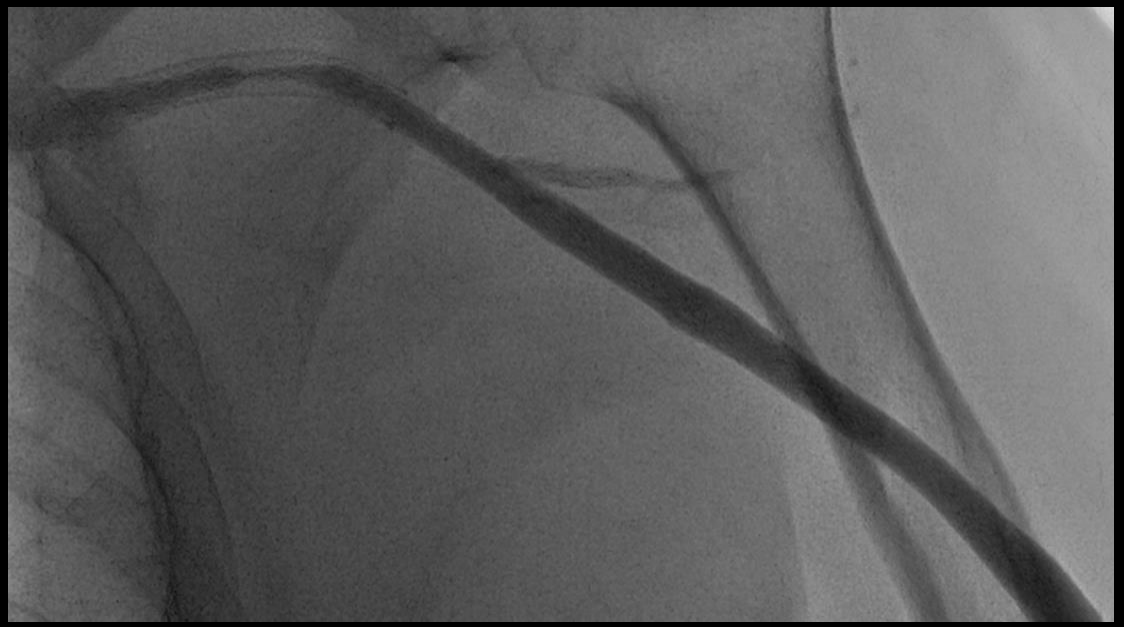
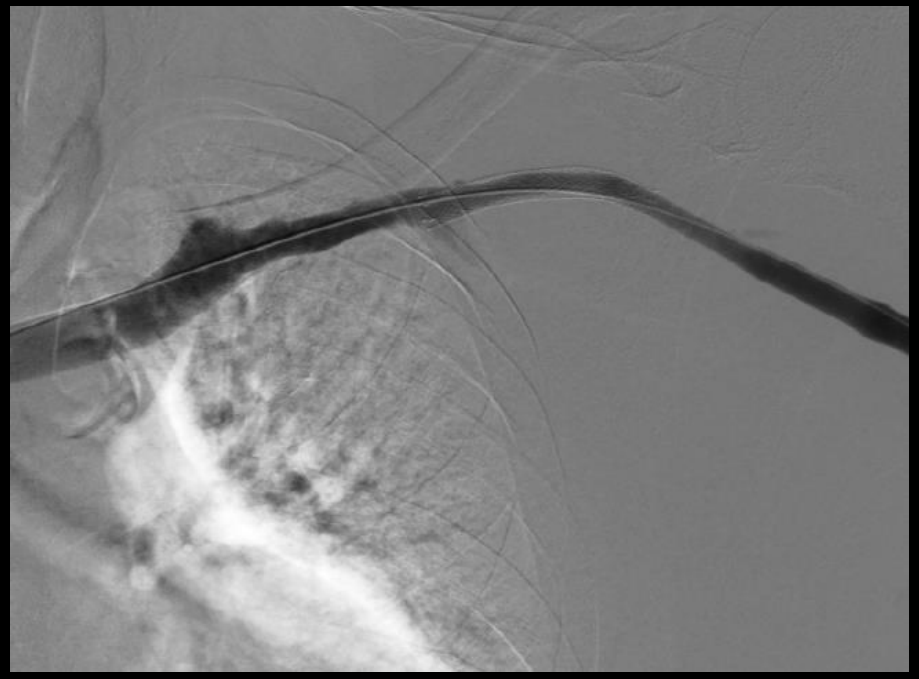
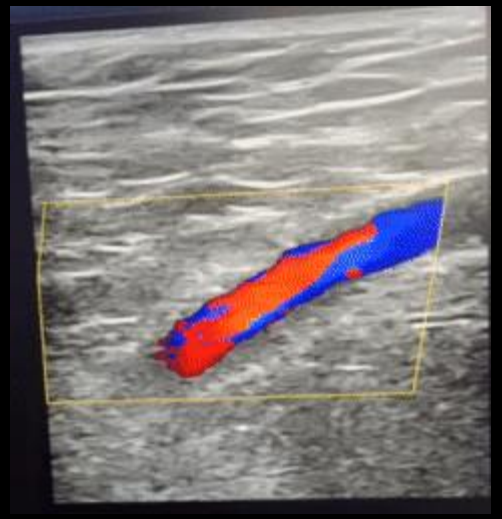
Κεφαλικό τόξο
Επαναστένωση stent graft

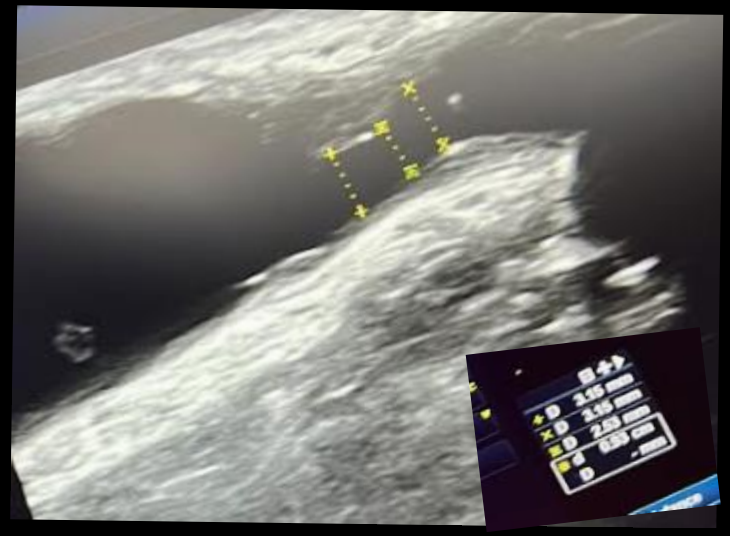


Αγγειοπλαστική στην αναστόμωση?
VF ~1000 ml/min

Όχι !!!

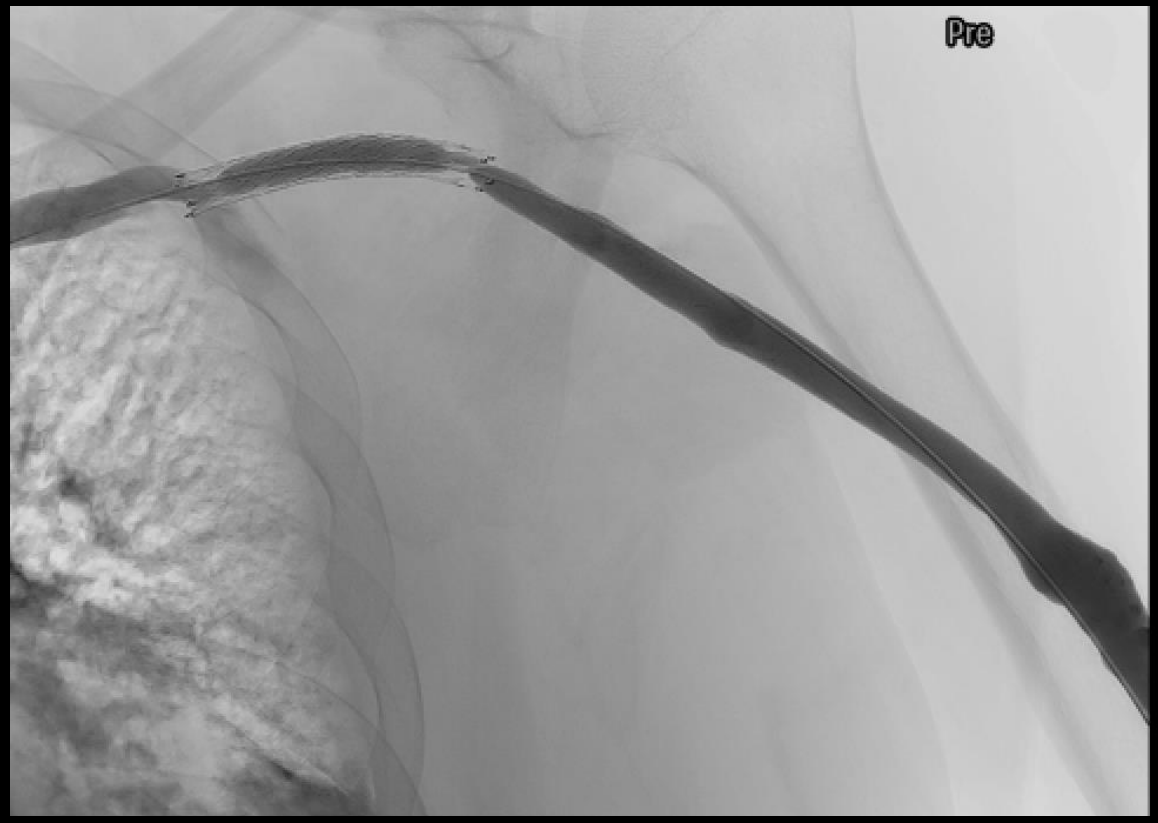




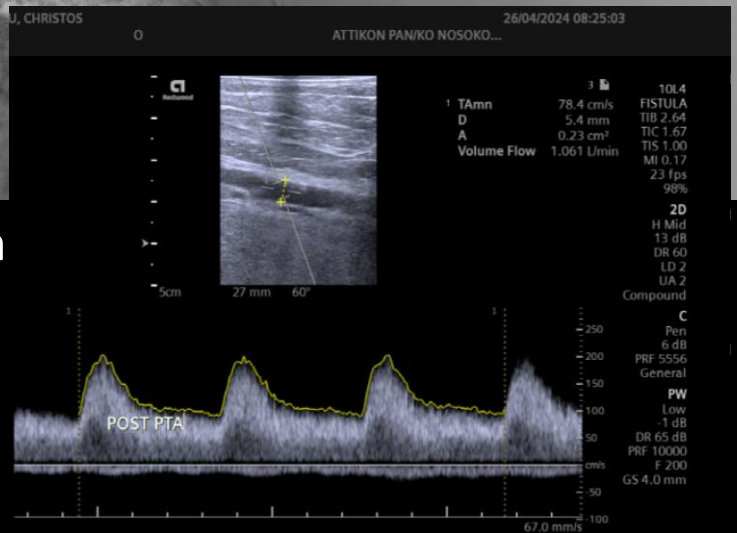


22 months TLR (4/2024)

Still no angioplasty at the anastomosis



VF ~1100ml/min



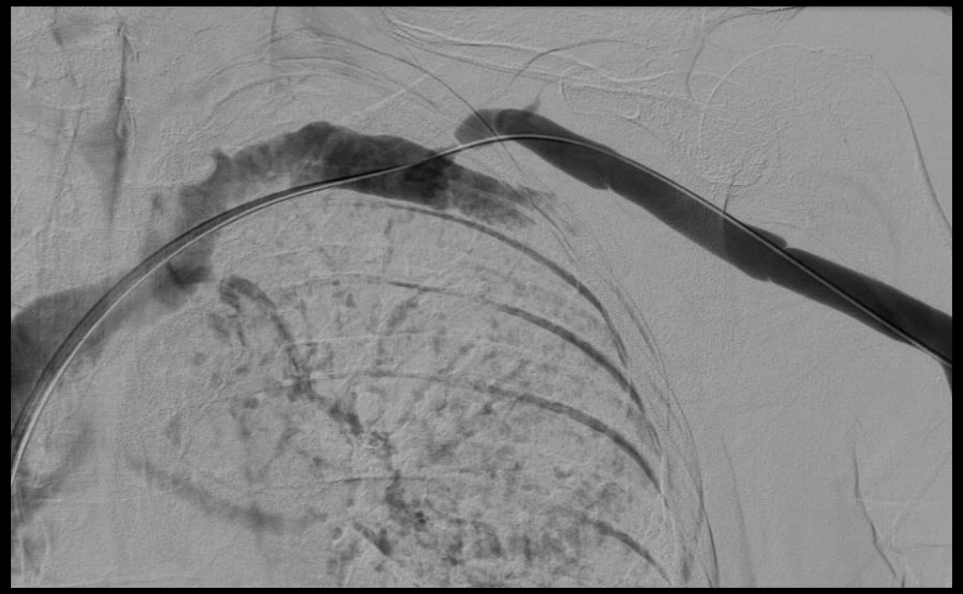
Αρ B-K AVF με παράταση αιμόστασης

Αυξημένες φλεβικές πιέσεις κατά την αιμοκάθαρση

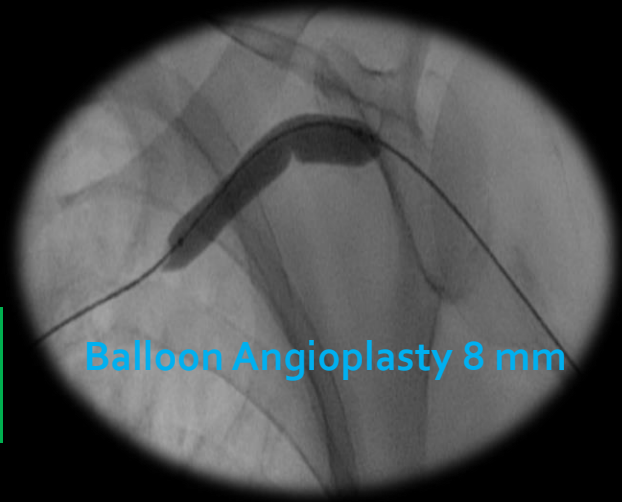
Μείωση VF

DUS 70-80% στένωση

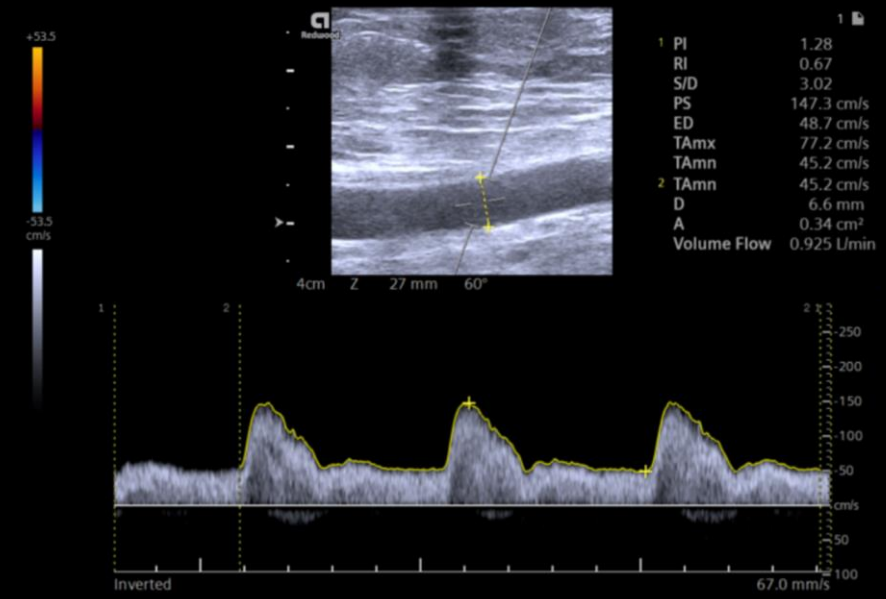
Στένωση κεφαλικού τόξου



Προ αγγειοπαστικής VF: ~900 ml/sec
(Baseline ~1700ml/min)



Balloon Angioplasty 8 mm



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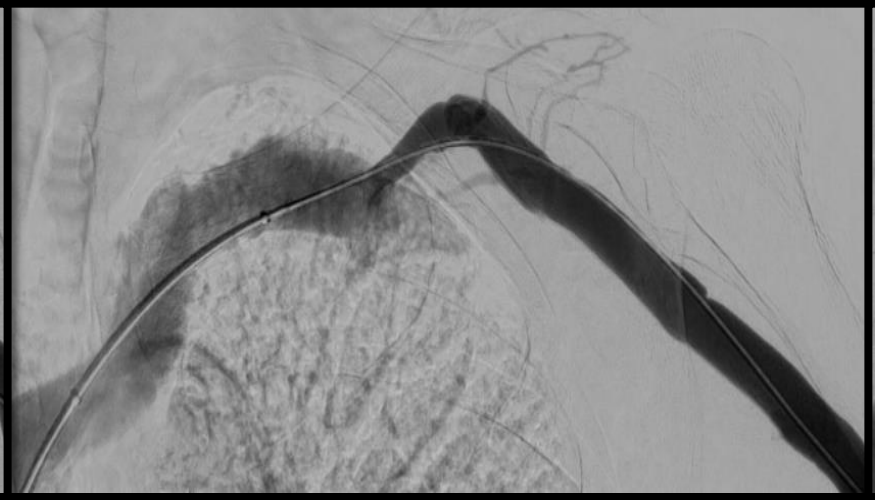
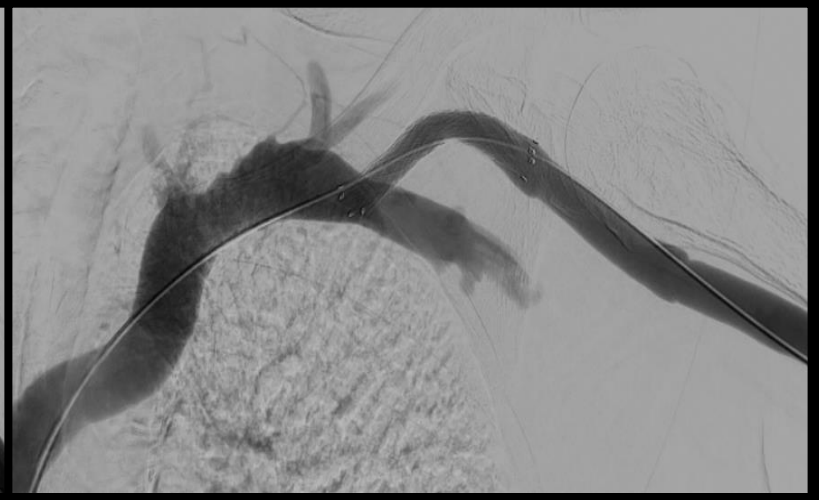
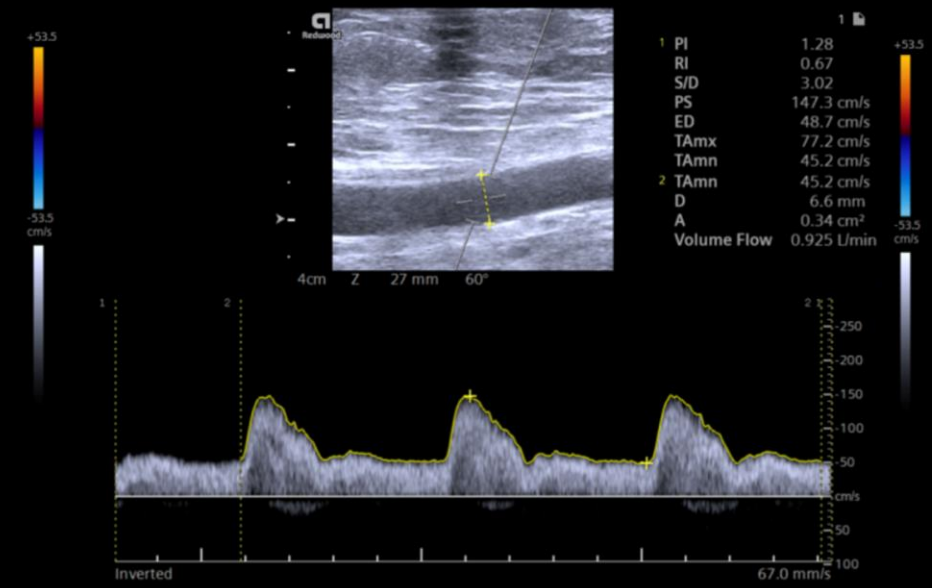




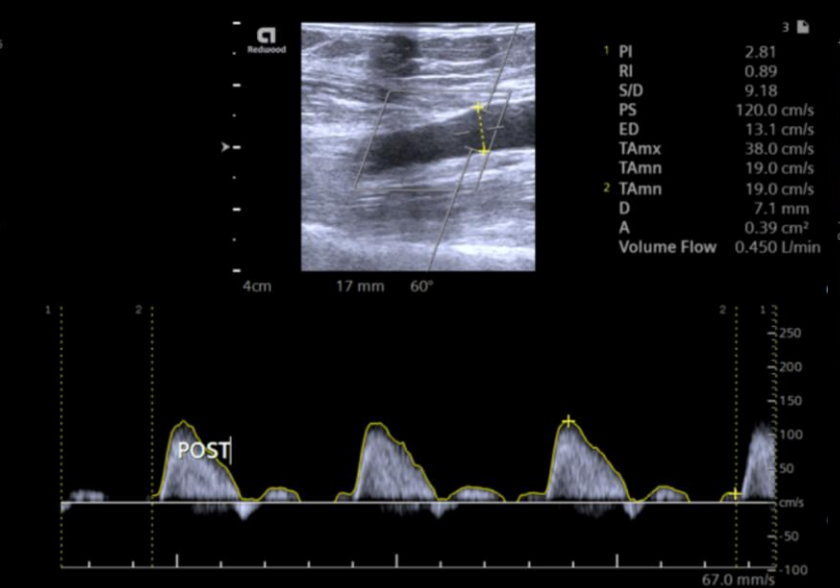
Pre PTA Venography

PRE PTA VF: 925 ml/sec



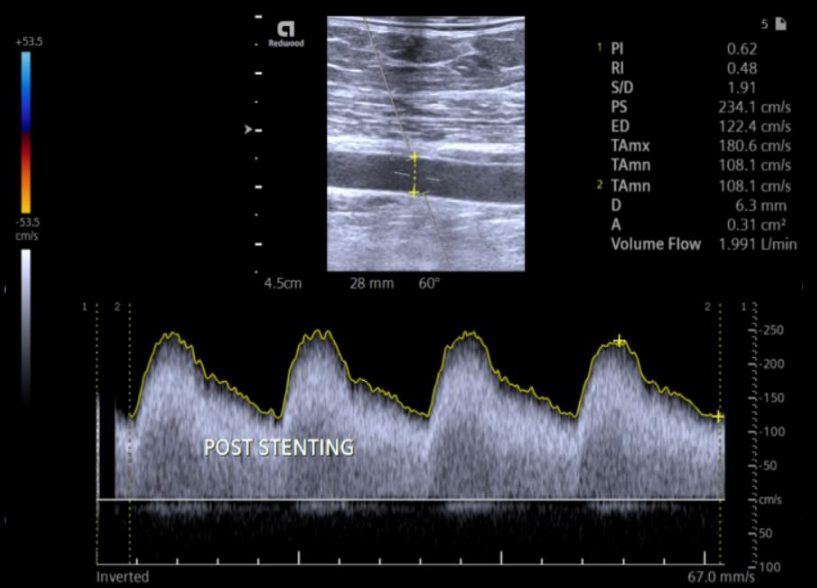
Post PTAs Angiographic result 8mm HPB

POST PTA VF: 450 ml/sec

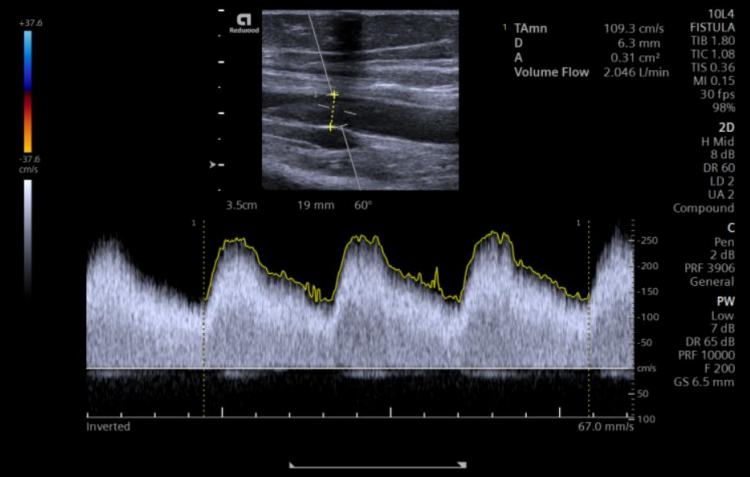


Post Stenting Angiographic result

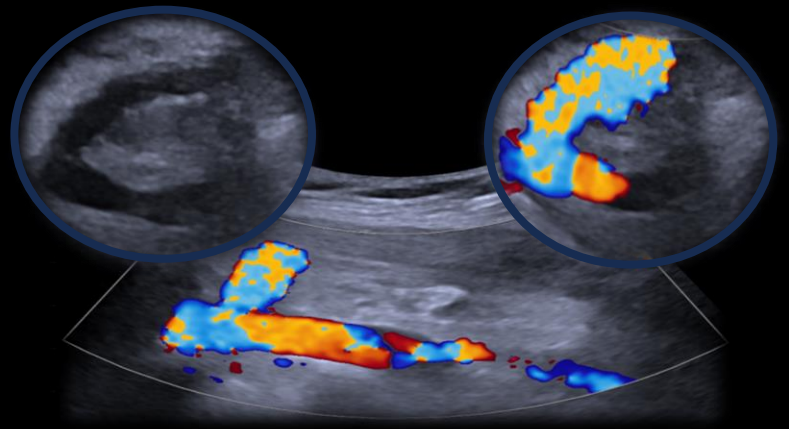
POST STENTING VF: 1990 ml/sec



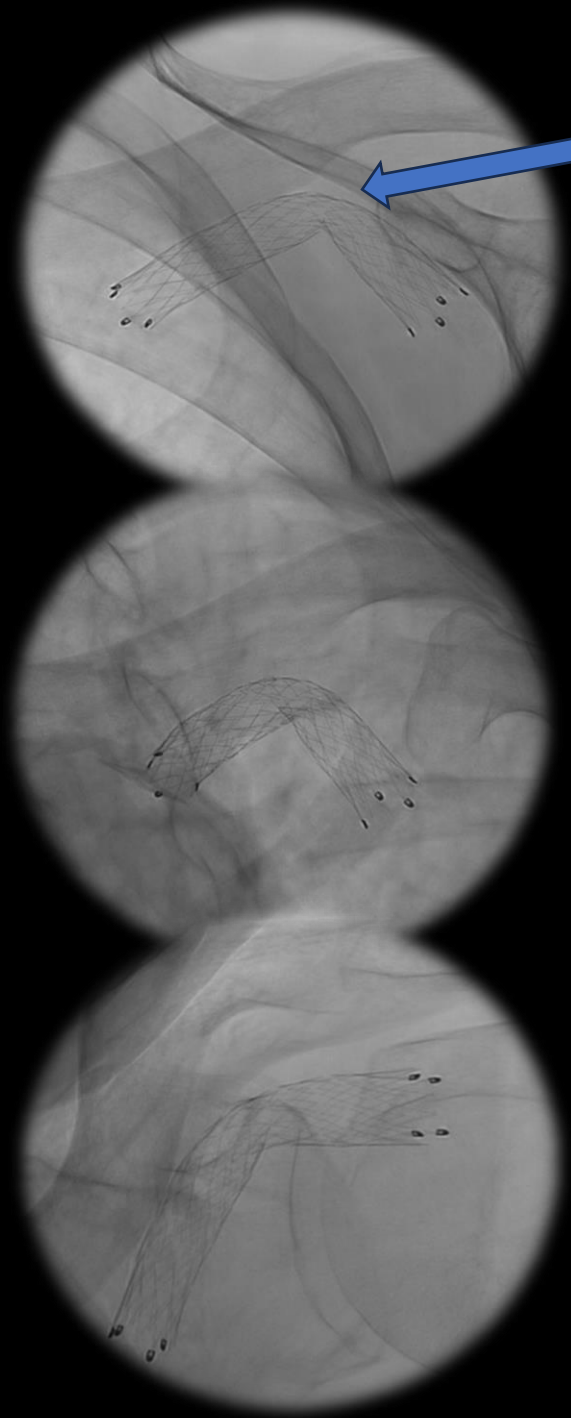
3 days Post Stenting Follow up (arm pain during movements)



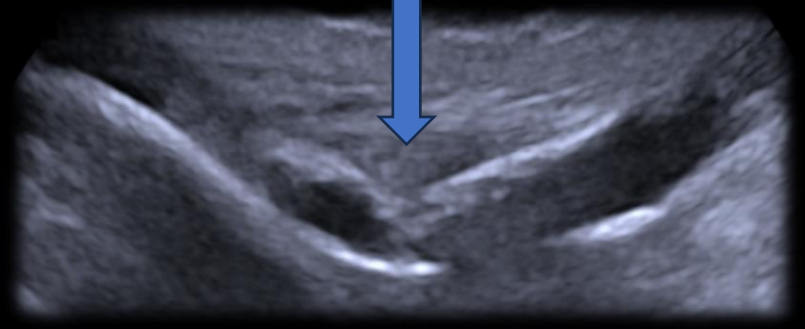
VF: 2046 ml/min

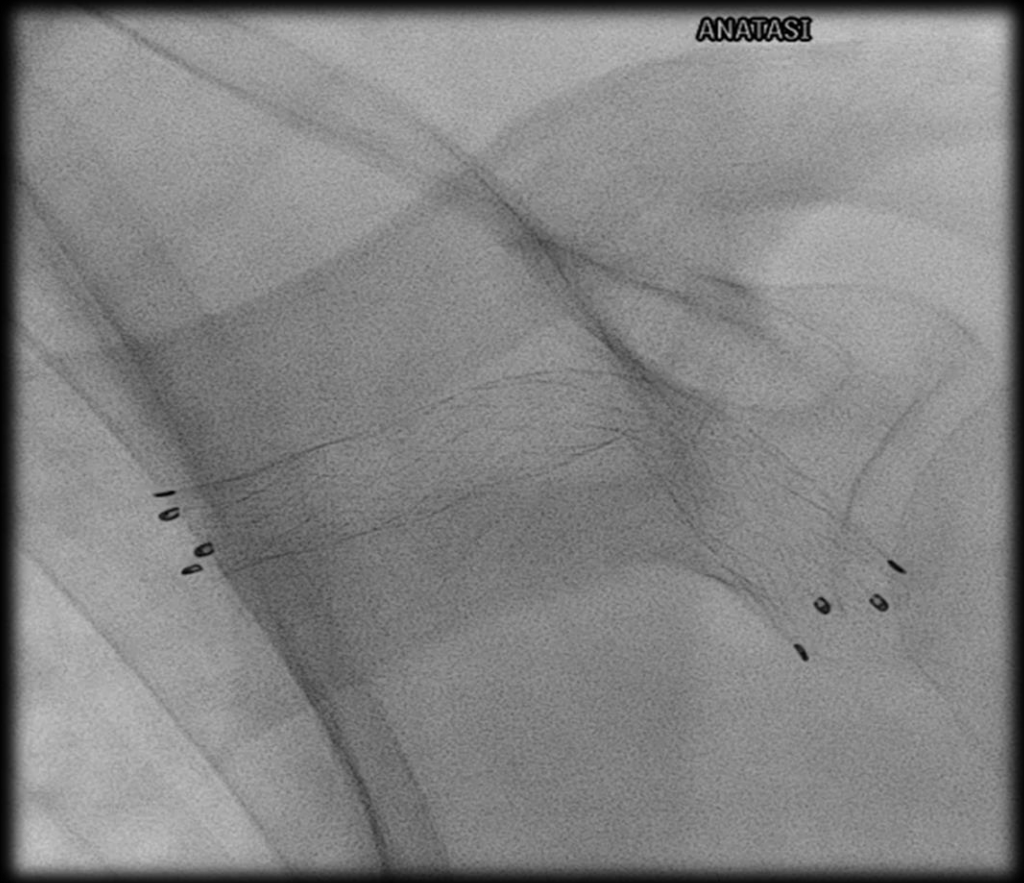


Patent stent



Dynamic Control (US & Fluoroscopy)





Prospective, randomized, multicenter clinical study comparing a self-expanding covered stent to percutaneous transluminal angioplasty for treatment of upper extremity hemodialysis arteriovenous fistula stenosis

OPEN

Bart Dolmatch[1,2], Timoteo Cabrera[3], Pablo Pergola[3], Saravanan Balamuthusamy[4,5], Angelo Makris[6], Randy Cooper[7], Erin Moore[8,9], Jonah Licht[10,11], Ewan Macaulay[12], Geert Maleux[13], Thomas Pfammatter[14], Richard Settlage[15], Ecaterina Cristea[16] and Alexandra Lansky[16]; and the AVeNEW Trial Investigators[17]

[1]Interventional Radiology, Palo Alto Medical Foundation, Mountain View, California, USA; [2]Interventional Radiology, El Camino Hospital, Mountain View, California, USA; [3]Renal Associates PA, San Antonio, Texas, USA; [4]Tarrant Nephrology Associates, Fort Worth, Texas, USA; [5]Department of Medicine and Nephrology, Texas Christian University School of Medicine, Fort Worth, Texas, USA; [6]Chicago Access Care, Westmont, Illinois, USA; [7]Southwest Kidney Institute Vascular Center, Tempe, Arizona, USA; [8]Cardiothoracic & Vascular Surgical Associates, Jacksonville, Florida, USA; [9]Department of Vascular Surgery, Baptist Medical Center Jacksonville, Jacksonville, Florida, USA; [10]Providence Interventional Associates, Providence, Rhode Island, USA; [11]Division of Nephrology, Warren Alpert Medical School of Brown University, Providence, Rhode Island, USA; [12]Department of Vascular Surgery, Royal Adelaide Hospital, Adelaide, South Australia, Australia; [13]Department of Vascular and Interventional Radiology, University Hospitals KU Leuven, Leuven, Belgium; [14]Department of Diagnostic and Interventional Radiology, University of Zürich Hospital, Zürich, Switzerland; [15]Medical Affairs Department, Becton, Dickinson and Company, Colorado Springs, Colorado, USA; and [16]Section of Cardiovascular Medicine, Yale School of Medicine, New Haven, Connecticut, USA

Prospective, Randomized, Concurrently-Controlled Study of a Stent Graft versus Balloon Angioplasty for Treatment of Arteriovenous Access Graft Stenosis: 2-Year Results of the RENOVA Study

Ziv J Haskal, MD, FSIR, Theodore F. Saad, MD, Jeffery G. Hoggard, MD, Randy I. Cooper, MD, George S. Lipkowitz, MD, Anwar Gerges, MD, John R. Ross, MD, Timothy A. Pflederer, MD, and Samuel W. Mietling, MD

270 patients at 28 sites

- Vein-graft anastomosis
- No required radiographic imaging follow-up studies (different from Flair trial)
- Access surveillance and intervention per local practice

Haskal et al, JVIR 2016;27:1105-1114

Prospective, Randomized, Concurrently-Controlled Study of a Stent Graft versus Balloon Angioplasty for Treatment of Arteriovenous Access Graft Stenosis: 2-Year Results of the RENOVA Study

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Balloon angioplasty versus Viabahn stent graft for treatment of failing or thrombosed prosthetic hemodialysis grafts

Thomas Vesely, MD,[a] William DaVanzo, MD,[b] Terry Behrend, MD,[c] Amy Dwyer, MD,[d] and John Aruny, MD,[c] *Saint Louis, Mo; St. Simons Island, Ga; San Diego, Calif; Louisville, Ky; and New Haven, Conn*

RCT, n=293, ViaBahn (n=145) vs PTA (n=148)
Failing (n=164) and clotted (n=129) grafts included
Vein-graft anastomosis
Primary end point 6 month TLPP, followed to 24 mo
Lesions across elbow included (n=22), better patency not stat sig
6 month TLPP 51.6% SG vs 34.2% PTA (ITT), P<0.006)
For clotted grafts, 36.1% SG vs 23.5% PTA, not stat sig
For patent grafts, 64.6% SG vs 36.1% PTA, not stat sig

Vesely et al, J Vasc Surg 2016; 64;1400-1410

The NEW ENGLAND JOURNAL of MEDICINE

Stent Graft versus Balloon Angioplasty for Failing Dialysis-Access Grafts

Ziv J. Haskal, M.D., Scott Trerotola, M.D., Bart Dolmatch, M.D., Earl Schuman, M.D., Sanford Altman, M.D., Samuel Mietling, M.D., Scott Berman, M.D., Gordon McLennan, M.D., Clayton Trimmer, D.O., John Ross, M.D., and Thomas Vesely, M.D.

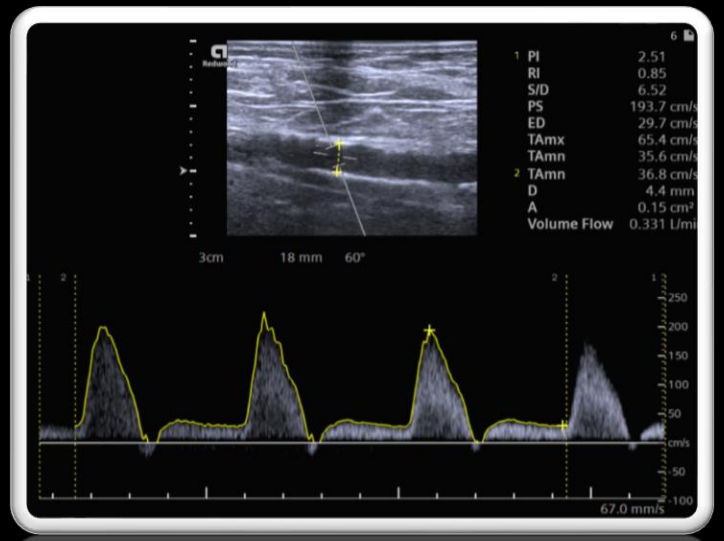
Βραχιονοκεφαλική AVF με αντίδρομο κλάδο προς το αντιβράχιο

- Δυσλειτουργία
- Stent άνω κοίλης
- 2 προηγηθείσες αγγειοπλαστικές
- Επαναστένωση κεφαλικού τόξου@ 4μήνες
- 7mm DCB τόξο καιν 12mm in-stent λόγω πρώιμης επαναστένωσης

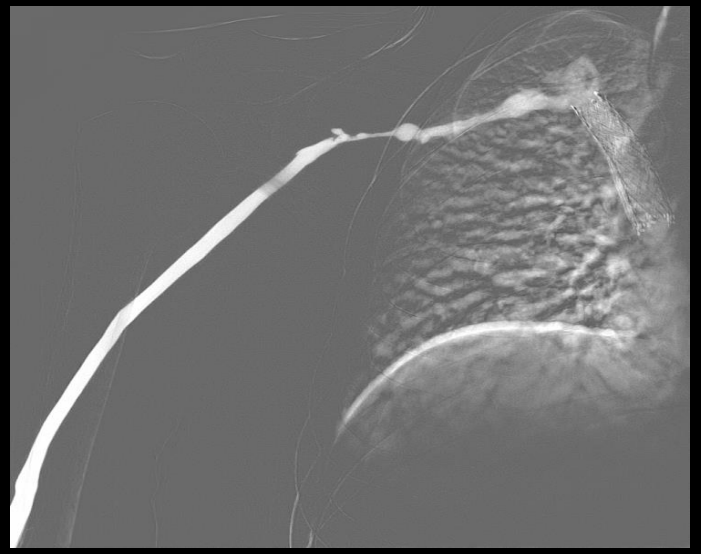
HELLENIC REPUBLIC
National and Kapodistrian University of Athens
EST. 1837

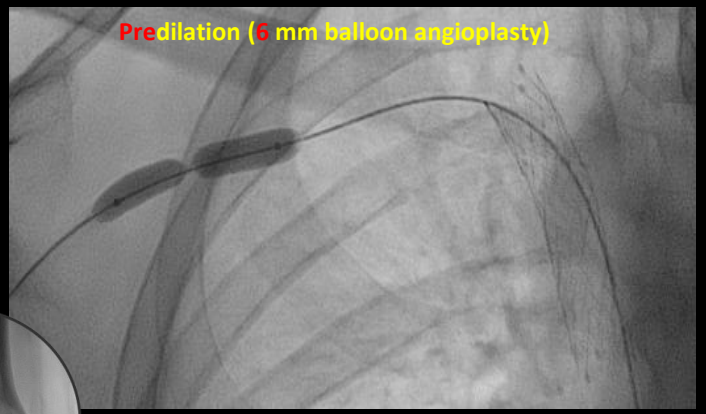
Ψευδώς αρνητικό

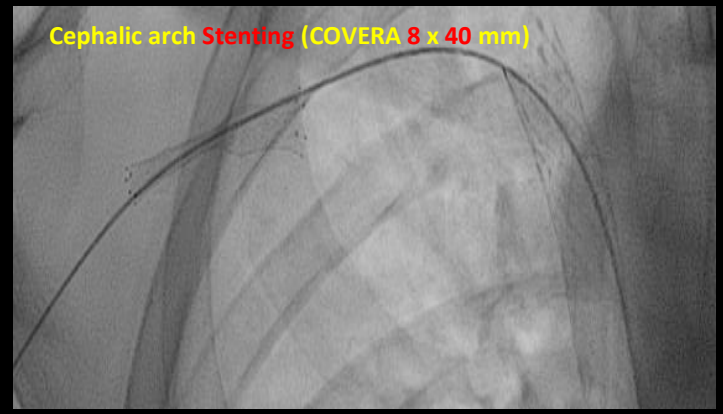
INITIAL VOLUME FLOW
WITHOUT VENOUS BRANCH OCCLUSION: **833** ml/min

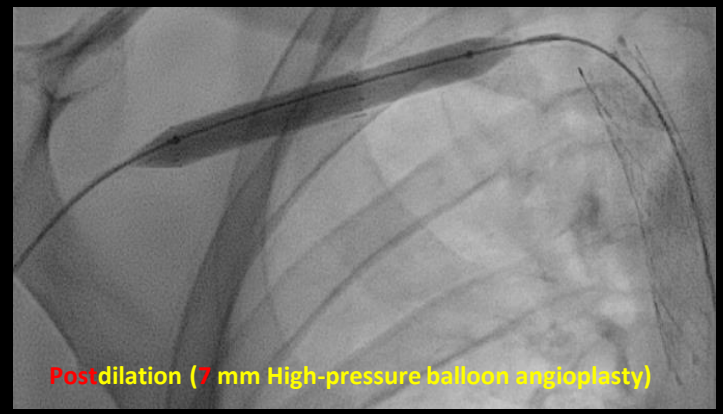


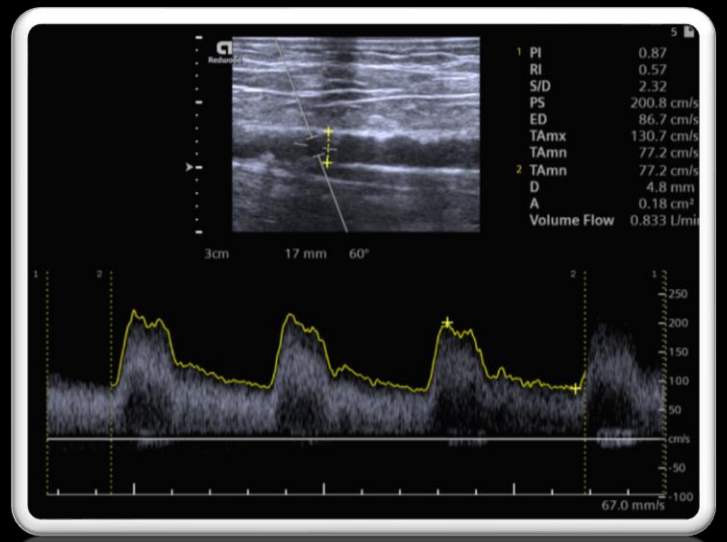
INITIAL VOLUME FLOW
WITH VENOUS BRANCH OCCLUSION: **331** ml/min



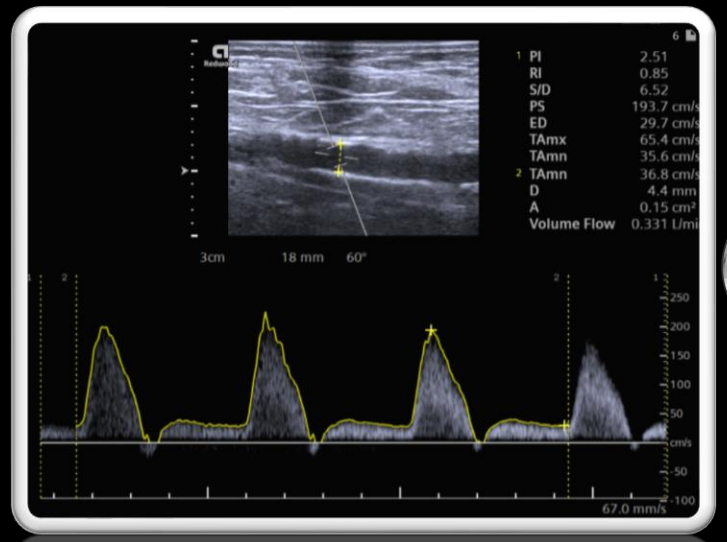




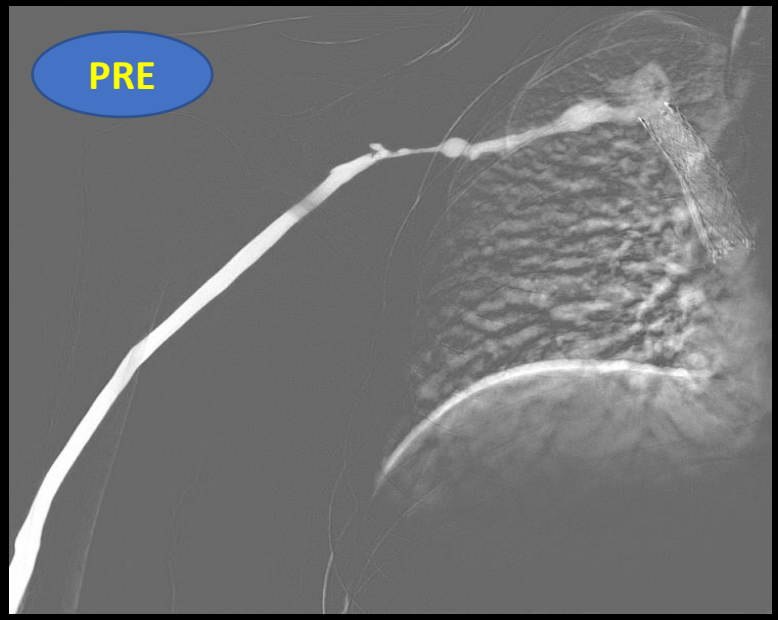


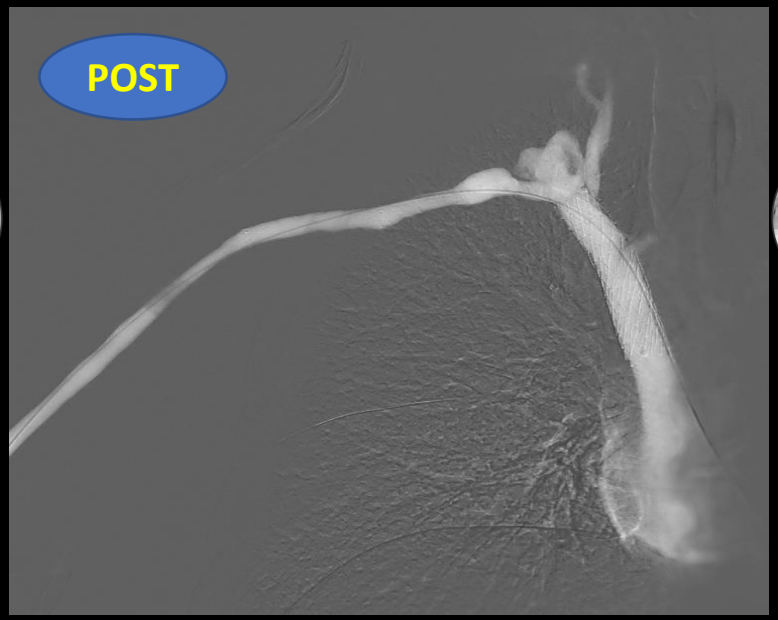


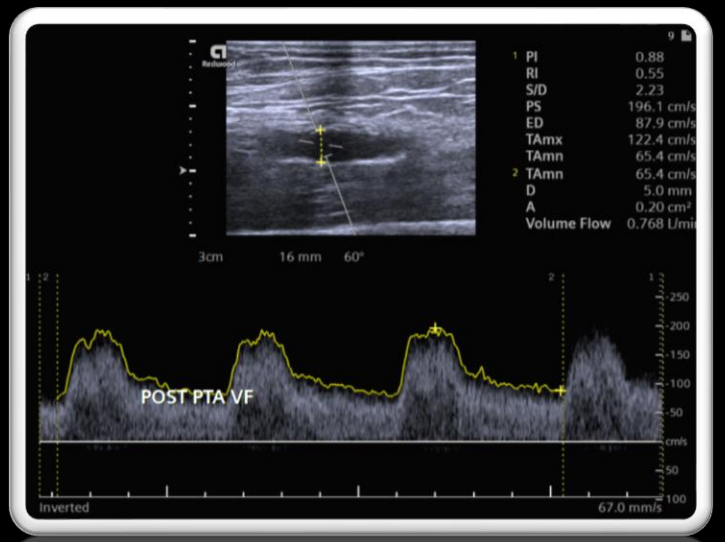
INITIAL VOLUME FLOW
WITHOUT VENOUS BRANCH OCCLUSION: **833** ml/min



INITIAL VOLUME FLOW
WITH VENOUS BRANCH OCCLUSION: **331** ml/min

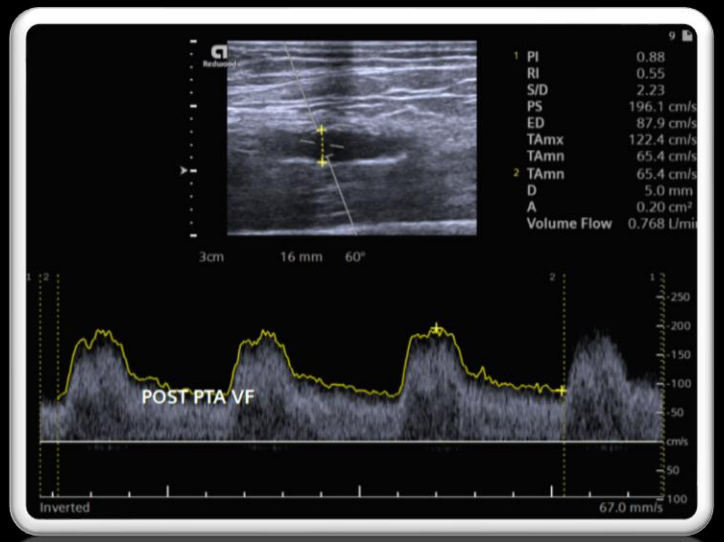






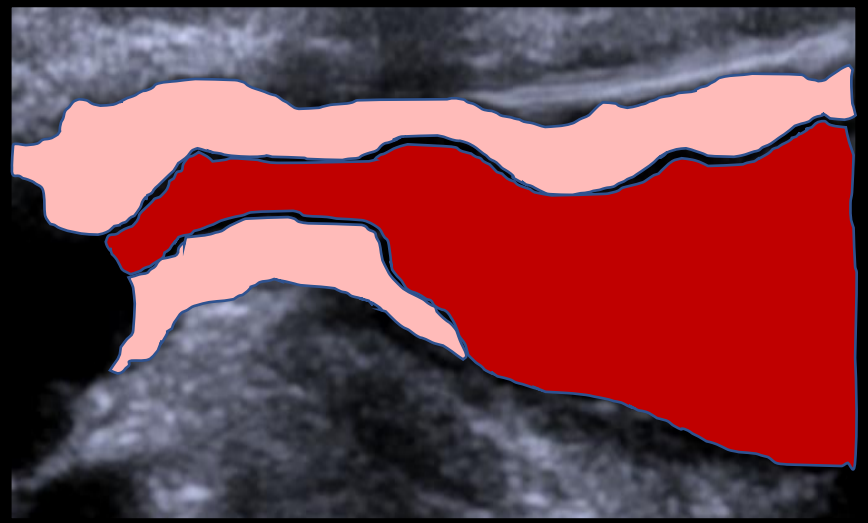
POST CEPHALIC ARCH & SUBCLAVIAN VEIN PTA
VOLUME FLOW
WITHOUT VENOUS BRANCH OCCLUSION: **768** ml/min

POST CEPHALIC ARCH & SUBCLAVIAN VEIN PTA
VOLUME FLOW
WITH VENOUS BRANCH OCCLUSION: **659** ml/min

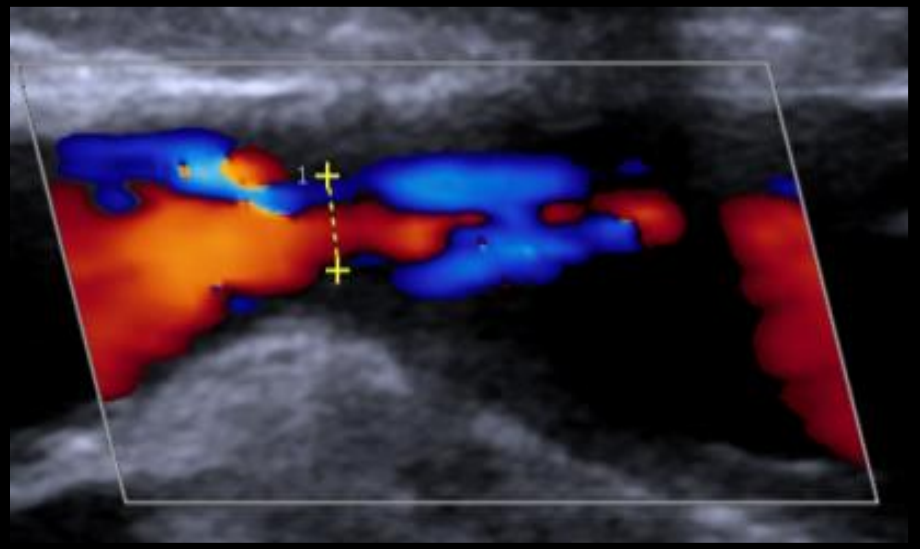


POST CEPHALIC ARCH & SUBCLAVIAN VEIN PTA
VOLUME FLOW
WITHOUT VENOUS BRANCH OCCLUSION: **768** ml/min

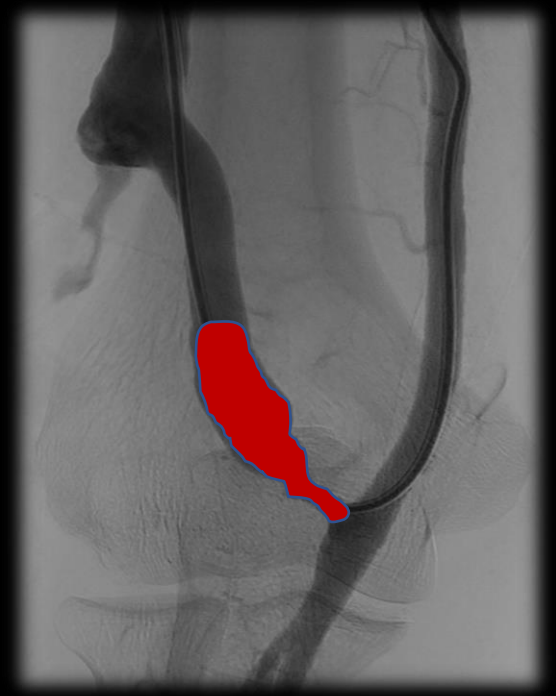
POST CEPHALIC ARCH & SUBCLAVIAN VEIN PTA
VOLUME FLOW
WITH VENOUS BRANCH OCCLUSION: **659** ml/min

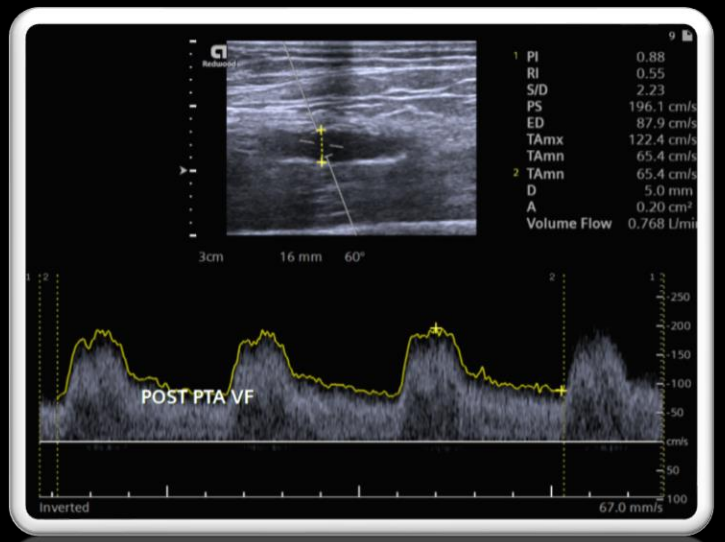


BRACHIAL ARTERY – CEPHALIC VEIN
ANASTOMOSIS STENOSIS (HYPERPLASTIC LESION)

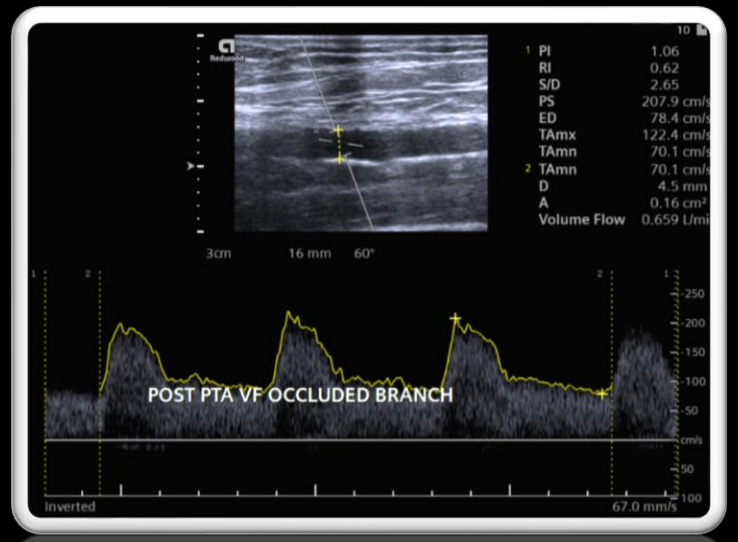


2.5mm MLD

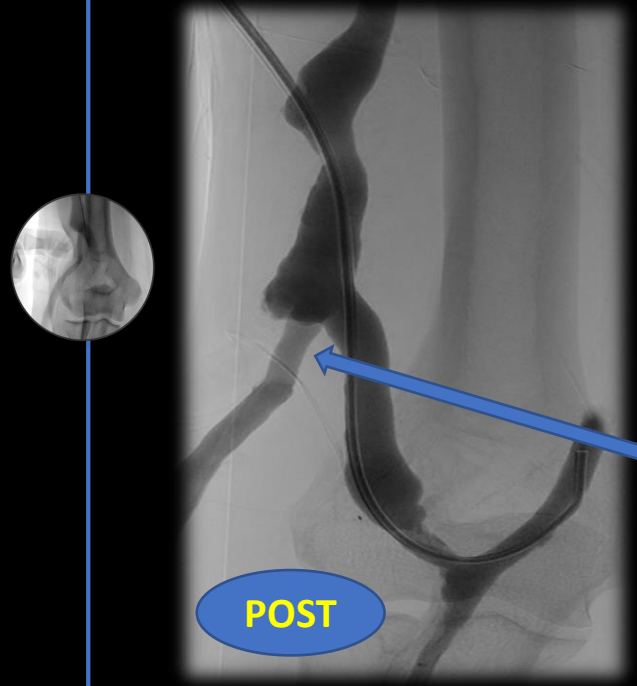


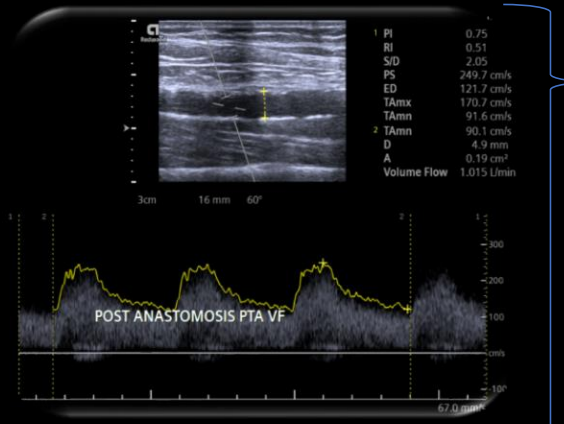


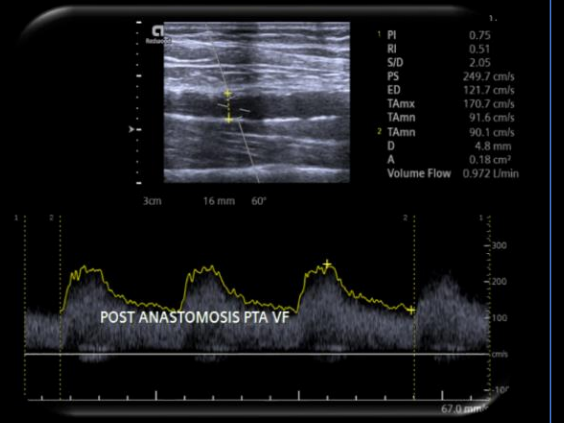
POST CEPHALIC ARCH & SUBCLAVIAN VEIN PTA VOLUME FLOW
WITHOUT VENOUS BRANCH OCCLUSION: 768 ml/min



POST CEPHALIC ARCH & SUBCLAVIAN VEIN PTA VOLUME FLOW
WITH VENOUS BRANCH OCCLUSION: 659 ml/min

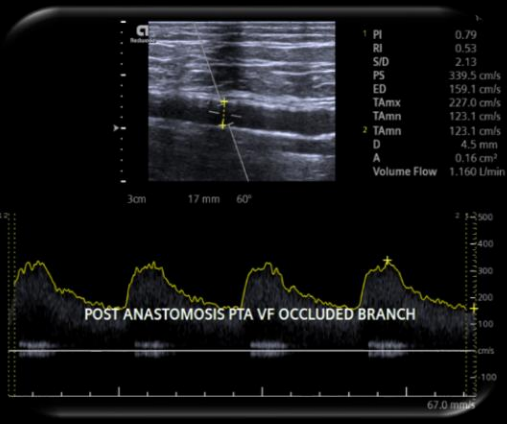


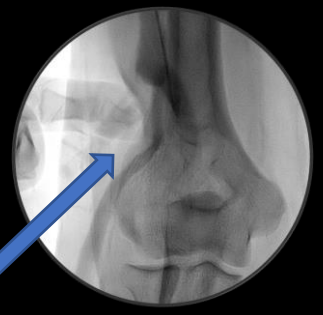




POST CEPHALIC ARCH & SUBCLAVIAN VEIN & ANASTOMOSIS PTA MEDIAN VOLUME FLOW
WITHOUT VENOUS BRANCH OCCLUSION 1125 ml/min

POST CEPHALIC ARCH & SUBCLAVIAN VEIN & ANASTOMOSIS PTA MEDIAN VOLUME FLOW
WITH VENOUS BRANCH OCCLUSION: 1160 ml/min





VENOUS BRANCH OCCLUSION

European Radiology
https://doi.org/10.1007/s00330-021-08139-7

INTERVENTIONAL

VOLume flow assistance for optimizing outcomes of dysfunctional autologous arteriovenous fistula Angioplasty: the VOLA Pilot Study

Stavros Spiliopoulos[1] · Ioannis E. Giannikouris[2] · Konstantinos Katsanos[3] · Panagiotis Filippou[1] · Evgenia Efthymiou[1] · Lazaros Reppas[1] · Panagiotis Kitrou[3] · Konstantinos Palialexis[1] · Dimitrios Filippiadis[1] · Elias Brountzos[1]

Received: 15 February 2021 / Revised: 1 June 2021 / Accepted: 6 June 2021

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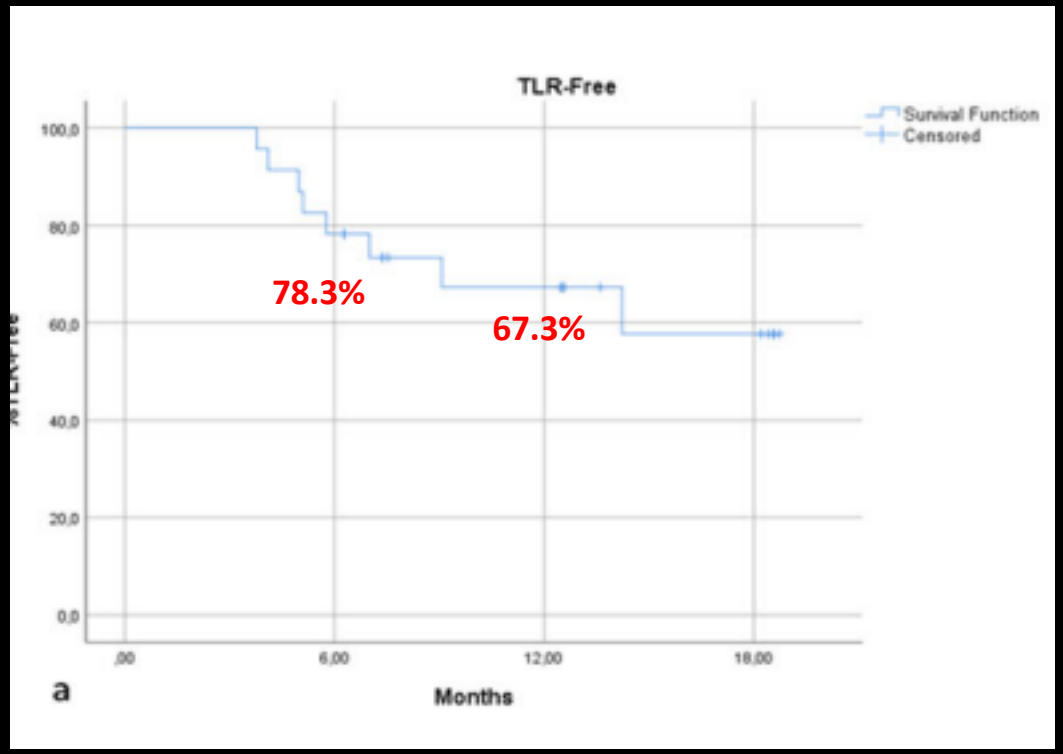
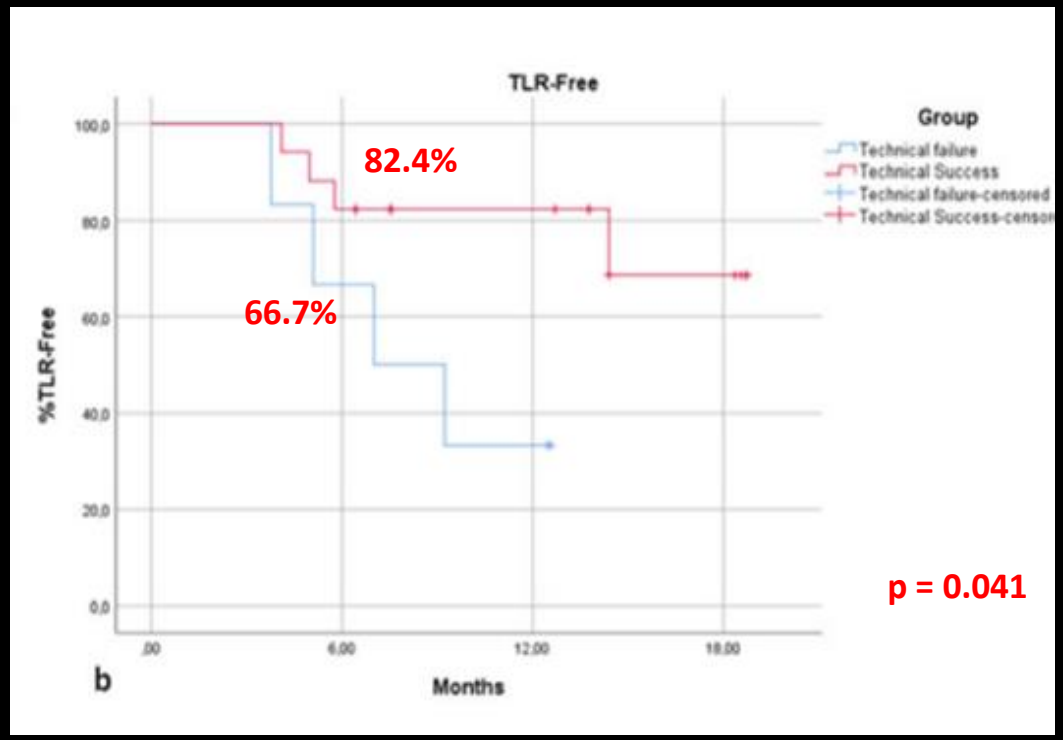
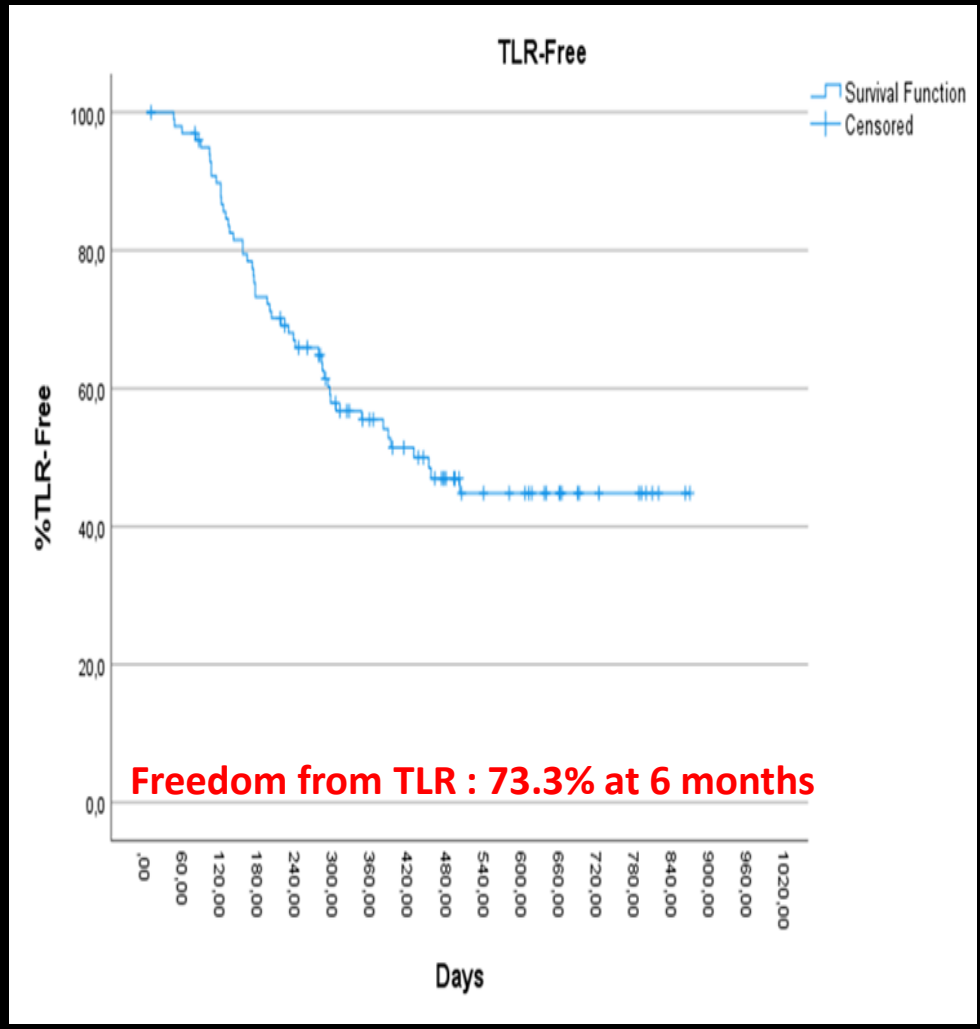




VOLA II: VF-guided HP-PTA ClinicalTrials.gov ID: NCT04694287

- 100 AVF
- Προοπτική, πολυκεντρική, κλινική μελέτη (Ε.Κ.Π.Α, Πανεπιστήμιο Πατρών)
- Κλινική επιτυχία: 100% @ 1 μήνα
- Χωρίς επανεπέμβαση: ***97% @ 3μ*** και **73.3% @ 6μ**
- **AVF διάσωση: 84% @ 2 έτη**
- Publication awaited (2nd Revision)



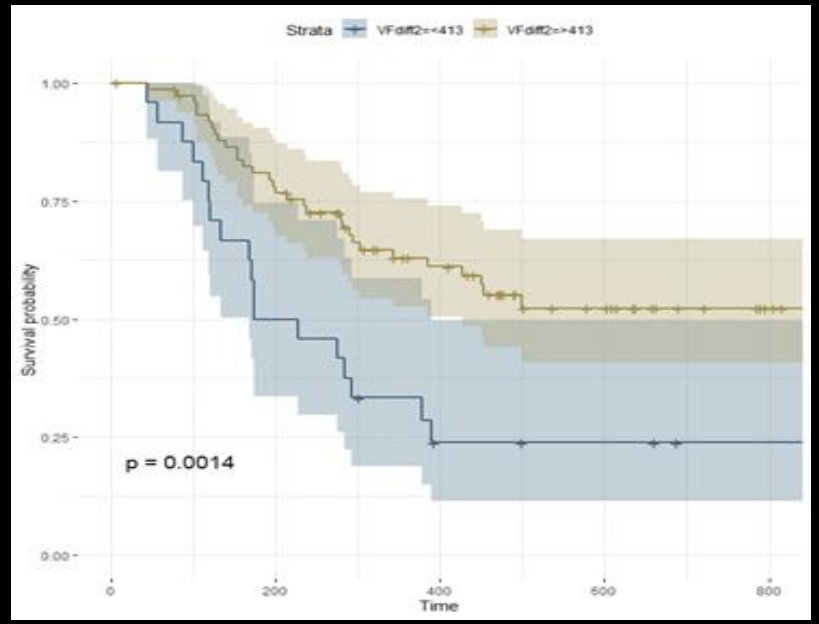
VOLA II: VF-guided HP-PTA ClinicalTrials.gov ID: NCT04694287

- Αύξηση του VF στο τέλος της επέμβασης: ανεξάρτητος παράγοντας βελτίωσης του ποσοστού επανεπέμβασης

- Cox multivariate analysis HR: 0.89; 95% CI:0.82 - 0.98 ανά 100ml/min; p:0.016

- Υψηλότερο VF ***μειώνει τον σχετικό κίνδυνο (RR) επανεπέμβασης κατά 11% ανά 100ml/min*** αύξησης του VF

SUBMITTED
UNDER REVISION



VOLA II: VF-guided HP-PTA ClinicalTrials.gov ID: NCT04694287

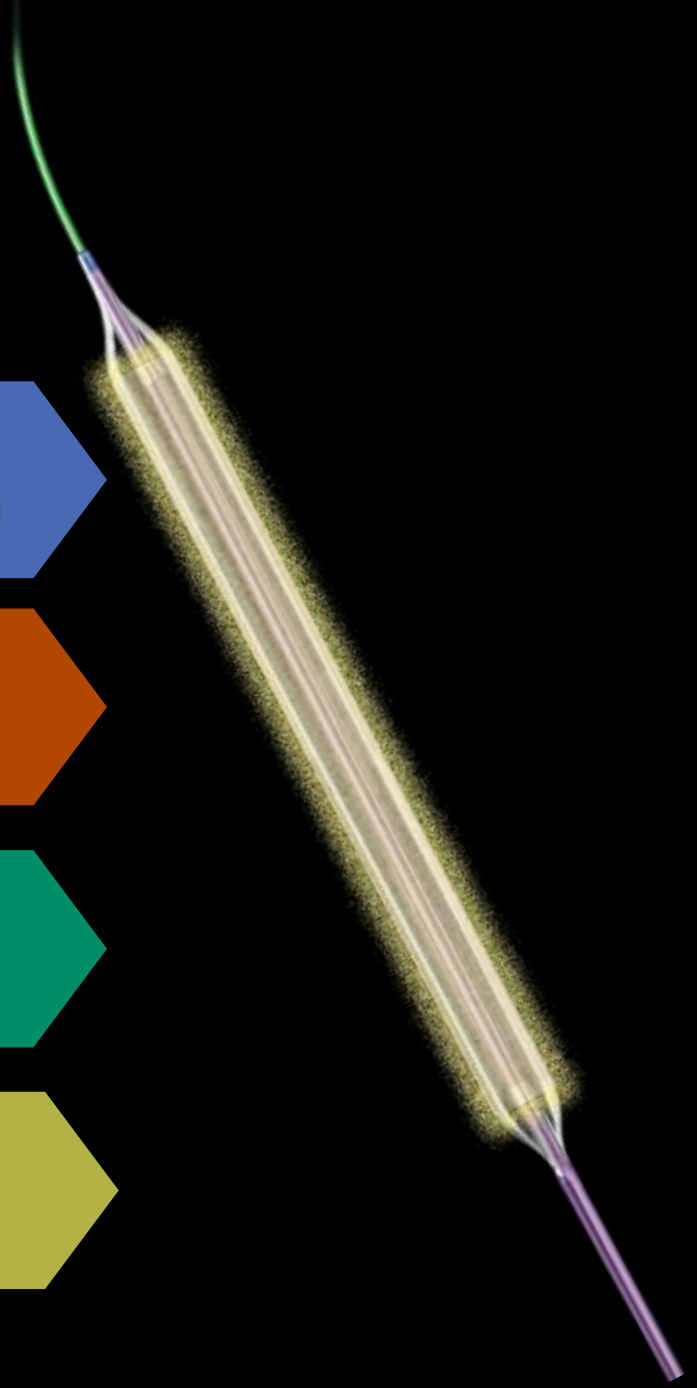
Η βέλτιστη τιμή (cutoff point) για την αποφυγή της επανεπέμβασης:

- ✓ ***1120 ml/min*** για τις βραχιονο-κεφαλικές/βασιλικές AVF
- ✓ ***720ml/min*** για τις κερκιδοκεφαλικές AVF

SUBMITTED
UNDER REVISION

DCB Τεχνολογία

Πλατφόρμα	Αγγειοπλαστική Μεταφορά του φαρμάκου
Τεχνολογία επικάλυψης	*Ομοιόμορφη απελευθέρωση*
Φορέας	Μεταφορά Διάχυση
Φάρμακο	Λιγότερη επαναστένωση



RENAL FAILURE
2022, VOL. 44, NO. 1, 155–170
https://doi.org/10.1080/0886022X.2022.2029487

Taylor & Francis
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CLINICAL STUDY

OPEN ACCESS Check for updates

Paclitaxel coated balloon versus conventional balloon angioplasty in dysfunctional dialysis arteriovenous fistula: a systematic review and meta-analysis of randomized controlled trials

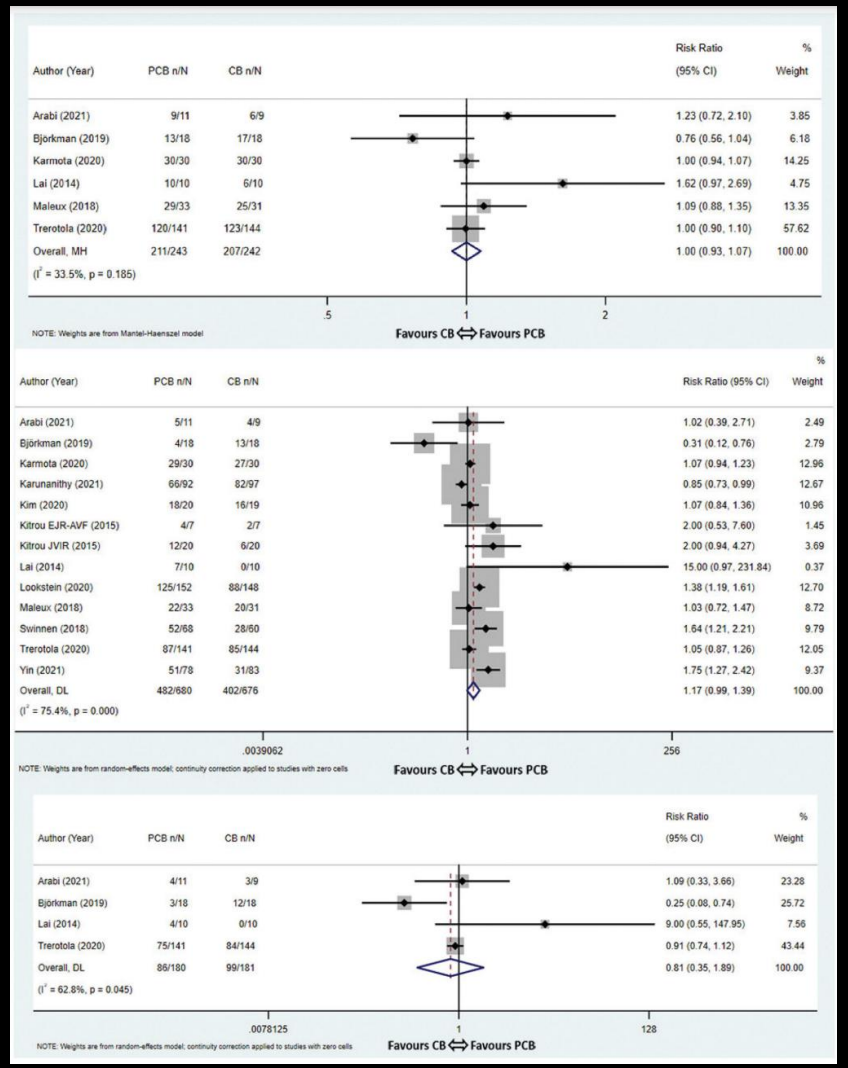
Chuxuan Luo[a,b*], Mingzhu Liang[b,c*], Yueming Liu[b], Danna Zheng[b], Qiang He[b] and Juan Jin[d]

[a]Division of Health Sciences, Hangzhou Normal University, Hangzhou, Zhejiang, China; [b]Department of Nephrology, Zhejiang Provincial People's Hospital, Affiliated People's Hospital, Hangzhou Medical College, Hangzhou, Zhejiang, China; [c]The Medical College of Qingdao University, Qingdao, Shandong, China; [d]Department of Nephrology, the First People's Hospital of Hangzhou Lin'an District, Affiliated Lin'an People's Hospital, Hangzhou Medical College, Hangzhou, Zhejiang, China

6 μήνες

9 μήνες

12 μήνες



- 14 RCTs
- 1535 ασθενείς

Conclusions: PCB angioplasty did not appear to convey any obvious advantage over CB angioplasty in the treatment of dysfunctional AVF. However, further multi-center, large-scale and well-designed RCTs are needed to prove outcomes.

- Patras
- Athens
- Singapore

Sirolimus-coated balloon
The SAVE Multicenter RCT

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Sirolimus-coated balloon
The SAVE Multicenter RCT

HELLENIC REPUBLIC
National and Kapodistrian University of Athens
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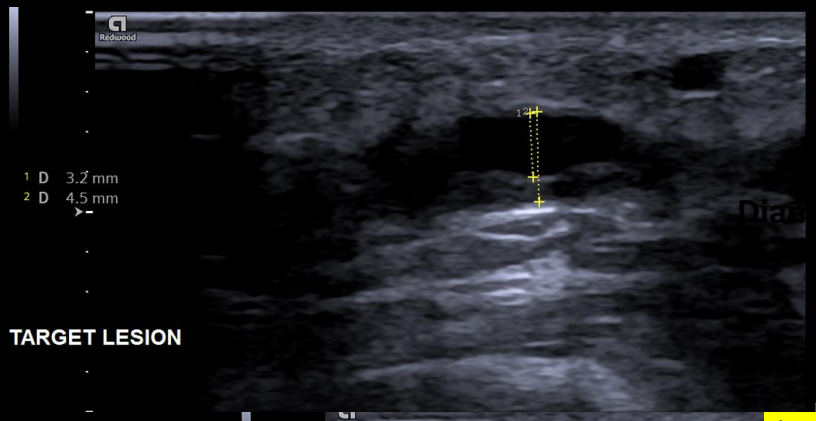
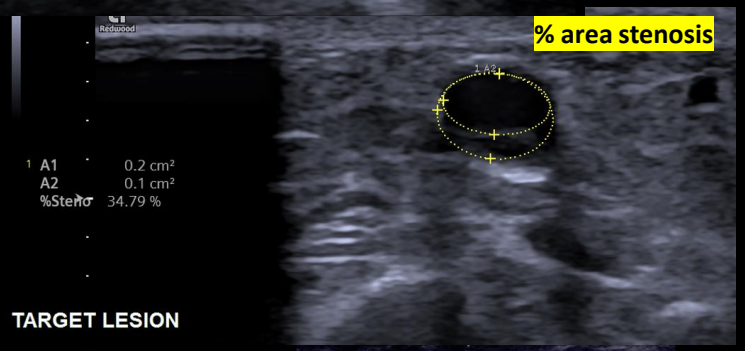
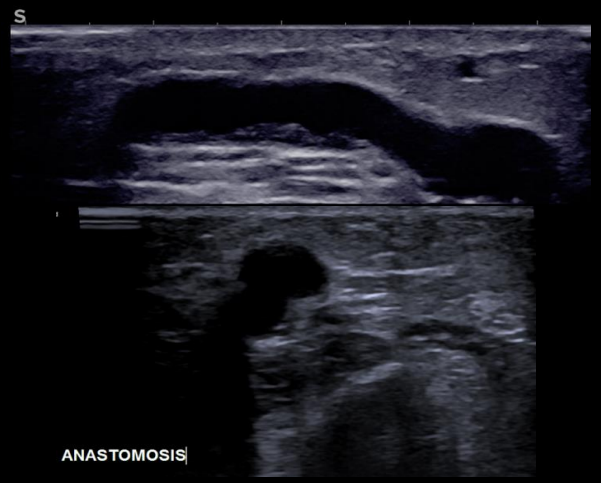
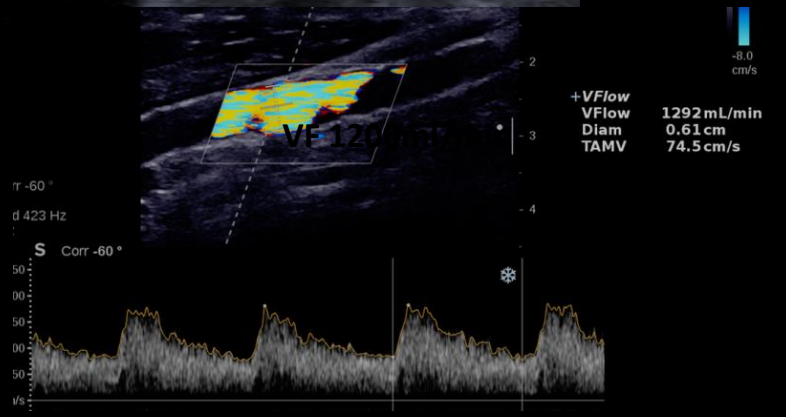
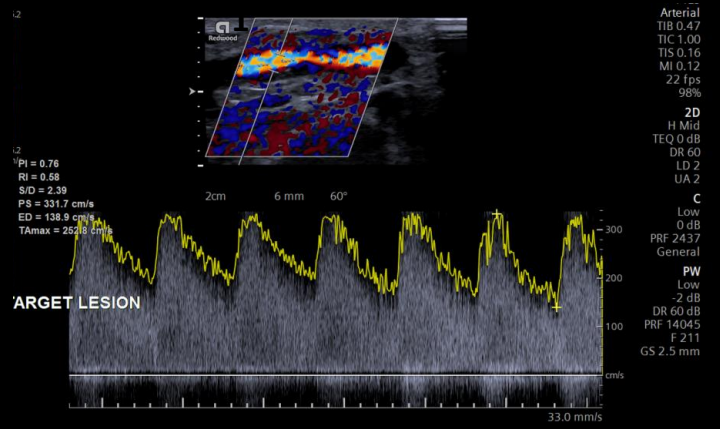




@ 6 months

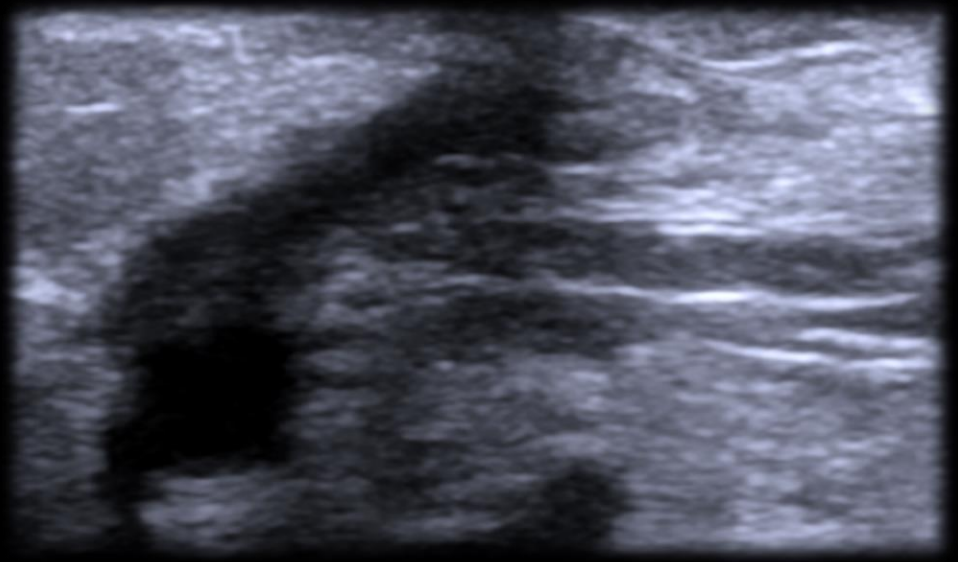


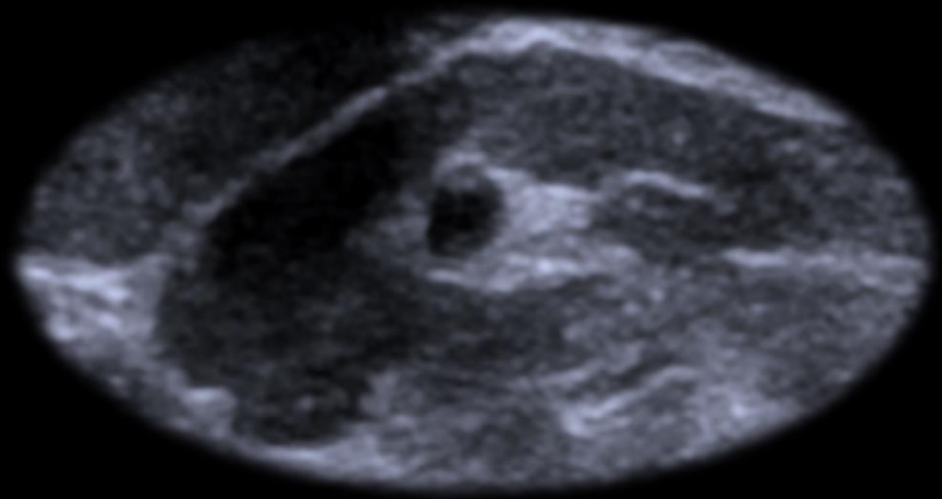




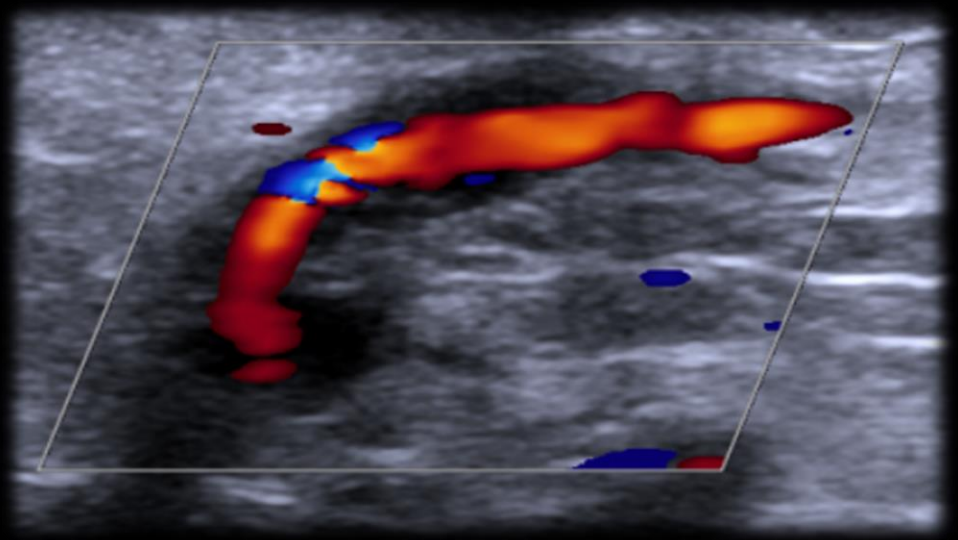
6 months

Ανώριμη βραχιονοκεφαλική AVF

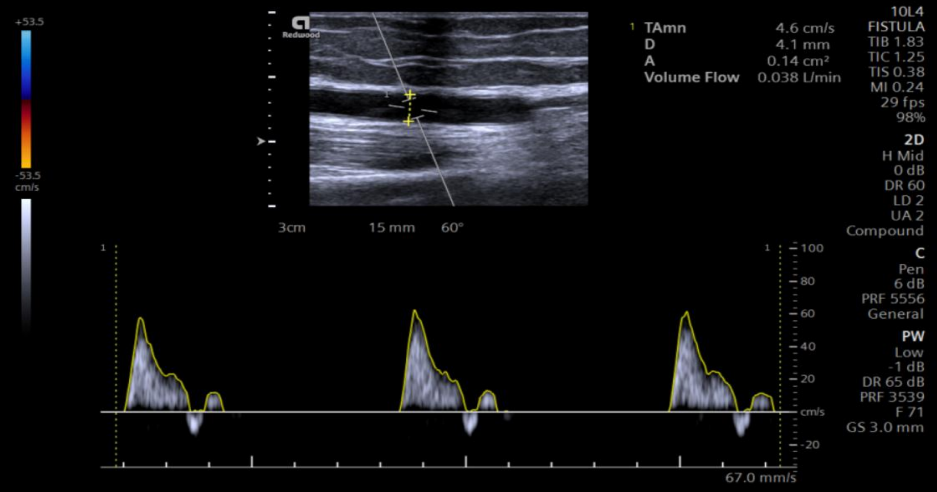




Αναστόμωση: υπερπλαστική στένωση

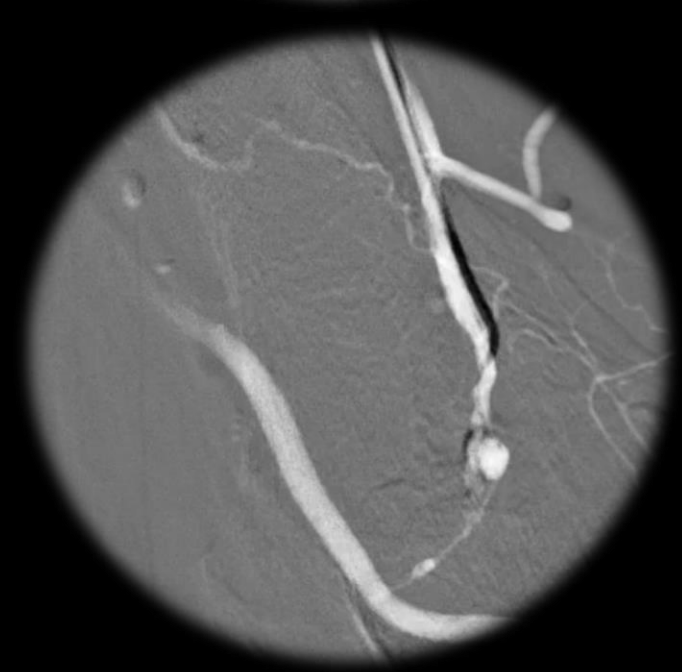


Juxta-anastomosis: ινωτική στένωση



PRE PTA VF: ~50 ml/min

Patient with IMMATURE left radial (HBBA) -cephalic AVF



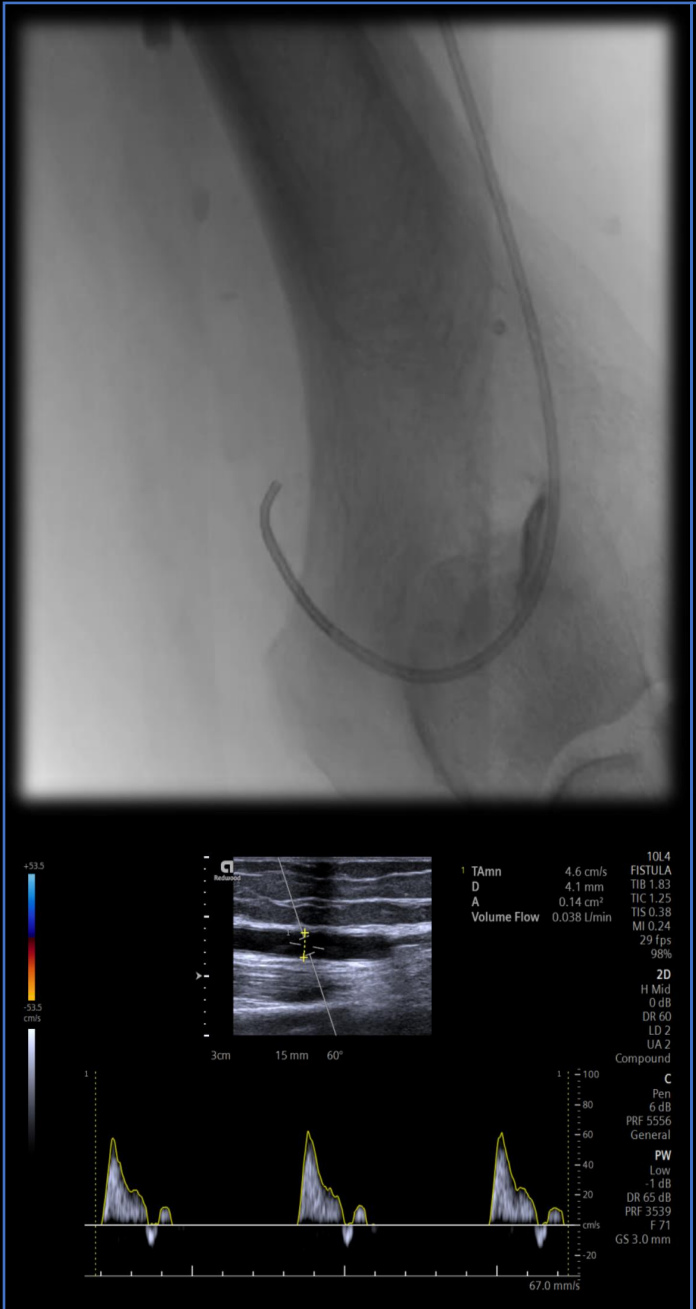
Patient with IMMATURE left radial (HBBA) -cephalic AVF

2nd High-Pressure Balloon Angioplasty

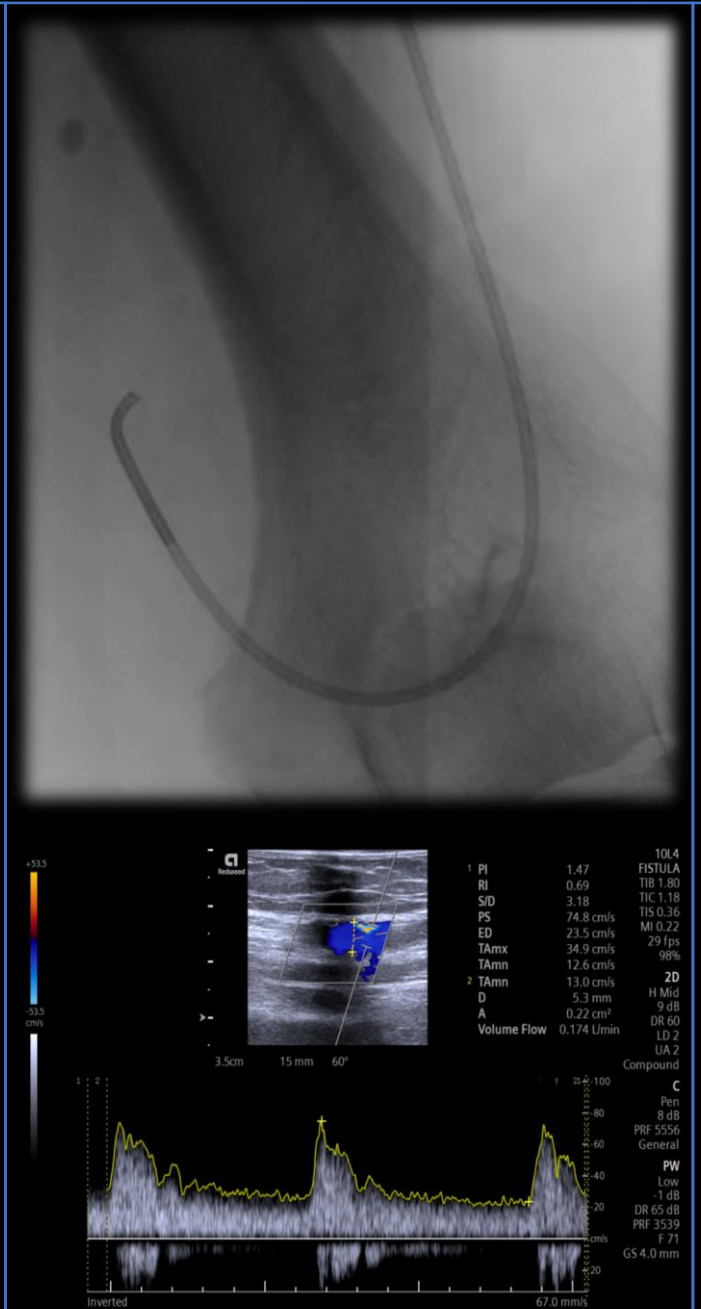
POST 1st Balloon Angioplasty

6 x 40 mm

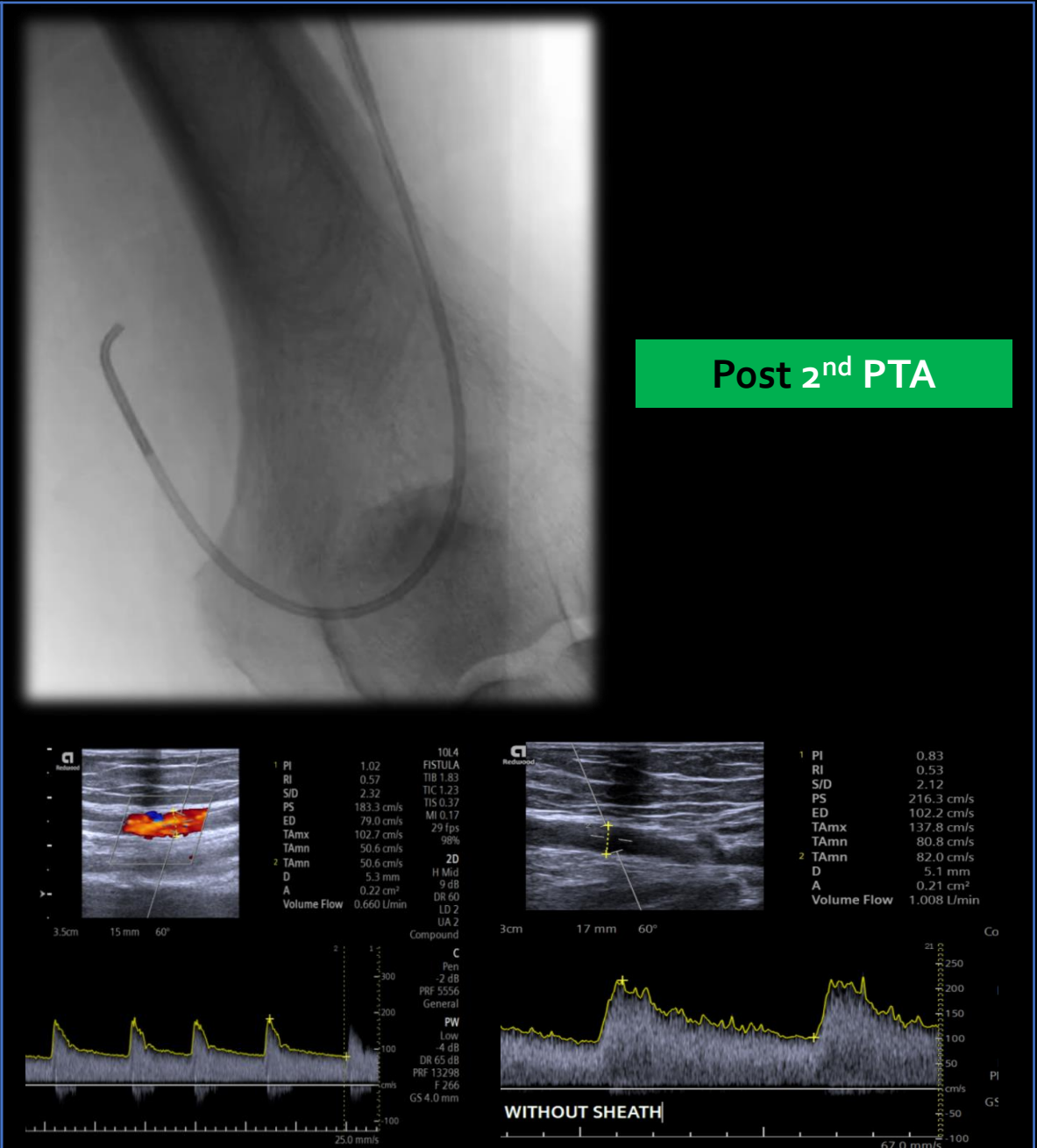
POST 2nd Balloon Angioplasty



Pre **PTA VF**: 38 ml/min



Post **1st PTA VF**: 174 ml/min

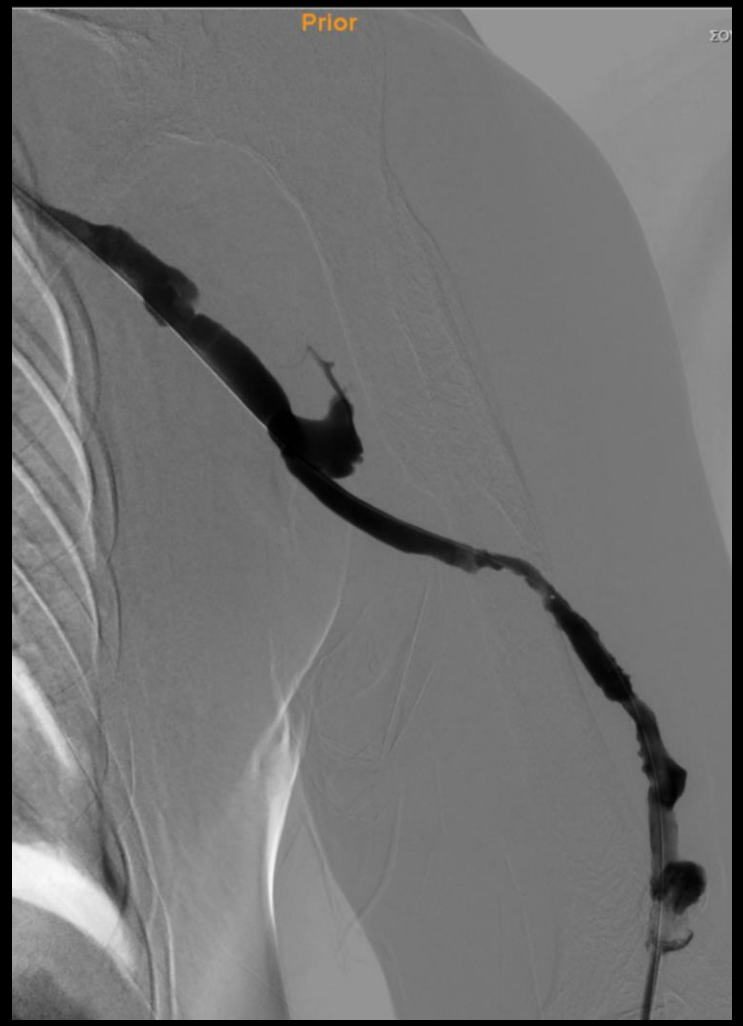


Sheath in place **VF**: 660 ml/min

Sheath Removal **VF**: **1008** ml/min

AVG 5 ετών
6mm HP-PTA

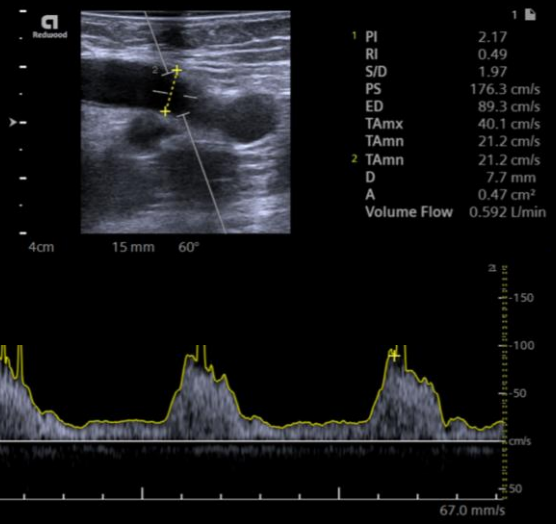
VF 220ml/min



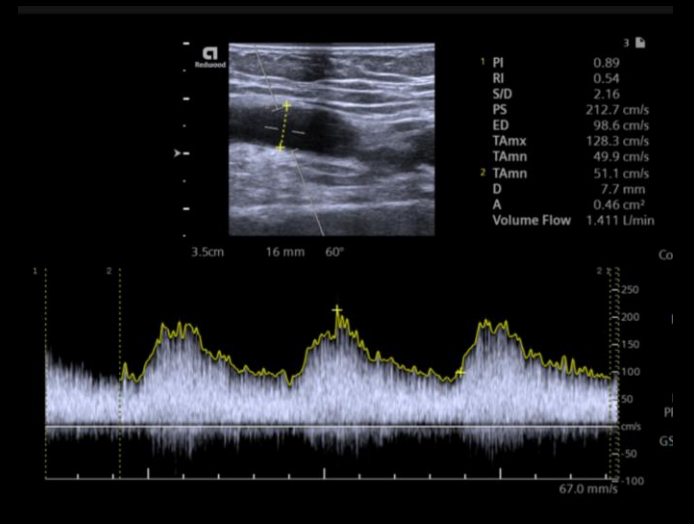
VF 1200ml/min

17 μήνες χωρίς επανεπέμβαση

VF 500ml/min



VF 1300ml/min



Όψιμη επανωρίμανση

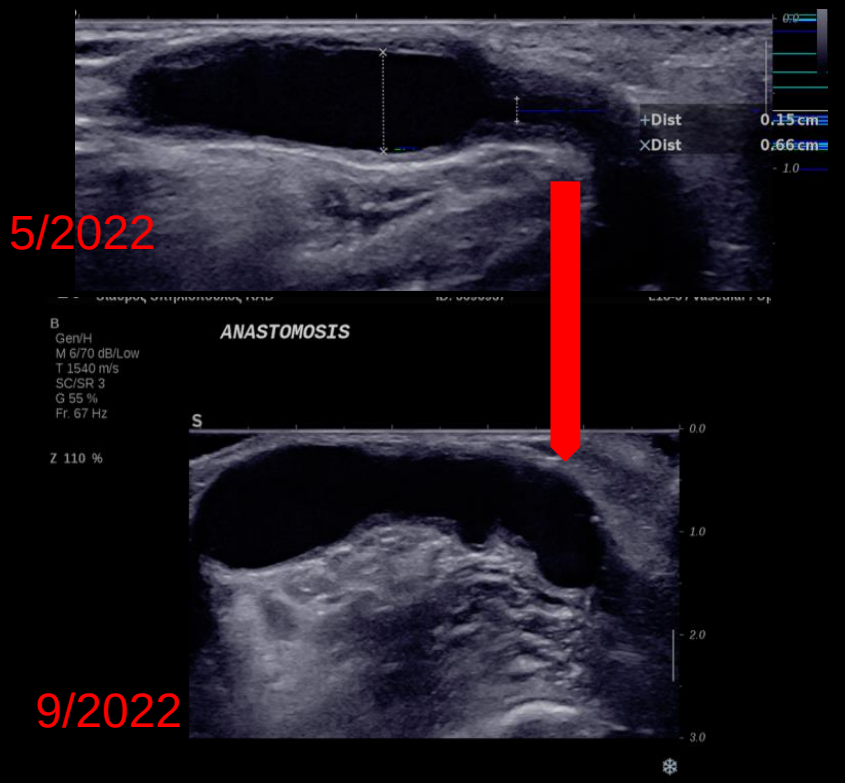
3 διαδοχικές αγγειοπλαστικές σε 14 μήνες:

1. Αύξηση της διαμέτρου παραναστομωτικά από 4χιλ σε 6.5χιλ

Πάντα προσπαθούμε για την διάσωση της γραμμής ζωής!

παρακέντησης αλλά και του όγκου ροής μετά την 3η αγγειοπλαστική.

3. Βατότητα χωρίς επανεπέμβαση 16 μηνές μετά την 3η αγγειοπλαστική
4. *30 μήνες συνολική βατότητα μετά την πρώτη δυσλειτουργία*



ΣΥΜΠΕΡΑΣΜΑΤΑ

Η αγγειοπλαστική και η χρήση stent graft αποτελούν στην πλειονότητα των στενώσεων gold standard μεθόδους διατήρησης της λειτουργίας των αγγειακών προσπελάσεων

Ενδαγγειακή αντιμετώπιση: υψηλά % διάσωσης και χαμηλά % επιπλοκών

Η συντήρηση των αγγειακών προσπελάσεων αιμοκάθαρσης περιλαμβάνει πληθώρα επεμβατικών τεχνικών και υλικών

Βατότητα-επαναστένωση: Level Ia evidence

Ο καθορισμός της έγκαιρης παρέμβασης είναι αποφασιστικής σημασίας και χρήζει περαιτέρω μελέτης (κόστος-όφελος)

Η χρήση των υπερήχων και του όγκου ροής (VF) αυξάνει της ασφάλεια και την αποτελεσματικότητα της ενδαγγειακής θεραπείας