La diagnosi precoce della stenosi di FAV attraverso l'utilizzo dello stetoscopio digitale

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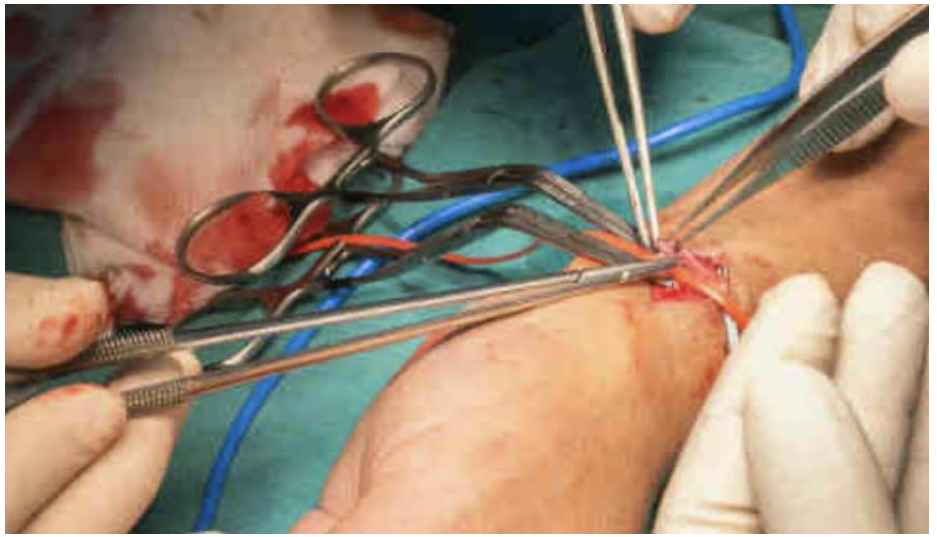
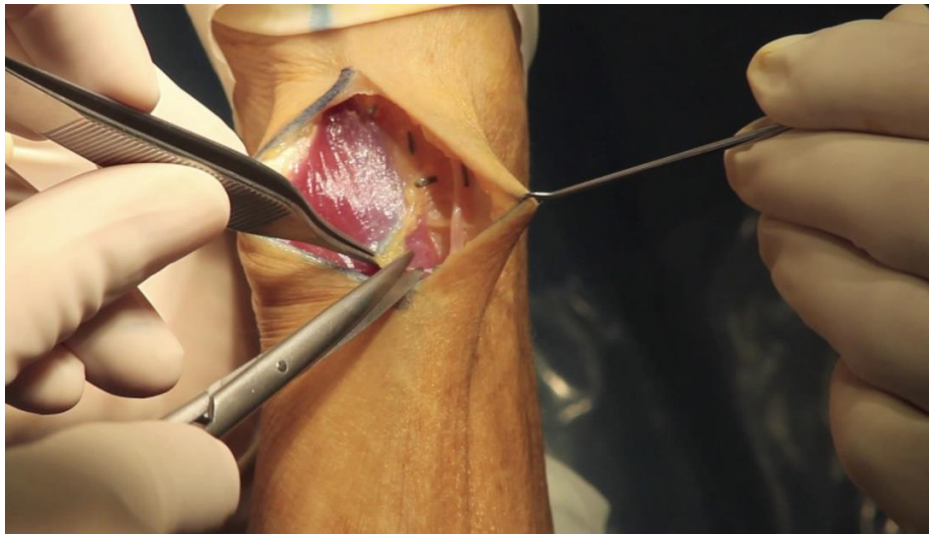
FISTOLA ARTERO-VENOSA

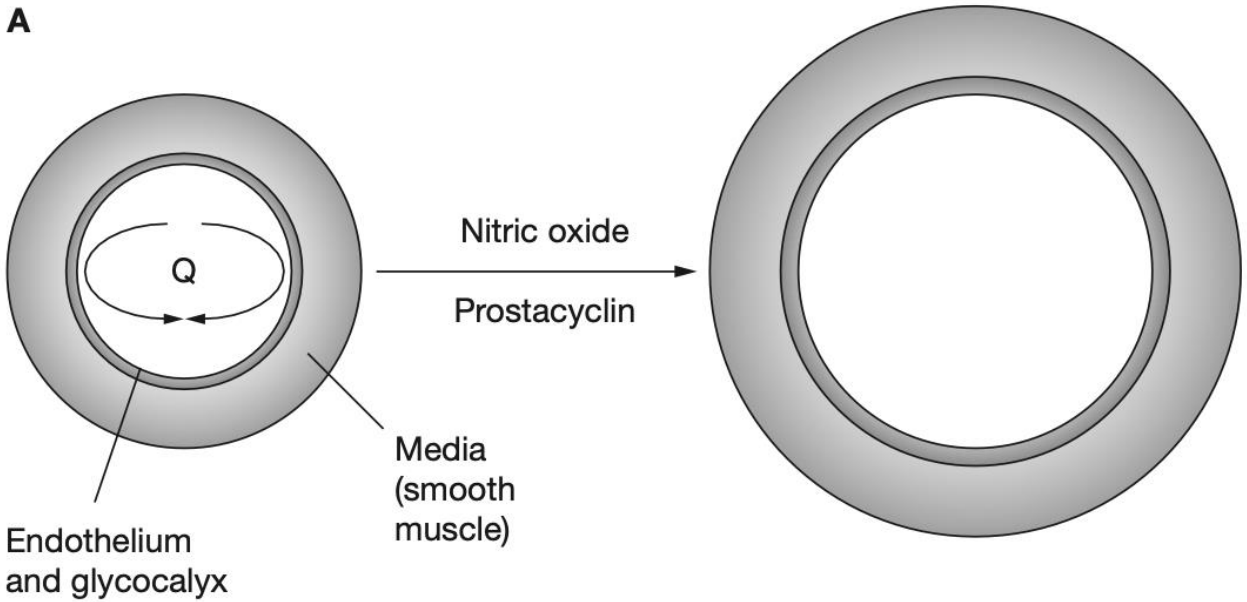
Il malfunzionamento dell'accesso vascolare è:

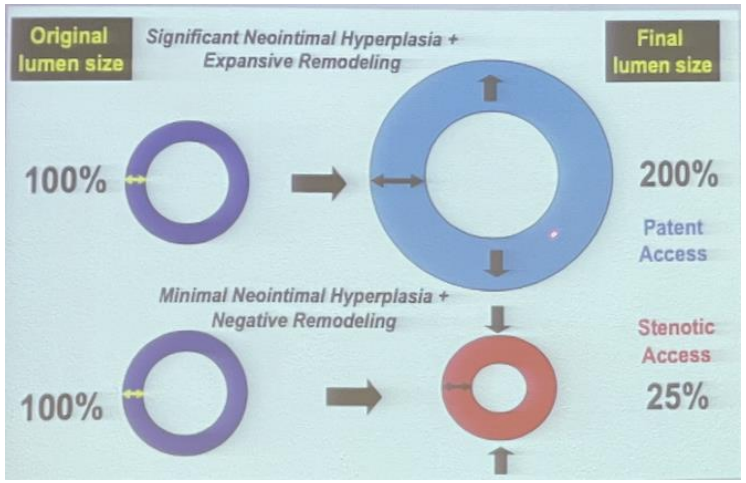
- la principale causa di morbidità nei pazienti emodializzati e rappresenta la prima causa di ricovero ospedaliero;

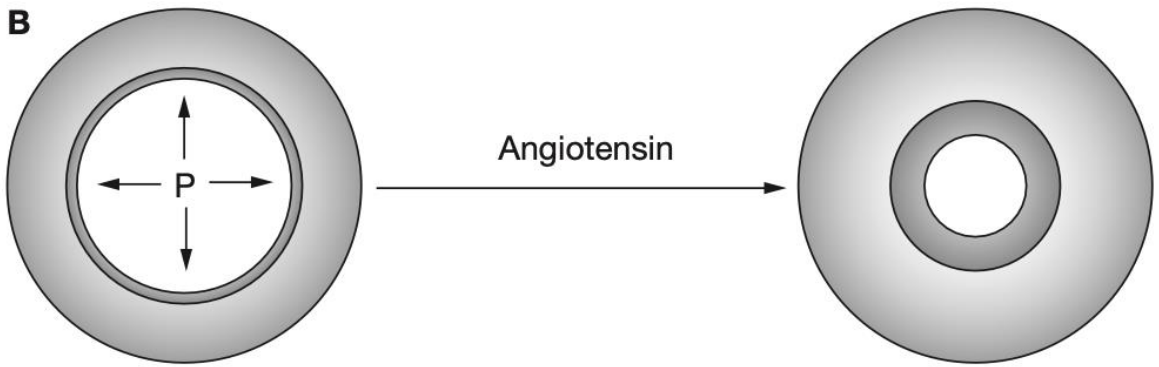
- il risultato di stenosi per iperplasia neo-intimale e/o inadeguato remodeling vascolare.

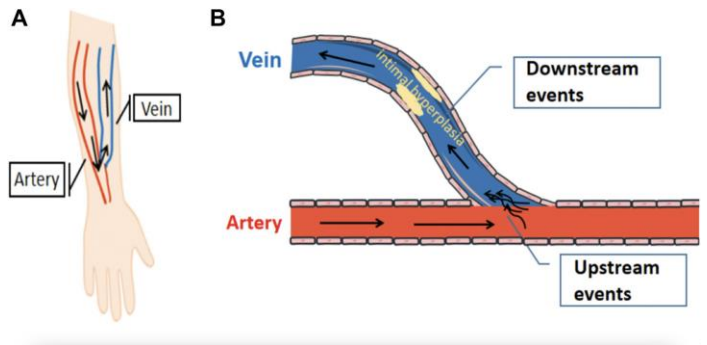


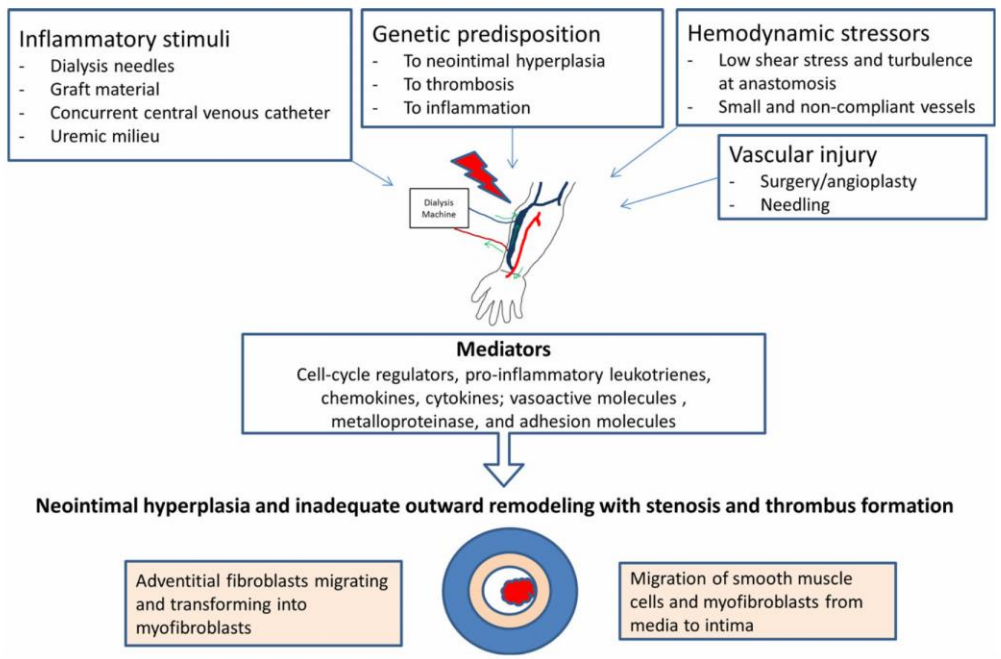


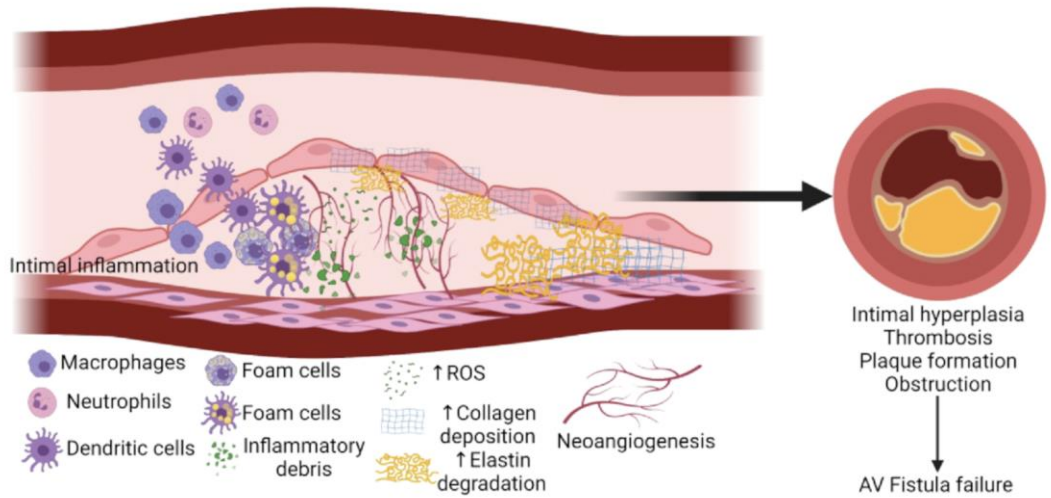

A
Q
Nitric oxide
Prostacyclin
Media
(smooth
muscle)
Endothelium
and glycocalyx


Original
lumen size
Significant Neointimal Hyperplasia +
Expansive Remodeling
Final
lumen size
100%
200%
Patent
Access
Minimal Neointimal Hyperplasia +
Negative Remodeling
Stenotic
Access
100%
25%

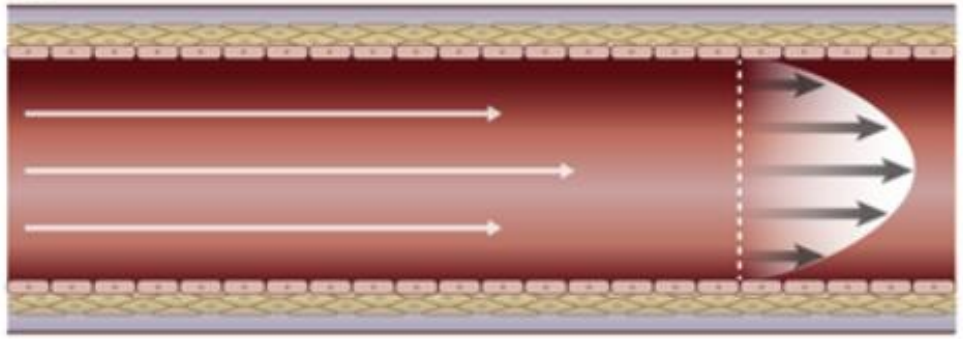

B
P
Angiotensin


A
Vein
Artery
B
Vein
Intimal hyperplasia
Downstream
events
Artery
Upstream
events

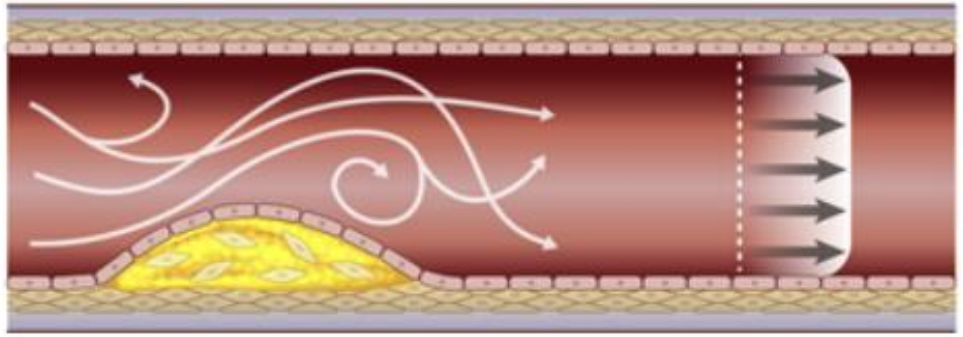

Inflammatory stimuli
- Dialysis needles
- Graft material
- Concurrent central venous catheter
- Uremic milieu
Genetic predisposition
- To neointimal hyperplasia
- To thrombosis
- To inflammation
Hemodynamic stressors
- Low shear stress and turbulence at anastomosis
- Small and non-compliant vessels
Vascular injury
- Surgery/angioplasty
- Needling
Dialysis Machine
Mediators
Cell-cycle regulators, pro-inflammatory leukotrienes, chemokines, cytokines; vasoactive molecules , metalloproteinase, and adhesion molecules
Neointimal hyperplasia and inadequate outward remodeling with stenosis and thrombus formation
Adventitial fibroblasts migrating and transforming into myofibroblasts
Migration of smooth muscle cells and myofibroblasts from media to intima


Intimal inflammation
Macrophages
Neutrophils
Dendritic cells
Foam cells
Foam cells
Inflammatory debris
↑ROS
↑Collagen deposition
↑Elastin degradation
Neoangiogenesis
Intimal hyperplasia
Thrombosis
Plaque formation
Obstruction
AV Fistula failure

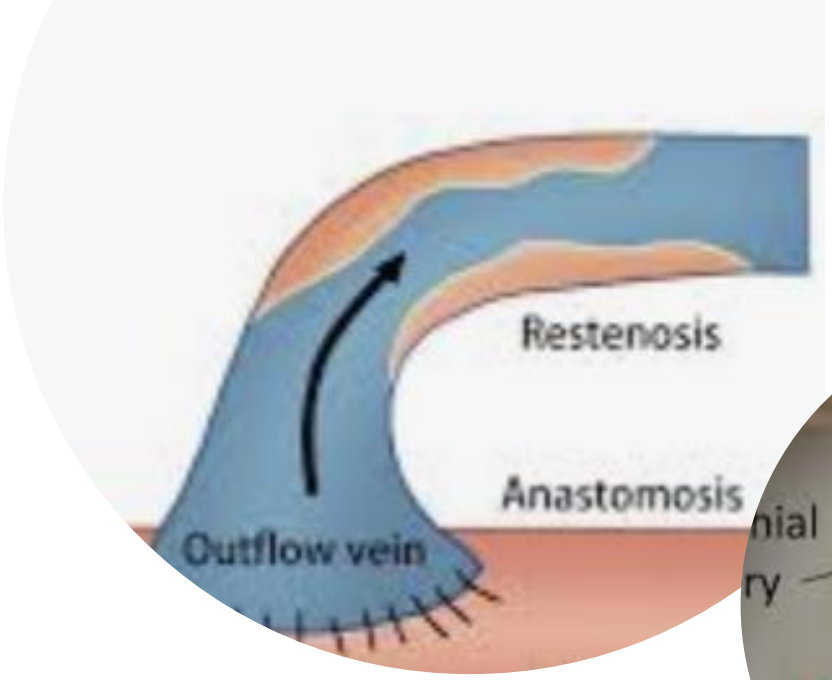
a) Laminar flow : Re < 2000

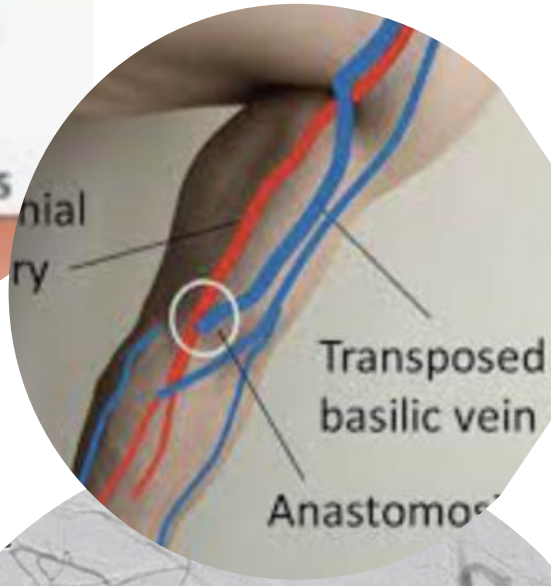


b) Turbulent flow : Re > 2000



- -biforcazioni
- -valvole venose
- -siti ad elevate velocità di flusso
- -swing point





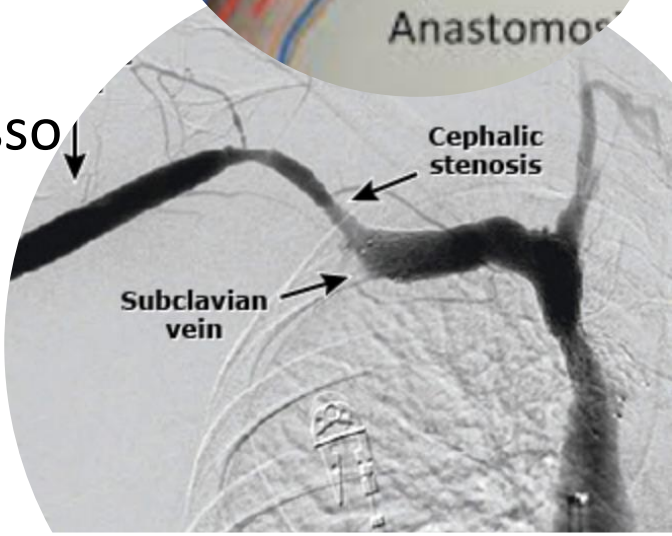


Table 13.1. Routine AV Access Monitoring by Physical Examination

Exam Steps	Fistula (Normal)	Graft (Normal)	Flow-related Dysfunction or Poor Maturation (Abnormal)	Infection, Steal Syndrome, or Aneurysm/Pseudoaneurysm[a] (Abnormal)
Look	Well-developed main venous outflow, no irregular/dilated areas or aneurysm formations, adequate areas of straight vein that can be used for 2-needle, rope-ladder cannulation Vessel collapses when arm is elevated above head	Uniform-sized graft in a loop or straight configuration No irregular areas or aneurysm or seroma formations with organized site rotation used for cannulation	AVF with poor maturation—multiple venous outflow veins (accessory veins), poorly defined cannulation areas **AVF:** Stenosis can occur in artery or any venous outflow vein Look for a narrowing of the outflow vein, abnormal pulsations, or aneurysm formations **AVF or AVG:** Dilated neck veins or surface collateral veins in the arm or neck above the vascular access	**Infection:** Redness, swelling, induration, drainage, or pus **Steal syndrome:** Extremity/hand discoloration, skin ulceration due to poor arterial blood flow to the hand Check nail beds, fingers and hand for unusual skin changes **Aneurysm** Abnormal areas of dilatation with overlying skin thinning
Listen with a stethoscope	Low-pitch continuous diastolic and systolic	Low-pitch continuous diastolic and systolic	High-pitch discontinuous systolic only	**Steal syndrome** AVF may have a very strong bruit
Feel with your fingers	Thrill at the arterial anastomosis and throughout the entire outflow vein that is easy to compress	Thrill strongest at the arterial anastomosis but should be felt over entire graft and be easy to compress	**AVF:** Pulse at the site of a stenotic lesion—may be water-hammer in quality and feel **AVG:** Thrill and/or pulse strong at the site of stenotic lesion pulse has a water-hammer feel An AVG with a low intra-access blood flow feels mushy Local area of the graft that feels mushy or irregular in shape can be a site of aneurysm formation	**Infection** Warm or painful to touch, swelling **Steal syndrome** Feel bilateral limbs (hands and fingers) and compare for the access limb to be the same as the nonaccess limb Compare temperature, grip strength, and range of motion and any complaints of changes in sensation or pain If the access limb has any major differences than the nonaccess limb, consider steal syndrome

Abbreviations: AVF, arteriovenous fistula; AVG, arteriovenous graft.
[a]Also see Guidelines 16 through 19 for specific complications.

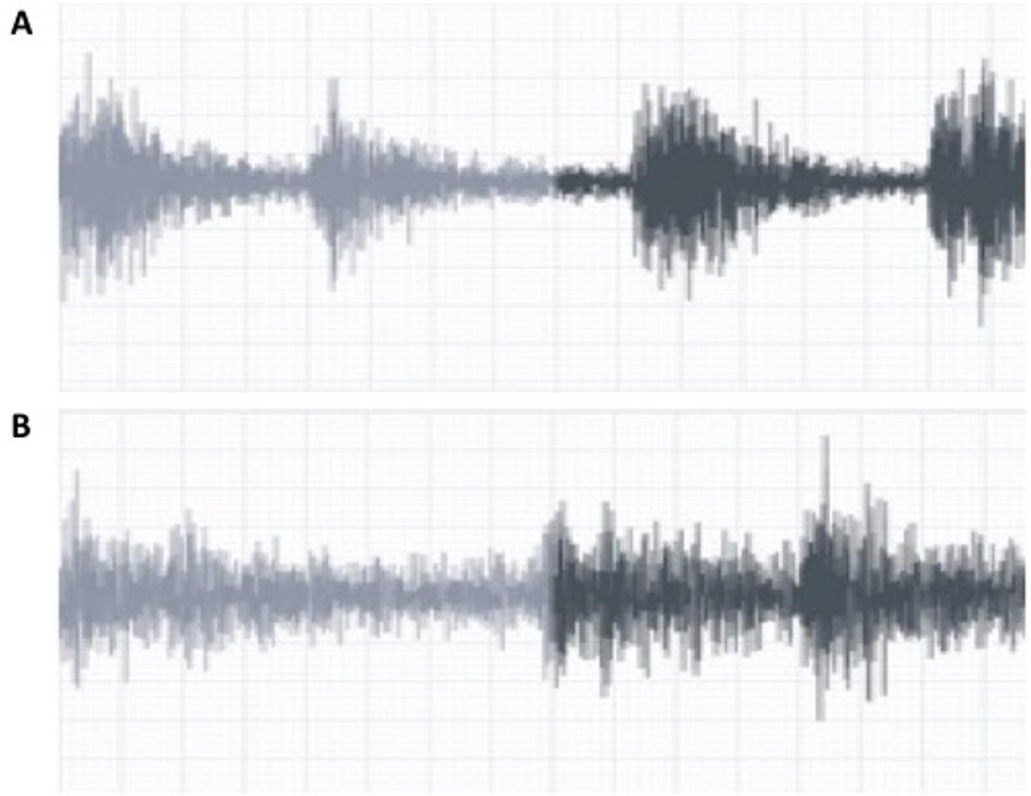
MONITORAGGIO FAV

Table 13.2. Clinical Indicators (Signs and Symptoms) Suggesting Underlying Clinically Significant Lesions During Access Monitoring

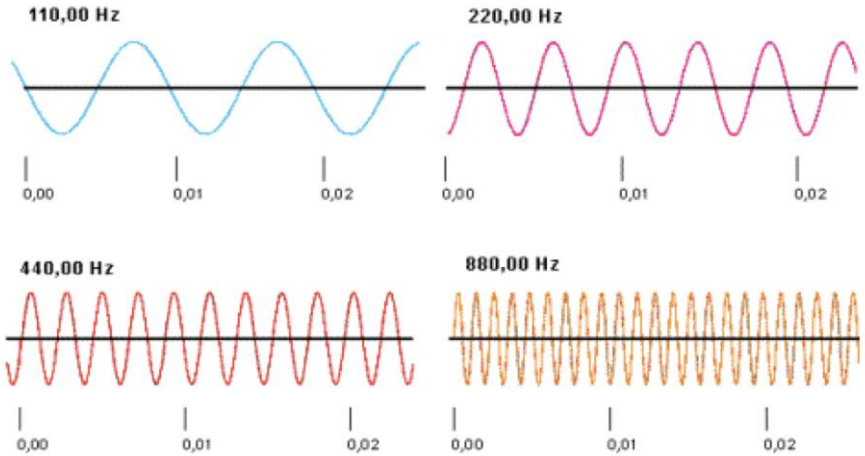
Procedure	Clinical Indicators	
Physical examination or check	• Ipsilateral extremity edema	354,365
	• Alterations in the pulse, with a weak or resistant pulse, difficult to compress, in the area of stenosis	378
	• Abnormal thrill (weak and/or discontinuous) with only a systolic component in the region of stenosis	239
	• Abnormal bruit (high pitched with a systolic component in the area of stenosis)	360
	• Failure of the fistula to collapse when the arm is elevated (outflow stenosis) and lack of pulse augmentation (inflow stenosis)	267
	• Excessive collapse of the venous segment upon arm elevation	
Dialysis	• New difficulty with cannulation when previously not a problem	379
	• Aspiration of clots	239
	• Inability to achieve the target dialysis blood flow	360
	• Prolonged bleeding beyond usual for that patient from the needle puncture sites for 3 consecutive dialysis sessions	
	• Unexplained (>0.2 units) decrease in the delivered dialysis dose (Kt/V) on a constant dialysis prescription without prolongation of dialysis duration	


BIG NEWS

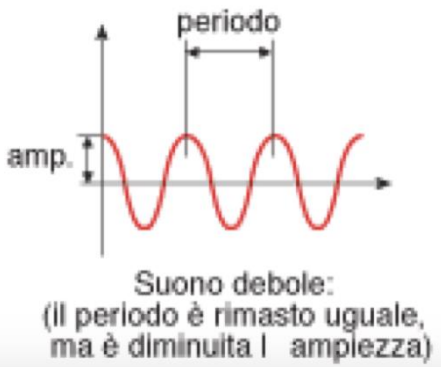

9:41
Eko PCG
Heart Rate
72 BPM
00:00
Done
Patient


A
B

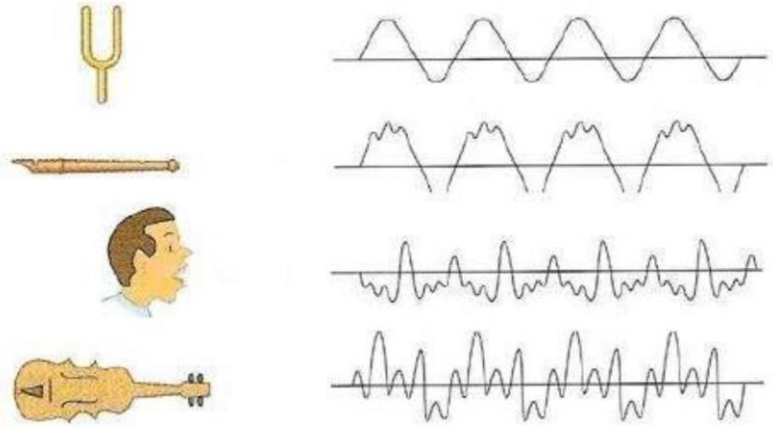
ALTEZZA



INTENSITA’



TIMBRO

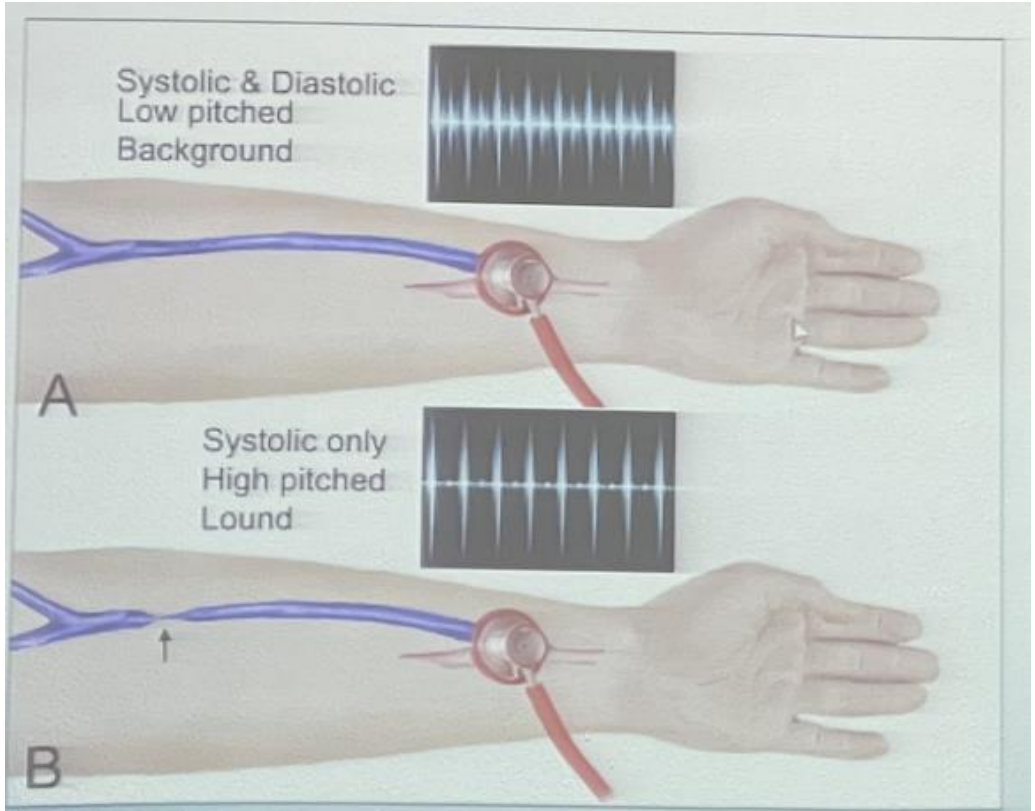


The **BRUIT** is the auditory manifestation of a thrill and has the same basic implications.

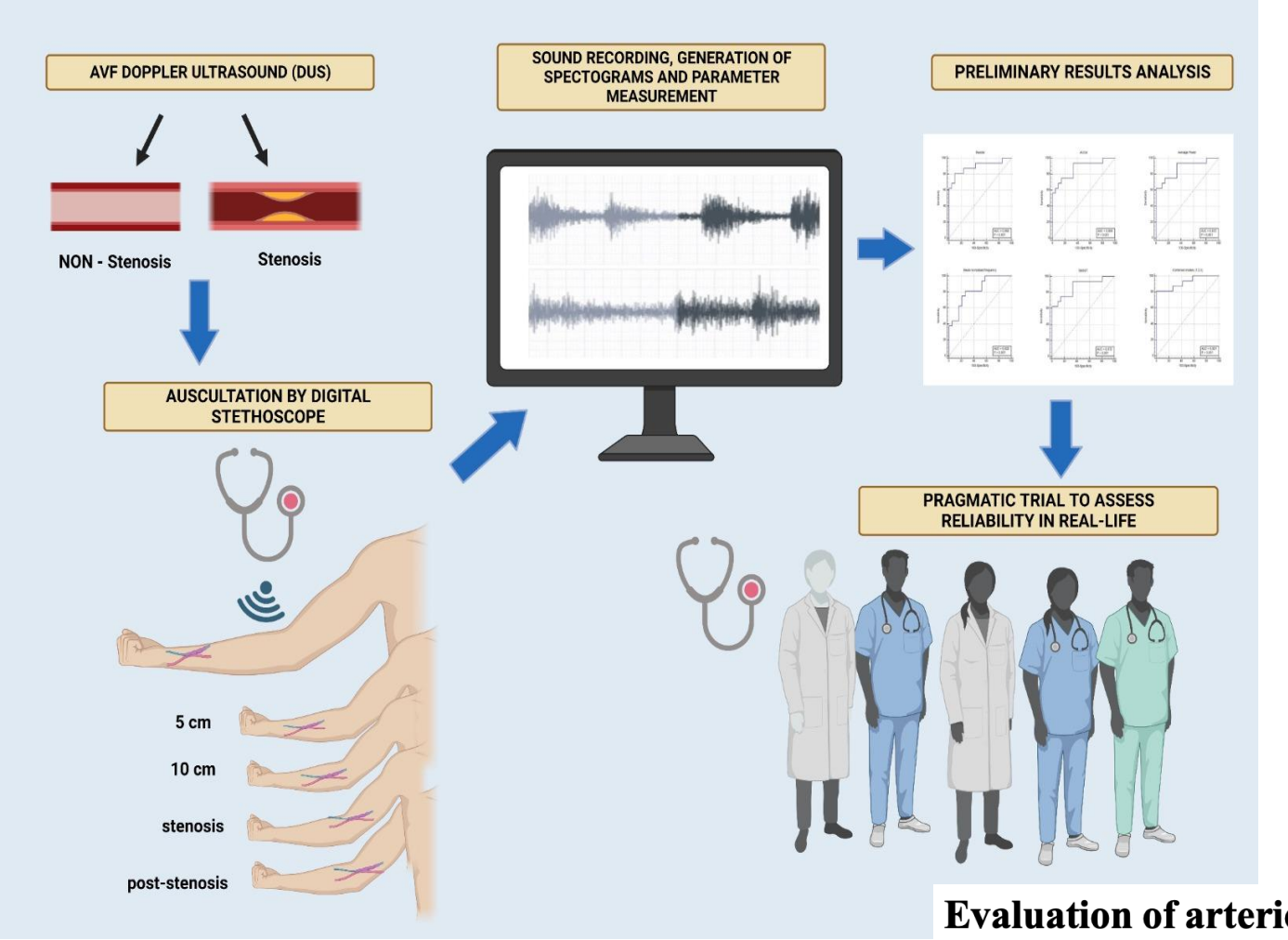
NORMAL BACKGROUND BRUIT: has both systolic and diastolic components and is a low-pitched, soft rumbling, machinery-like sound.

OUTFLOW STENOSIS: Increasing resistance from a progressively stenotic lesion will result in the progressive loss of the diastolic component and with this the pitch becomes progressively higher.

INFLOW STENOSIS: discontinuous and decreased



A. Normal situation
B. Outflow stenosis



Evaluation of arteriovenous fistula for hemodialysis with a new generation digital stethoscope: a pilot study

Pierangela Presta[a], Nazareno Carullo[a], Annarita Armeni[b], Maria Teresa Zicarelli[a], Michela Musolino[a], Salvatore Chiarella[b], Michele Andreucci[a], Antonino S Fiorillo[c], Salvatore Andrea Pullano[c], Davide Bolignano[a] and Giuseppe Coppolino[a*]

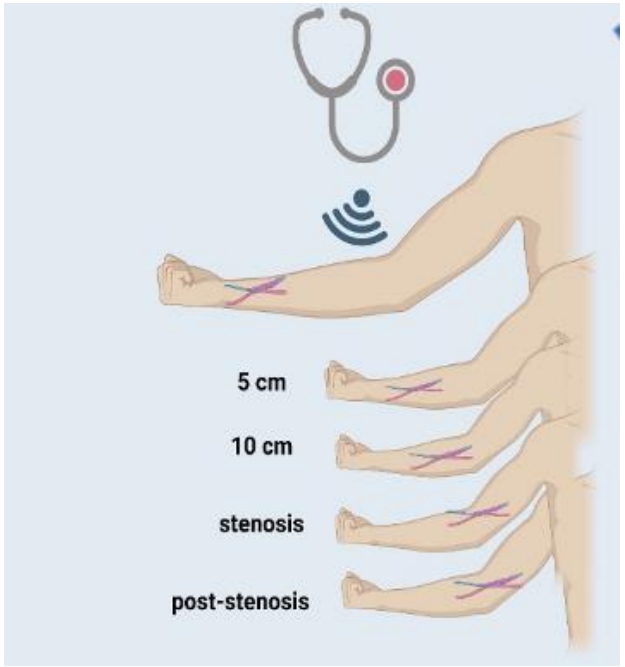
SETTEMBRE 2022 A GENNAIO 2023 → 64 PAZIENTI IN HD CON FAV → 48 PAZIENTI

<18 anni
FAV protesica
FAV non chirurgica
FAV allestita da meno di 6 mesi
Recente trattamento per trombosi di FAV

FAV allestite chirurgicamente da almeno 6 mesi

STENOSI

16



NON STENOSI

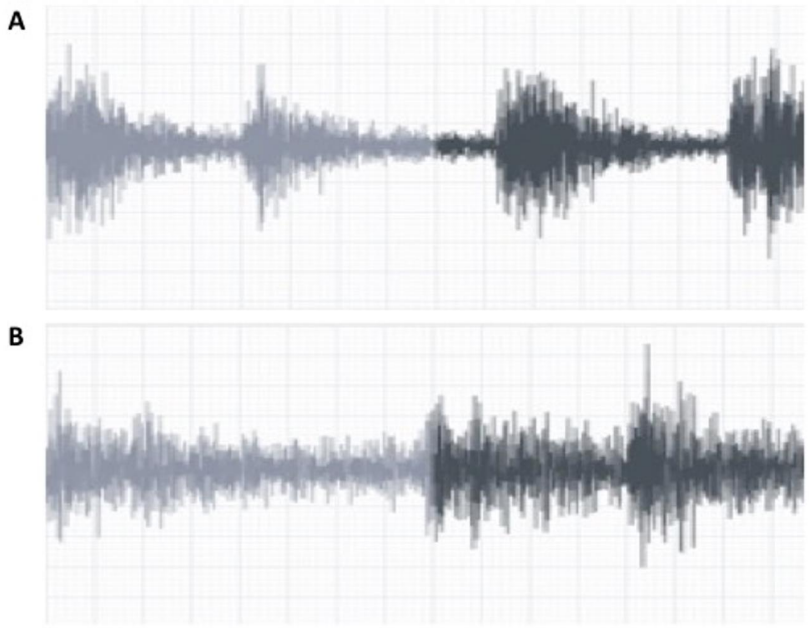
32

STENOSI EMODINAMICAMENTE SIGNIFICATIVA

46.88%

CRITERI MAGGIORI	Riduzione del diametro del vaso > 50%	Rapporto fra velocità di picco sistolico (SPV) nella regione di stenosi e nella regione pre-stenotica > 2	
CRITERI MINORI	Riduzione della portata [QA] <500ml/min	Riduzione della QA>25% rispetto ai valori precedenti	Lume residuo<2mm

1. Roca-Tey R et al., *J Vasc Access*. 2018;19:422-429.
2. Malik J et al,. *J Vasc Access*. 2014;15 Suppl 7:S28-32.



Maximum feature

Average feature

RMS feature

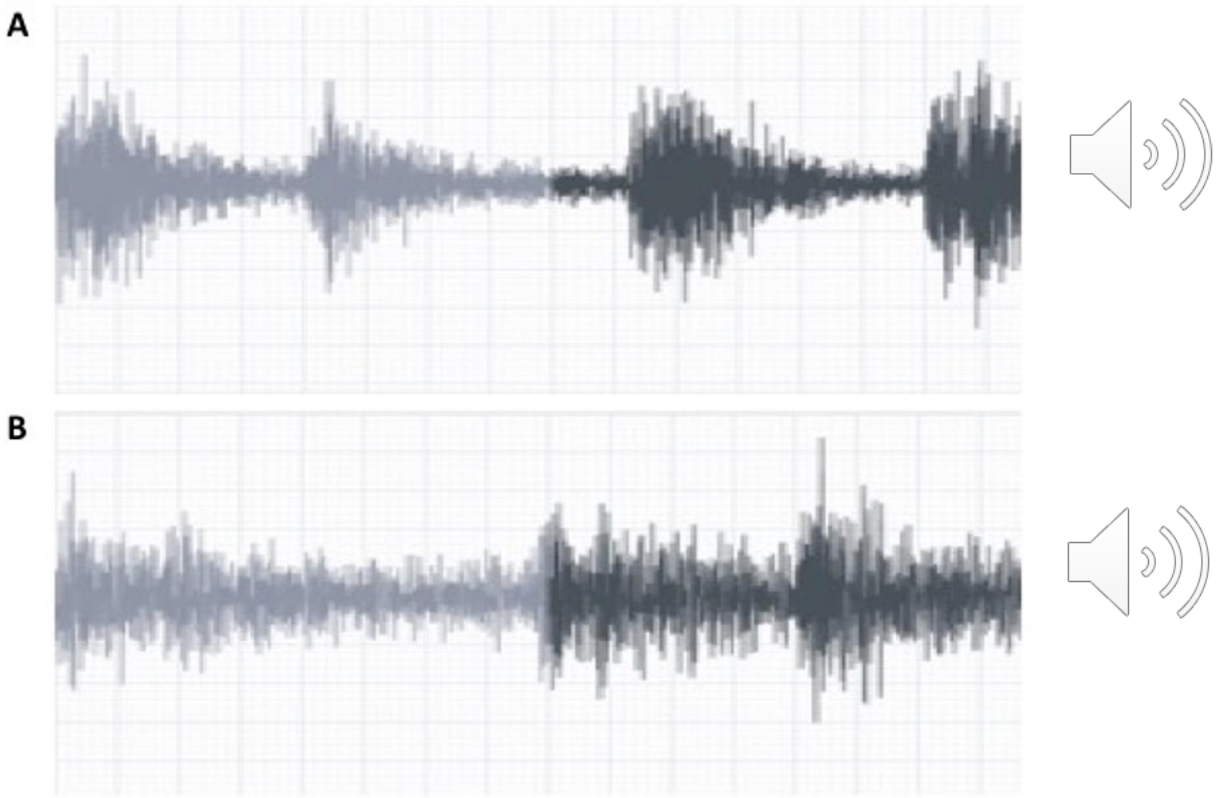
→ INTENSITA’ DEL SEGNALE

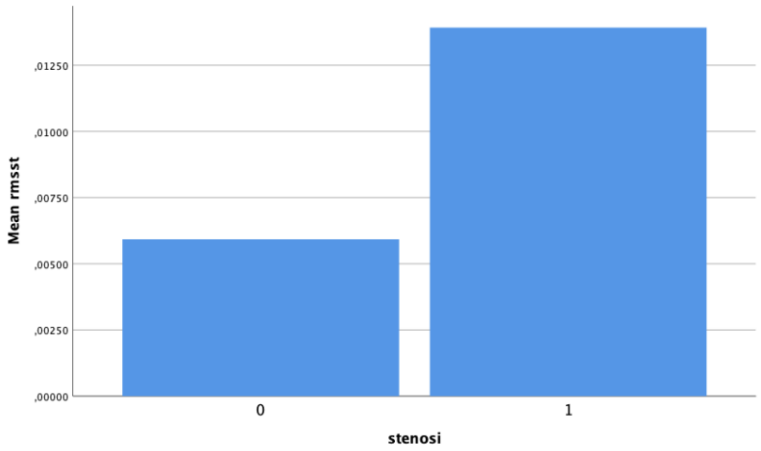
Average Power feature

Mean Normalized Frequency feature

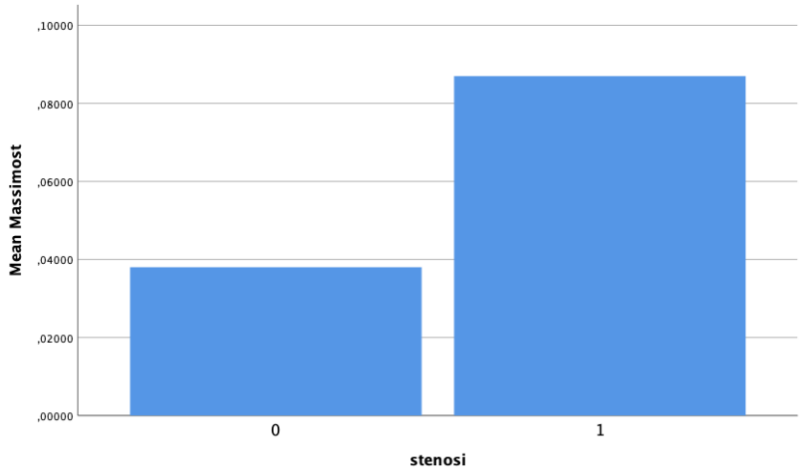
→ FREQUENZA DEL SEGNALE

		Stenosis		
	Overall	Yes	No	p
Number (%)	48 (100)	16 (33)	32 (67)	-
Age (years)	68.73±13.8	72±10.9	66.35±15.9	0.47
Males (%)	29 (60.41)	9 (56.25)	20 (43.75)	0.3
BMI (kg/m^2)	25.9±3.5	24.7±4.1	27.2±3	0.4
Diabetes (%)	14 (29.1)	5 (31.25)	8 (25)	0.6
History of CVD (%)	25 (52)	9 (56.25)	16 (50)	0.6
Smoking (%)	3 (6.25)	1 (6.25)	2 (6.25)	0.4
Hypertension (%)	16 (33.3)	7 (43.75)	9 (28.12)	0.2
Systolic blood pressure (mmHg)	136±14	138±15	135±14	0.8
Diastolic blood pressure (mmHg)	81±6	82±5	81±6	0.3
Antihypertensive drugs (n)	1.5±0.5	1.5±0.5	1.5±0.5	0.7
HD vintage (months)	28.95±8.5	29.5±10	28.4±7	0.4
Vintage of AV access (years)	25.5±10.7	24.7±11.7	26.4±9.5	0.4
Types of FAV	-	-	-	0.6
Distal	14 (29.2)	6 (37.5)	8 (25)	
Mid-arm	11 (22.9)	3 (18.75)	8 (25)	
Proximal	23 (47.9)	7 (43.75)	16 (50)	
Access flow (ml/min)	916.36±626.81	798±445.89	1007±827.47	0.45





P<0.05



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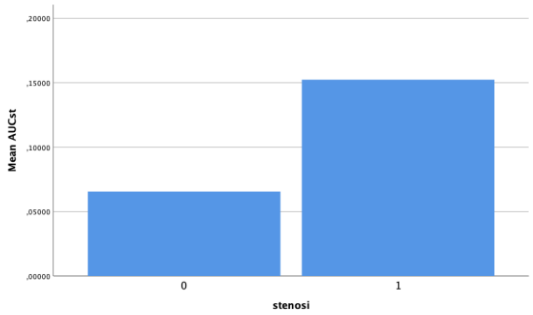

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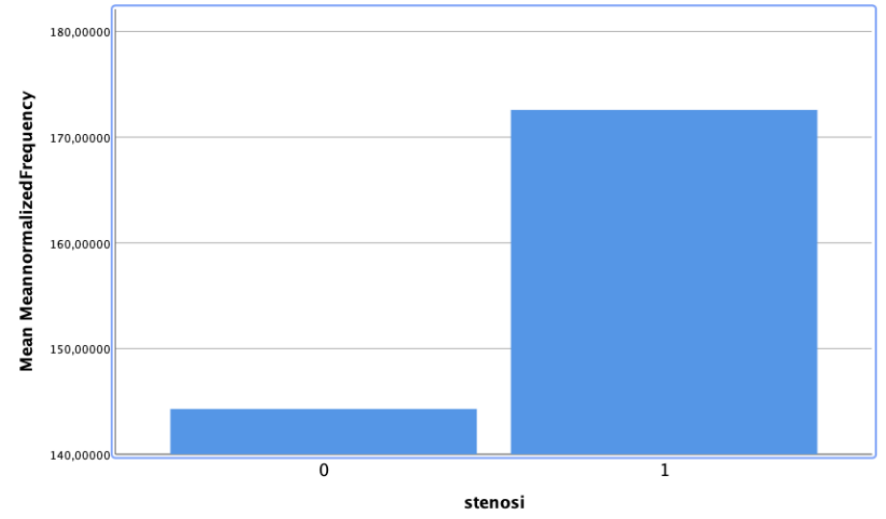

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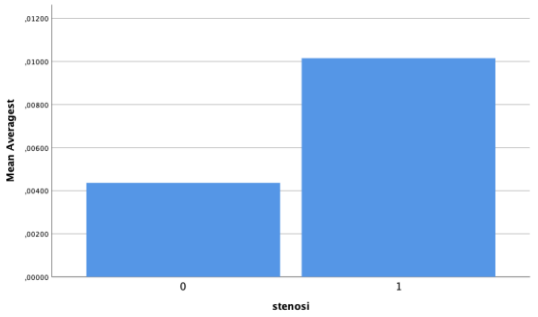

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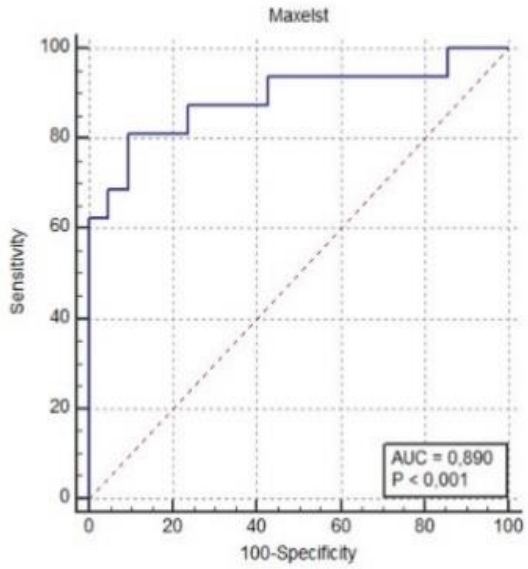
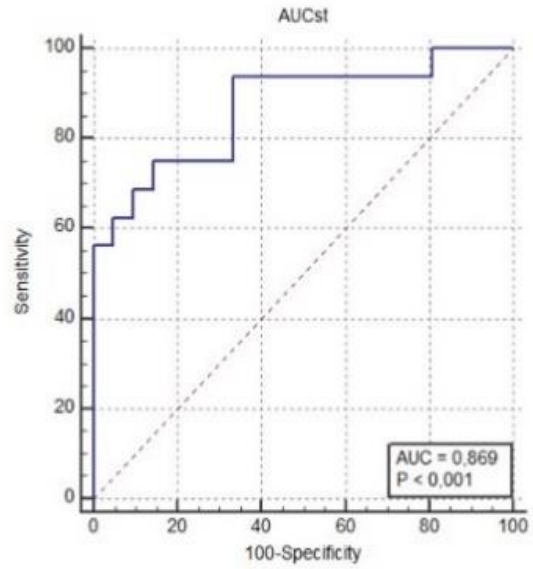
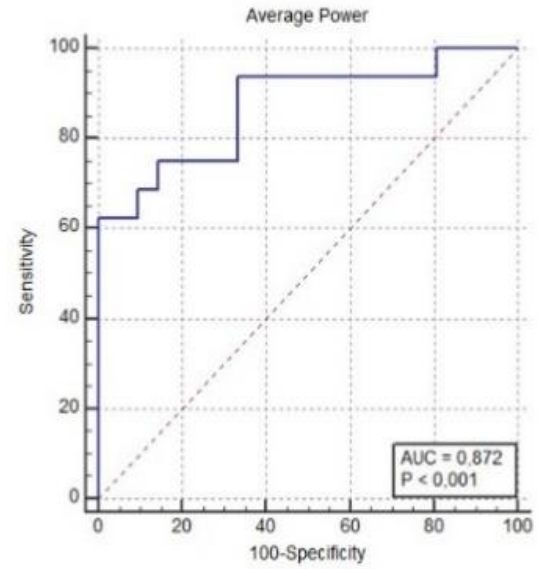
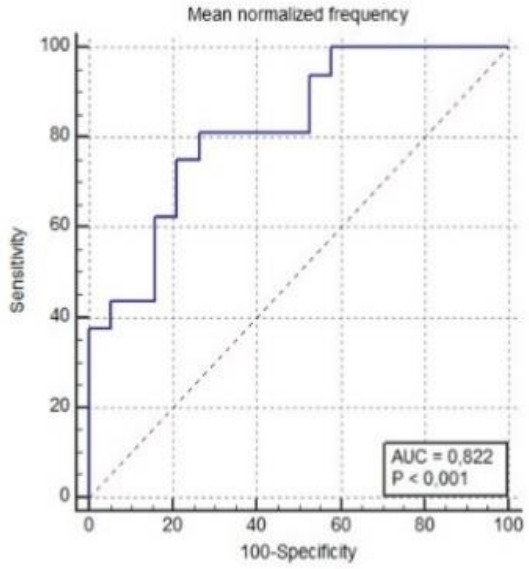
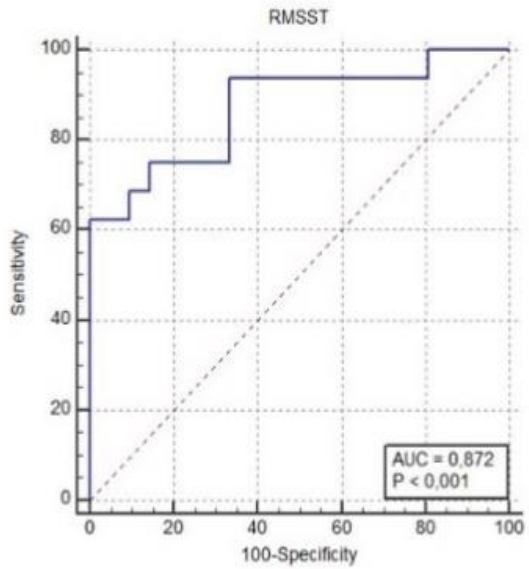
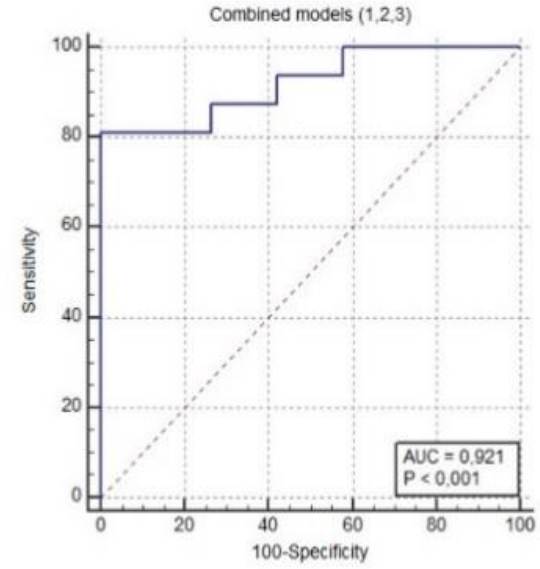

MaxeIst
Sensitivity
100-Specificity
AUC = 0,890
P < 0,001


AUCst
Sensitivity
100-Specificity
AUC = 0,869
P < 0,001


Average Power
Sensitivity
100-Specificity
AUC = 0,872
P < 0,001


Mean normalized frequency
Sensitivity
100-Specificity
AUC = 0,822
P < 0,001


RMSST
Sensitivity
100-Specificity
AUC = 0,872
P < 0,001


Combined models (1,2,3)
Sensitivity
100-Specificity
AUC = 0,921
P < 0,001

8 giovani medici

↓

training

↓

4 siti di auscultazione

↓

32 rilevazioni

↓

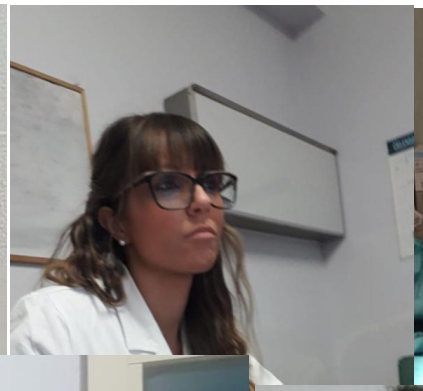
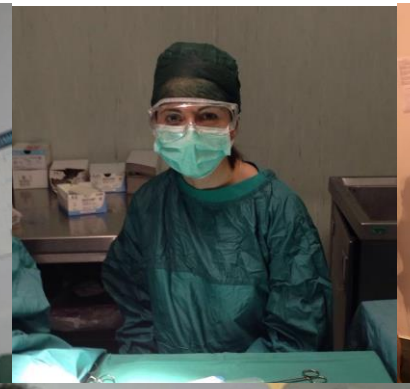
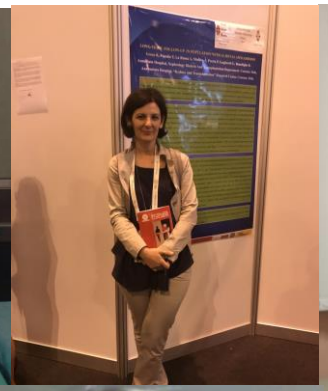
78,125%

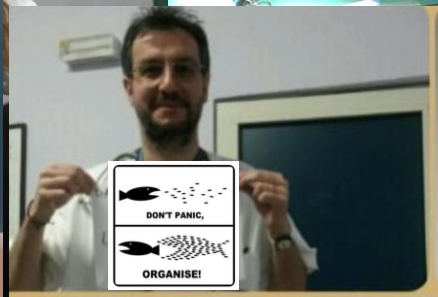
VALORE PREDITTIVO POSITIVO DEL 87.5%

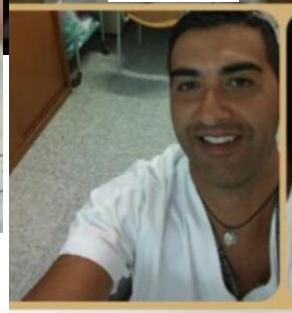
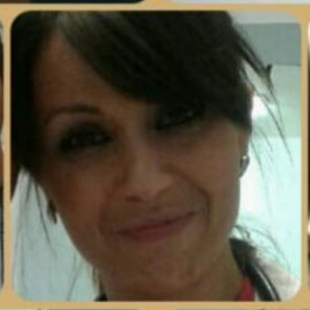
VALORE PREDITTIVO NEGATIVO DEL 68.45%

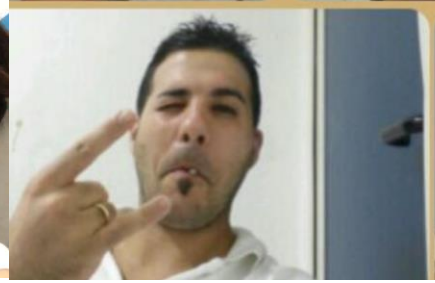
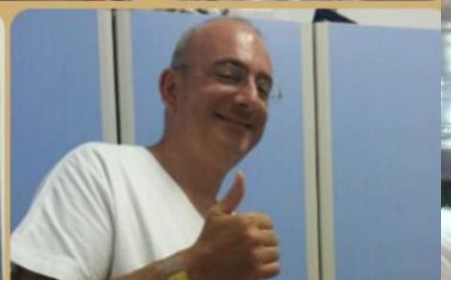
Conclusioni

Il fonendoscopio digitale potrebbe essere uno strumento utile per il monitoraggio dell’accesso vascolare.


MEDICI






DON'T PANIC,
ORGANISE!


MEDICO



O. Fallaci
Non si fa il proprio dovere
perche' qualcuno ci dica grazie...
lo si fa per principio,
per se stessi,
per la propria dignita'.


Se ciascuno di noi
facesse il suo pezzettino,
ci troveremmo in un
mondo più bello senza
neanche accorgercene.
Teresa Sarti
Disegno di Guido Scarabottolo


UMG