I PER-CORSI
IN
NEFROLOGIA
E DIALISI

II CORSO
L'ACCESSO DIALITICO

14 ottobre 2022
NH Hotel Pontevecchio
Lecco

Scelta dell'accesso vascolare per emodialisi

Mapping ecografico/flebografico dei vasi degli arti superiori

Dott.ssa Sara Colzani

Sistema Socio Sanitario
Regione Lombardia
ASST Brianza

Scelta dell'accesso vascolare per emodialisi

CLINICAL EPIDEMIOLOGY www.jasn.org

Associations between Hemodialysis Access Type and Clinical Outcomes: A Systematic Review

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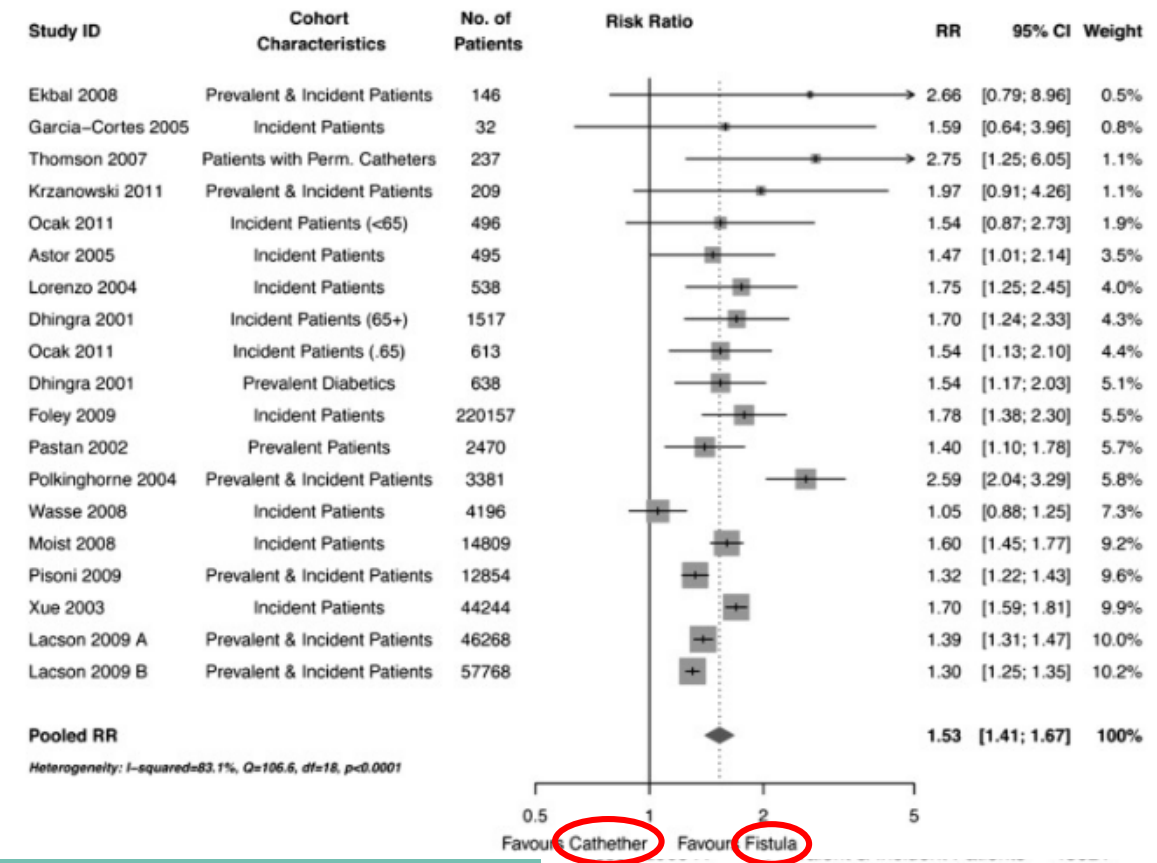
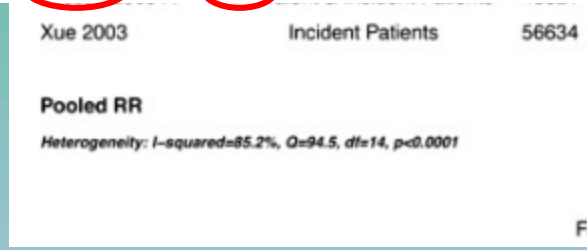
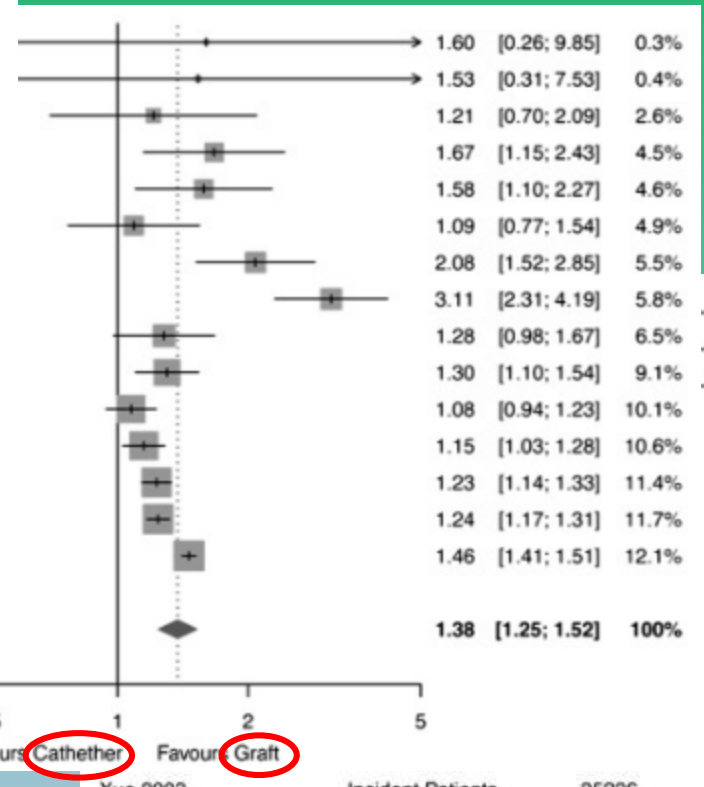
Ravani, P., Palmer, S. C., Oliver, M. J., Quinn, R. R., MacRae, J. M., Tai, D. J., Pannu, N. I., Thomas, C., Hemmelgarn, B. R., Craig, J. C., Manns, B., Tonelli, M., Strippoli, G. F., & James, M. T. (2013). Associations between hemodialysis access type and clinical outcomes: a systematic review. *Journal of the American Society of Nephrology : JASN*, *24*(3), 465–473.

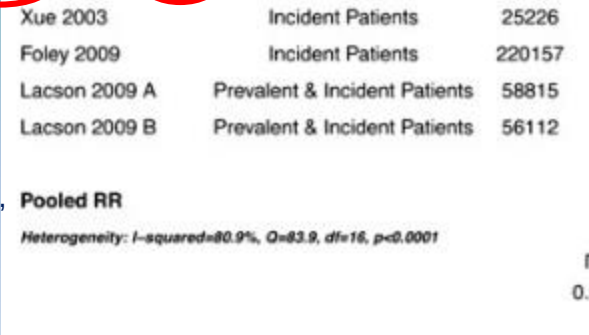
Scelta dell'accesso vascolare per emodialisi

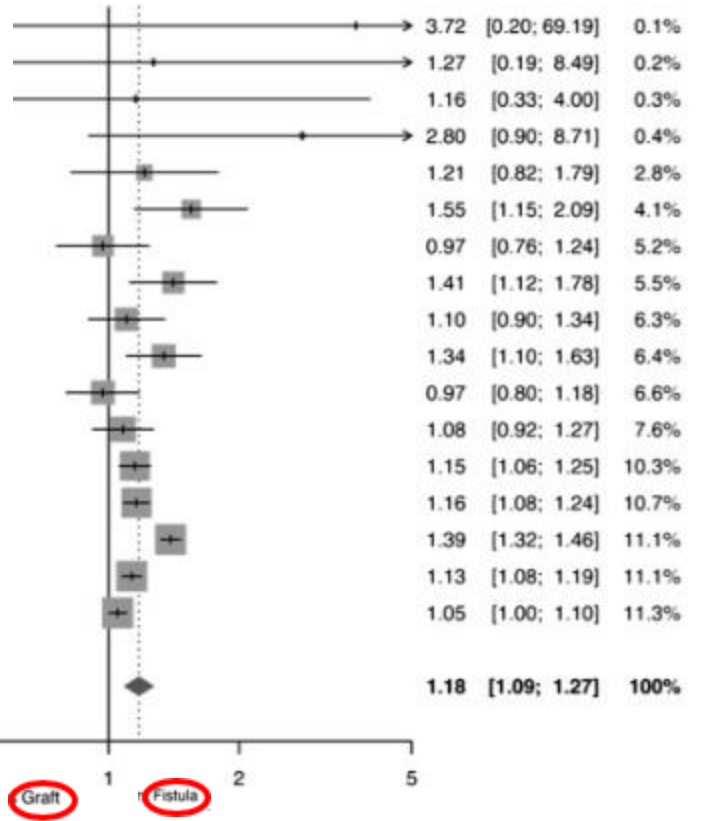
meta-analisi (62 studi di coorte)
risk of all-cause mortality











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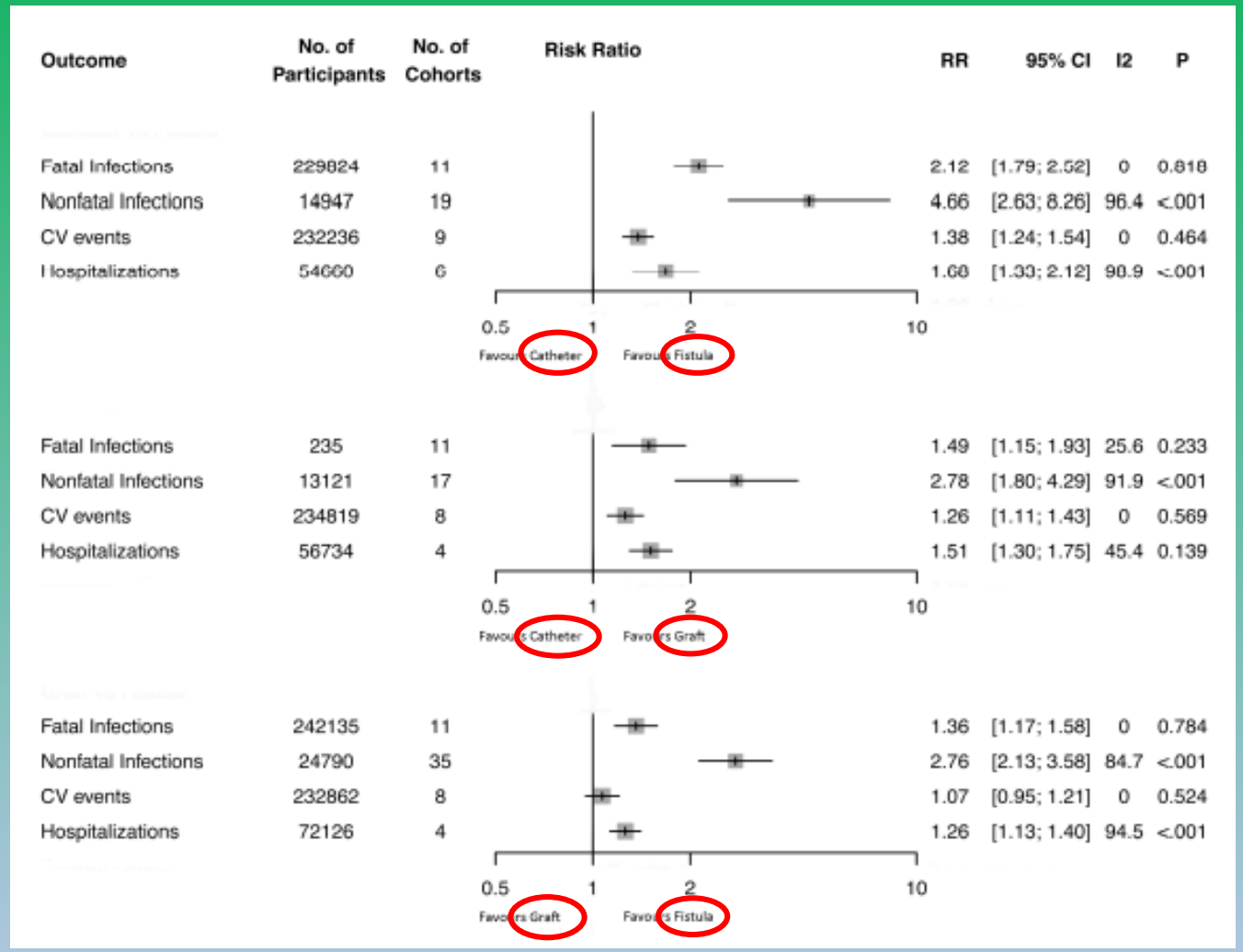
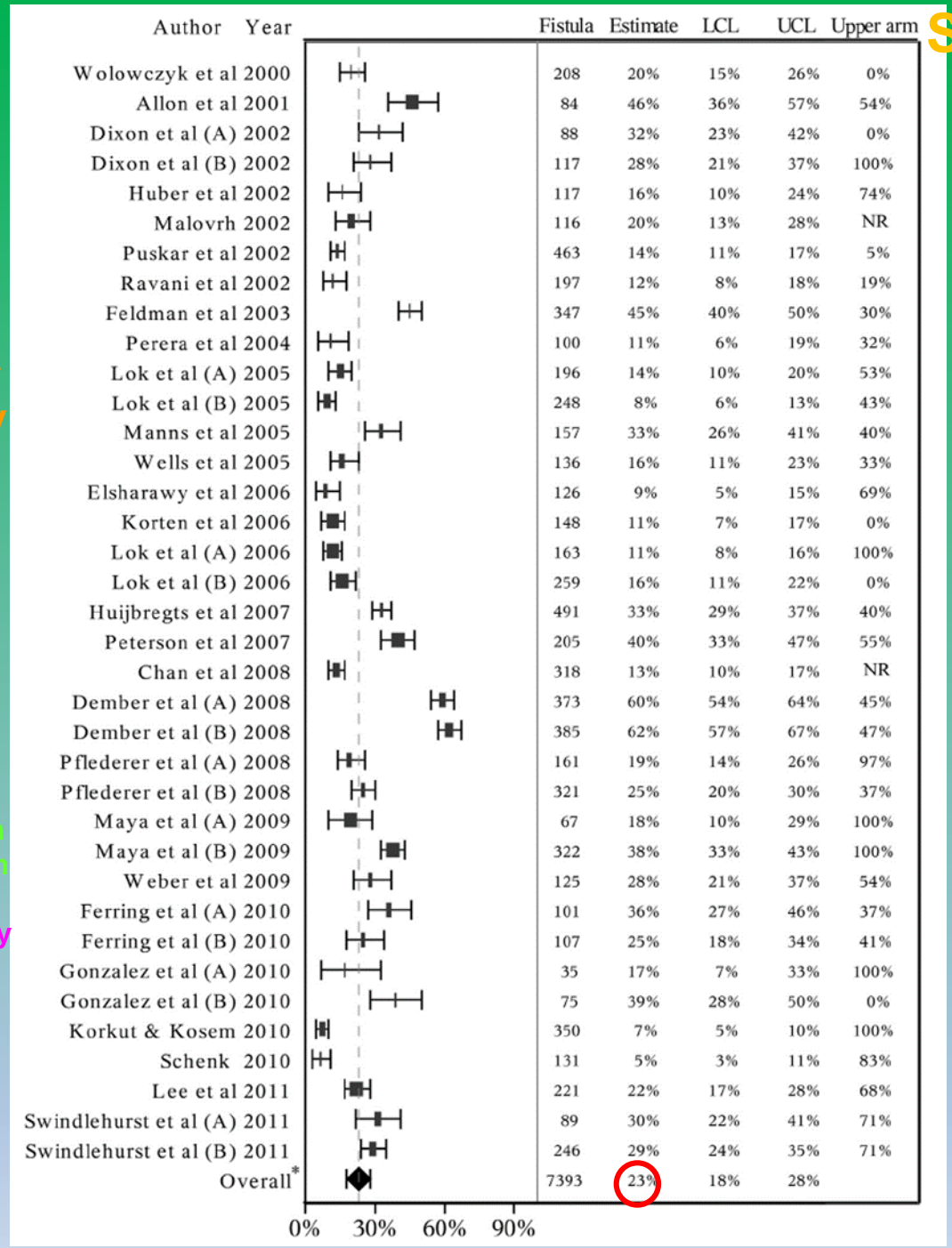
Scelta dell'accesso vascolare per emodialisi



meta-analisi (62 studi di coorte)
risk of all-cause mortality
infezioni fatale e non fatale
eventi cardiovascolari maggiori*
ospedalizzazione

Ravani, P., Palmer, S. C., Oliver, M. J., Quinn, R. R., MacRae, J. M., Tai, D. J., Pannu, N. I., Thomas, C., Hemmelgarn, B. R., Craig, J. C., Manns, B., Tonelli, M., Strippoli, G. F., & James, M. T. (2013). Associations between hemodialysis access type and clinical outcomes: a systematic review. *Journal of the American Society of Nephrology : JASN*, *24*(3), 465–473.

Scelta dell'accesso vascolare per emodialisi



Author Year	Fistula	Estimate	LCL	UCL	Upper arm
Wolowczyk et al 2000	208	20%	15%	26%	0%
Allon et al 2001	84	46%	36%	57%	54%
Dixon et al (A) 2002	88	32%	23%	42%	0%
Dixon et al (B) 2002	117	28%	21%	37%	100%
Huber et al 2002	117	16%	10%	24%	74%
Malovrh 2002	116	20%	13%	28%	NR
Puskar et al 2002	463	14%	11%	17%	5%
Ravani et al 2002	197	12%	8%	18%	19%
Feldman et al 2003	347	45%	40%	50%	30%
Perera et al 2004	100	11%	6%	19%	32%
Lok et al (A) 2005	196	14%	10%	20%	53%
Lok et al (B) 2005	248	8%	6%	13%	43%
Manns et al 2005	157	33%	26%	41%	40%
Wells et al 2005	136	16%	11%	23%	33%
Elsharawy et al 2006	126	9%	5%	15%	69%
Korten et al 2006	148	11%	7%	17%	0%
Lok et al (A) 2006	163	11%	8%	16%	100%
Lok et al (B) 2006	259	16%	11%	22%	0%
Huijbregts et al 2007	491	33%	29%	37%	40%
Peterson et al 2007	205	40%	33%	47%	55%
Chan et al 2008	318	13%	10%	17%	NR
Dember et al (A) 2008	373	60%	54%	64%	45%
Dember et al (B) 2008	385	62%	57%	67%	47%
Pflederer et al (A) 2008	161	19%	14%	26%	97%
Pflederer et al (B) 2008	321	25%	20%	30%	37%
Maya et al (A) 2009	67	18%	10%	29%	100%
Maya et al (B) 2009	322	38%	33%	43%	100%
Weber et al 2009	125	28%	21%	37%	54%
Ferring et al (A) 2010	101	36%	27%	46%	37%
Ferring et al (B) 2010	107	25%	18%	34%	41%
Gonzalez et al (A) 2010	35	17%	7%	33%	100%
Gonzalez et al (B) 2010	75	39%	28%	50%	0%
Korkut & Kosem 2010	350	7%	5%	10%	100%
Schenk 2010	131	5%	3%	11%	83%
Lee et al 2011	221	22%	17%	28%	68%
Swindlehurst et al (A) 2011	89	30%	22%	41%	71%
Swindlehurst et al (B) 2011	246	29%	24%	35%	71%
Overall*	7393	23%	18%	28%	

0% 30% 60% 90%

lower-arm
upper-arm

elderly
nonelderly

upper-arm
lower-arm

placebo
clopidogrel

28% lower-arm
20% upper-arm
37% elderly
27% nonelderly

mapping ecografico

nonelderly
elderly

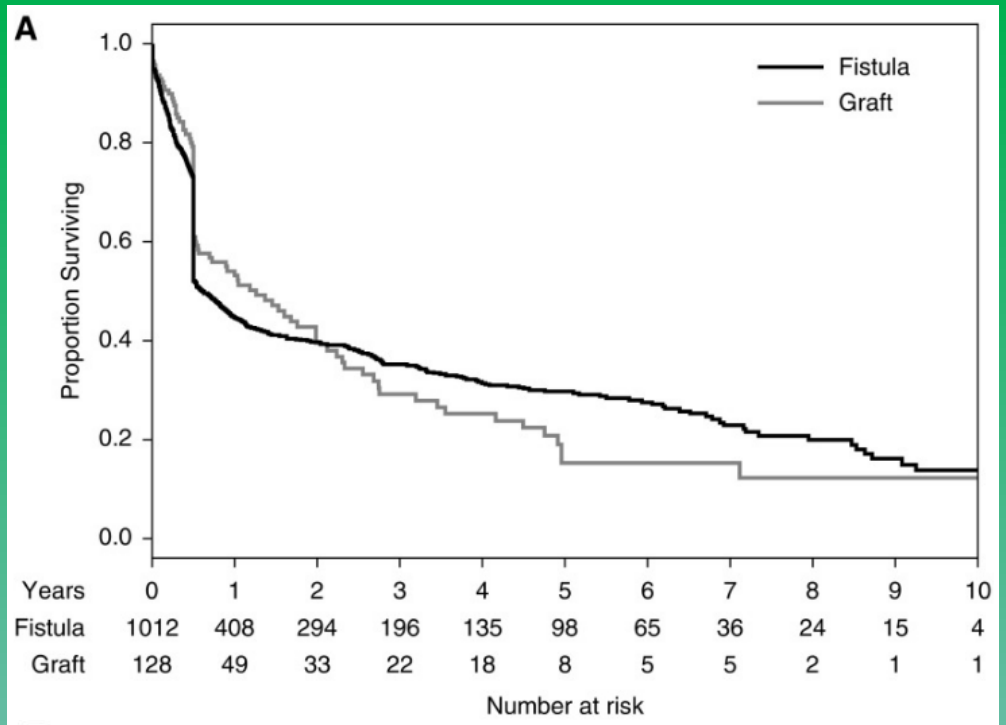
Fallimento primario della FAV nativa

Meta-analisi di studi osservazionali
- **dati raccolti prospetticamente**
- **follow up di almeno 3 mesi**
- **studi con 100 o più fistole**
- **dati pubblicati tra gennaio del 2000 e giugno del 2012**

definizione: trombosi entro 72 ore, non utilizzabile entro 3 mesi (early) o 6 (late)

Al-Jaishi AA et al. Am K Kidney Dis 2014; 63(3): 464-478

Scelta dell'accesso vascolare per emodialisi



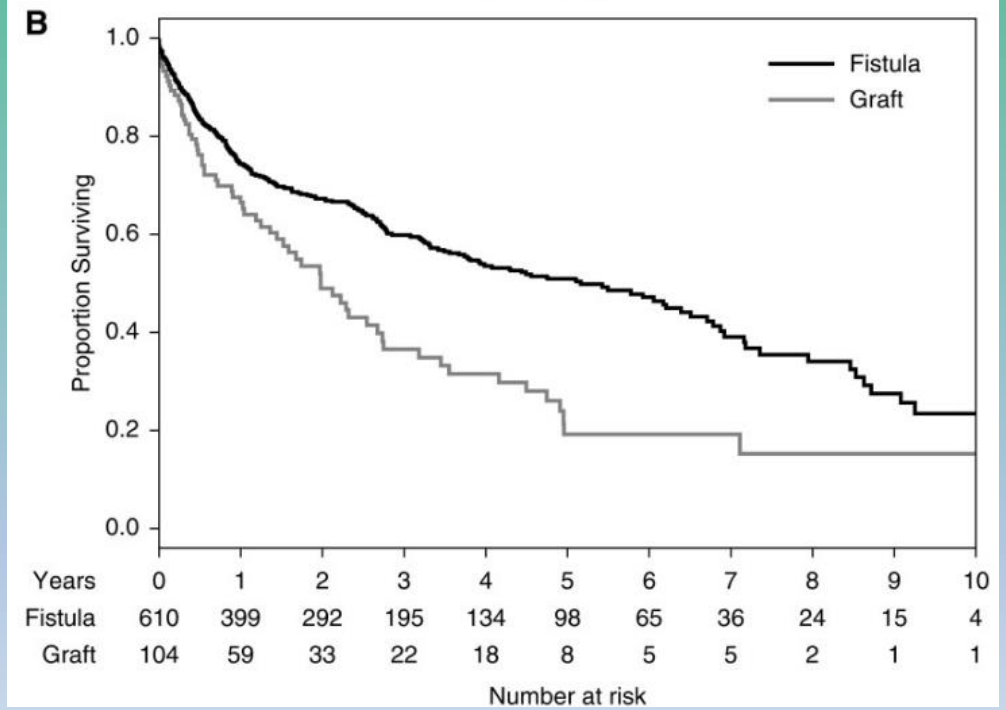


Table 2.

Frequency of interventions before successful AVF use (assisted maturation) in published studies

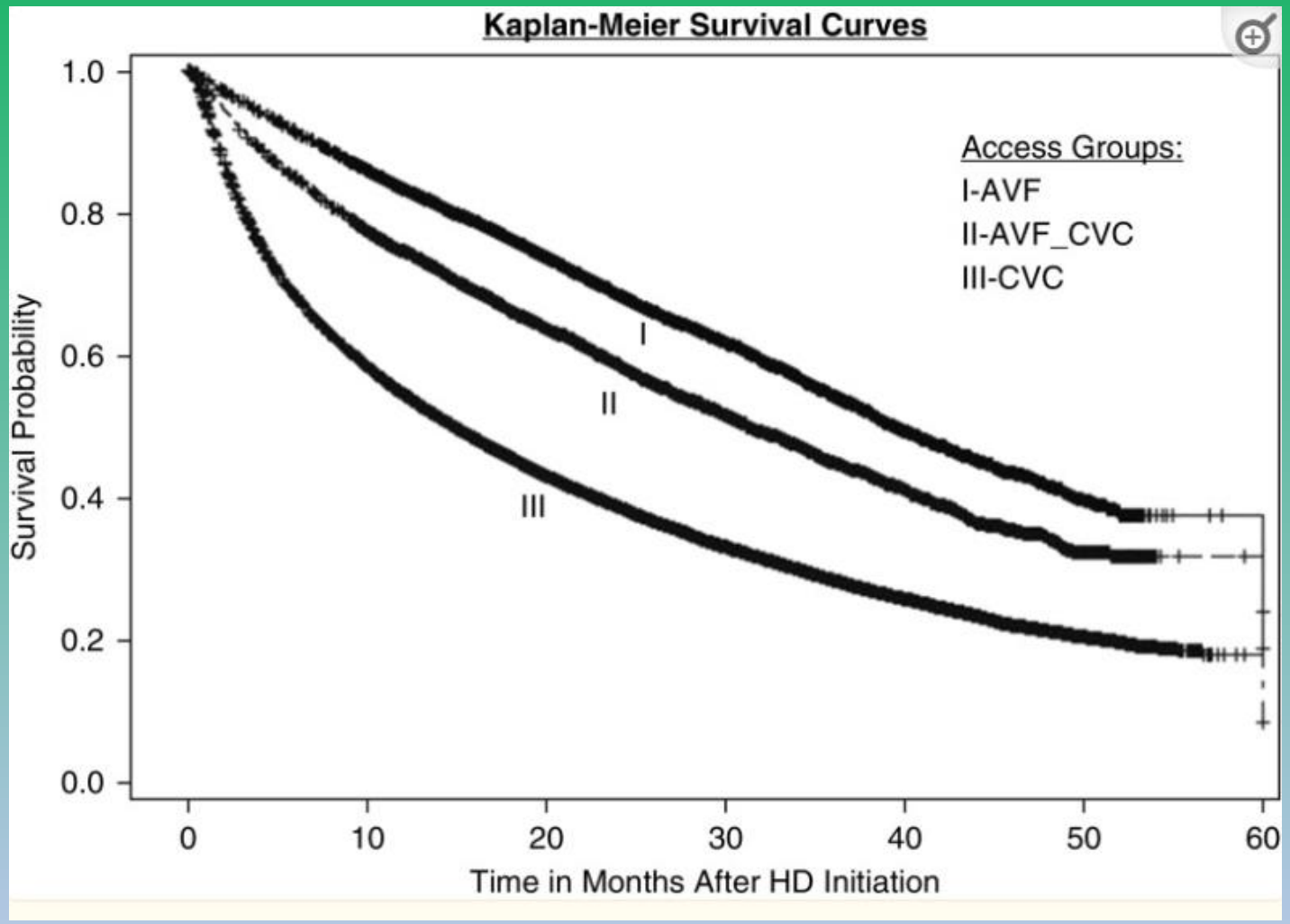
Reference	Patient Source	Percent of Patients with Assisted AVF Maturation
Falk (48)	Access ambulatory center	58%
Lee *et al.* (18)	Two academic centers	44%
Harms *et al.* (16)	One academic center	50%
Allon *et al.* (8)	Seven academic centers (HFM Study)	27%
Lee *et al.* (17)	US Renal Data System	42%

AVF, arteriovenous fistula; HFM, Hemodialysis Fistula Maturation.

Allon M. Vascular Access for Hemodialysis Patients: New Data Should Guide Decision Making. Clin J Am Soc Nephrol. 2019 Jun 7;14(6):954-961

Lok CE, Sontrop JM, Tomlinson G, Rajan D, Cattral M, Oreopoulos G, Harris J, Moist L. Cumulative patency of contemporary fistulas versus grafts (2000-2010). Clin J Am Soc Nephrol. 2013 May;8(5

Scelta dell’accesso vascolare per emodialisi



Allon M. Vascular Access for Hemodialysis Patients: New Data Should Guide Decision Making. Clin J Am Soc Nephrol. 2019 Jun 7;14(6):954-961

Brown RS, Patibandla BK, Goldfarb-Rumyantzev AS. The Survival Benefit of "Fistula First, Catheter Last" in Hemodialysis Is Primarily Due to Patient Factors. J Am Soc Nephrol. 2017 Feb;28(2):645-652

Scelta dell'accesso vascolare per emodialisi

The KDOQI 2006 Vascular Access Update and Fistula First Program Synopsis

KDOQI

KIDNEY DISEASE OUTCOMES QUALITY INITIATIVE

National Kidney Foundation

KDOQI CLINICAL PRACTICE GUIDELINE FOR VASCULAR ACCESS: 2019 UPDATE

life-plan
patient first

Lok CE, Huber TS, Lee T, Shenoy S, Yevzlin AS, Abreo K, Allon M, Asif A, Astor BC, Glickman MH, Graham J, Moist LM, Rajan DK, Roberts C, Vachharajani TJ, Valentini RP; National Kidney Foundation. KDOQI Clinical Practice Guideline for Vascular Access: 2019 Update. Am J Kidney Dis. 2020 Apr;75(4 Suppl 2):S1-S16

Scelta dell’accesso vascolare per emodialisi

1.anamnesi

età
razza
sesso
diabete mellito
tempo di dialisi
ipertensione arteriosa
cardiopatia
vasculopatia periferica
PM
precedenti CVC
precedenti accessi vascolari
neoplasia
disordini della coagulazione
fragilità
obesità
arto dominante

Scelta dell'accesso vascolare per emodialisi

1.anamnesi

Fattori demografici

età

Table 2 VA advantages and disadvantages in the elderly

	Advantages	Disadvantages
Pre-emptive AVF	No age limit for this procedure with adequate vessels	Competing risk of death before HD start
	Lower infection rates compared to CVC and AVG	Higher rates of failure to mature compared to AVG
	Better survival (?)	More AVFs created than used (increased morbidity and costs)
	Patients can shower	
AVF after dialysis start	Surgery as needed	Start of dialysis with a CVC
	Most functioning AVF will be used	Higher AVF dysfunction and infection rates compared to pre-emptive AVF
	Advantages of pre-emptive AVF are maintained, but CVC is needed	Higher rates of failure to mature compared to AVG
		With low mean survival, actual AVF utilization may be short
AVG	Short timing from procedure to use (days–weeks)	Higher cost
	Lower infection rates compared to CVC	Needs accurate maintenance with interventional procedures
CVC	Quick and easy procedure	Increased infection rates, carrying higher morbidity and mortality
	No needle punctures	
	Higher patient preference	

Lomonte C, Forneris G, Gallieni M, Tazza L, Meola M, Lodi M, Senatore M, Morale W, Spina M, Napoli M, Bonucchi D, Galli F. The vascular access in the elderly: a position statement of the Vascular Access Working Group of the Italian Society of Nephrology. J Nephrol. 2016 Apr;29(2):175-184. doi: 10.1007/s40620-016-0263-z. Epub 2016 Jan 16. Erratum in: J Nephrol. 2017 Aug;30(4):617. PMID: 26780568; PMCID: PMC5429362.

Scelta dell’accesso vascolare per emodialisi

1.anamnesi

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obesità
arto dominante

	Entire study population (n = 20,360)		"Early" AVF placement group (n = 11,258)	
	Odds ratio (95% CI)	P value	Odds ratio (95% CI)	P value
Age at onset of ESRD	1.01 (1.00–1.01)	0.006	1.01 (1.00–1.02)	0.003
Female (vs male)	1.55 (1.46–1.65)	<0.001	1.69 (1.55–1.83)	<0.001
White	Reference		Reference	
Black	1.33 (1.22–1.45)	<0.001	1.41 (1.26–1.58)	<0.001
Asian	0.91 (0.77–1.08)	0.27	0.90 (0.71–1.13)	0.36
Native American	1.13 (0.80–1.60)	0.50	1.23 (0.78–1.94)	0.37
Other	2.45 (0.50–11.98)	0.27	0.82 (0.05–4.73)	0.89
Time between access placement and hemodialysis initiation (in months)	0.94 (0.94–0.95)	<0.001	1.00 (0.99–1.01)	0.72
Body mass index (kg/m^2)	1.01 (1.00–1.01)	0.013	1.00 (1.00–1.01)	0.33
Primary cause of ESRD				
Diabetes	Reference		Reference	
Hypertension	1.00 (0.90–1.11)	0.56	1.00 (0.85–1.11)	0.72
Glomerulonephritis	0.83 (0.71–0.97)	0.007	0.75 (0.60–0.93)	0.005
Cystic disease	0.92 (0.73–1.15)	0.51	0.97 (0.73–1.29)	0.91
Other	1.32 (0.99–1.75)	0.013	1.27 (0.88–1.84)	0.06
Presence of diabetes	1.20 (1.09–1.33)	0.0003	1.22 (1.06–1.39)	0.005
Presence of peripheral vascular disease	1.06 (0.98–1.14)	0.18	1.06 (0.95–1.18)	0.29
Presence of malignancy	1.06 (0.96–1.17)	0.28	1.03 (0.90–1.18)	0.64
Presence of cerebrovascular disease	1.13 (1.03–1.24)	0.01	1.22 (1.07–1.38)	0.002
Presence of congestive heart failure	1.30 (1.22–1.39)	<0.001	1.26 (1.15–1.37)	<0.001
Duration of pre-ESRD nephrology care (mo)				
>12	Reference		Reference	
6–12	1.24 (1.15–1.33)	<0.001	1.3 (1.18–1.43)	<0.001
<6	1.27 (1.16–1.39)	<0.001	1.22 (1.07–1.38)	<0.001
Zero	4.17 (3.58–4.86)	<0.001	4.09 (3.35–5.00)	<0.001
Missing data	3.04 (2.64–3.50)	0.002	3.28 (2.73–3.94)	0.09
Income (annual per family)	1.00 (1.00–1.00)	0.52	1.00 (1.00–1.00)	0.37
Employment status				
Unemployed	Reference		Reference	
Retired	1.00 (0.90–1.10)	0.04	1.00 (0.85–1.12)	0.20
Working part time	0.86 (0.66–1.12)	0.55	0.80 (0.55–1.17)	0.39
Working full time	0.81 (0.65–1.00)	0.14	0.85 (0.63–1.15)	0.60
History of smoking (no vs. yes)	1.02 (0.87–1.20)	0.81	1.00 (0.80–1.25)	0.97
Alcohol dependence (no vs. yes)	1.47 (0.90–2.41)	0.12	1.13 (0.62–2.05)	0.69
Drug dependence (no vs. yes)	2.18 (0.62–7.69)	0.22	2.22 (0.45–10.90)	0.32
Geographic location				
Rural	Reference		Reference	
Urban	1.02 (0.95–1.10)	0.39	1.09 (1.00–1.21)	0.68
Unknown	0.91 (0.68–1.22)	0.48	1.10 (0.76–1.59)	0.79

1.anamnesi

fattori di rischio

analisi retrospettiva
20360 pz ≥ 65 aa USRDS

Hod T et al. Hemodialysis International 2014; 18: 507-515

Scelta dell'accesso vascolare per emodialisi

REGULAR ARTICLE | VOLUME 74, ISSUE 1, P8-10, JANUARY 01, 1998

Incidence and Characteristics of Patients with Hand Ischemia after a Hemodialysis Access Procedure

Amro H. Morsy, M.D. • Mark Kulbaski, M.D. • Changyi Chen, M.D., Ph.D. • Halit Isiklar, M.D. • Alan B. Lumsden, M.D.

Studio retrospettivo su 352 pz sottoposti a 409 interventi tra febbraio '92 e gennaio '97 c/o Emory University Hospital

15 hanno sviluppato una steal syndrome

Clinical characteristics of patients with hand ischemia included long-standing insulin-dependent diabetes (10), chronic hypertension (12), peripheral arterial disease (14; 93.3%), coronary artery disease (8), and systemic lupus erythematosis (1). Severe peripheral arterial diseases are commonly found and may be markers for risk of hand ischemia after access surgery.

Morsy AH, Kulbaski M, Chen C, Isiklar H, Lumsden AB. Incidence and characteristics of patients with hand ischemia after a hemodialysis access procedure. J Surg Res. 1998 Jan;74(1):8-10

Scelta dell'accesso vascolare per emodialisi

Variable	Subgroup: Participants without ARHI (n = 576)	Participants with ARHI (cases) (n = 26)	Weighted,[a] matched controls (n = 235)
	% or mean ± SD		
Age at time of consent, years	54.9 ± 13.5	59.6 ± 9.9	59.1 ± 9.5
Female	28.8	53.8	53.8
Diabetes	57.1	92.3	92.3
AVF in upper arm	75.5	92.3	92.3
Peripheral artery disease	15.5	30.8	22.0
Coronary artery disease	24.8	50.0	29.9
Hypertension	96.5	96.2	99.4
Prior permanent hemodialysis access in the index AVF arm	22.2	11.5	22.6
Functional hemodialysis catheter ipsilateral to AVF	33.6	38.9	22.2
Current hemodialysis or peritoneal dialysis	64.1	69.2	56.9
Smoking status			
Never	45.9	38.5	52.1
Former	37.0	34.6	34.3
Current	17.2	26.9	13.5
Length of anastomosis, mm	7.8 ± 2.8	8.8 ± 2.1	7.7 ± 1.2
Preoperative feeding artery diameter, mm	0.38 ± 0.12	0.40 ± 0.08	0.40 ± 0.07
Preoperative radial artery diameter at wrist, mm	0.22 ± .053	0.21 ± 0.05	0.20 ± 0.30
Mean preoperative draining vein diameter, mm	0.37 ± 0.12	0.40 ± 0.11	0.38 ± 0.04
Minimum preoperative draining vein diameter, mm	0.30 ± 0.11	0.32 ± 0.11	0.30 ± 0.04
AVF configurations			
Upper arm cephalic vein and antecubital/ proximal forearm artery	46.9	57.7	52.6
Upper arm basilic vein transposition and antecubital artery/proximal forearm artery	26.7	30.8	35.9
Upper arm brachial vein transposition and antecubital artery	1.9	3.9	3.8

Variable	Subgroup: Participants without ARHI (n = 576)	Participants with ARHI (cases) (n = 26)	Weighted,[a] matched controls (n = 235)
	% or mean ± SD		
Forearm cephalic vein and wrist radial artery	22.7	7.7	7.7
Forearm basilic vein transposition and wrist radial artery	1.7	0	0
AVF classification based on feeding artery			
Brachial artery	62.7	84.6	78.3
Distal radial artery	24.5	7.7	7.7
Antecubital artery	10.6	7.7	8.1
Proximal radial artery	2.3	0	5.9

Studio americano multicentrico, prospettico, osservazionale
602 partecipanti, follow up di 4 anni

No interventi per favorire la maturazione
nelle prime 6 settimane
ARHI outcome secondario
45 pazienti

steal syndrome

Huber TS, Larive B, Imrey PB, Radeva MK, Kaufman JM, Kraiss LW, Farber AM, Berceli SA; HFM Study Group. Access-related hand ischemia and the Hemodialysis Fistula Maturation Study. J Vasc Surg. 2016 Oct;64(4):1050-1058

Scelta dell'accesso vascolare per emodialisi

steal syndrome

Risk factor	*No.*[b]	*OR (95% CI)*	*P value*[c]
Age (per decade)[d]	470	1.16 (0.72-1.86)	.55
Female vs male[e]	319	3.17 (1.27-7.91)	.013
Diabetes[f]	389	13.62 (1.81-102.4)	.011
Peripheral artery disease	261	1.91 (0.75-4.88)	.17
Coronary artery disease	261	2.60 (1.03-6.58)	.044
Hypertension	261	0.35 (0.03-4.55)	.42
Smoking (never; former; current; per more current category)	259	1.56 (0.90-2.69)	.11
Prior permanent hemodialysis access in the index AVF arm	115	0.33 (0.071-1.53)	.16
Functional hemodialysis catheter ipsilateral to AVF	113	0.79 (0.32-1.94)	.60
Current hemodialysis or peritoneal dialysis	261	1.65 (0.63-4.27)	.31

Risk factor	*No.*[b]	*OR (95% CI)*	*P value*[c]
AVF configuration			
Forearm vs upper arm[d]	353	0.38 (0.085-1.71)	.21
High radial artery takeoff	261	1.41 (0.31-6.38)	.66
Cephalic vs transpositions (both basilic and brachial vein)	251	1.26 (0.48-3.32)	.64
Brachial transpositions vs basilic transpositions	38	0.32 (0.02-5.84)	.44
Surgical technique			
Length of anastomosis (per 1 mm)	107	1.12 (0.88-1.42)	.34
Vascular characteristics			
Preoperative feeding artery diameter (per 1 mm)	243	1.26 (0.006-260)	.93
Preoperative radial artery diameter (per 1 mm)	245	1.45 (0.60-3.49)	.41
Mean preoperative draining vein diameter (per 1 mm)	234	1.09 (0.76-1.57)	.64
Minimum preoperative draining vein diameter (per 1 mm)	234	1.14 (0.78-1.65)	.51
Preoperative upper arm fistula feeding artery flow (per 10 mL/min)	226	0.99 (0.93-1.07)	.87
Preoperative feeding artery ultrasound calcification (none or mild vs moderate or severe)	260	0.91 (0.45-1.87)	.80
Draining vein histologic calcification (intimal or medial vs none)	222	2.46 (0.73-8.28)	.14
Brachial artery dilation measures			
Brachial artery FMD% (per %)	211	0.93 (0.83-1.04)	.22
Brachial artery NMD% (per %)	125	0.98 (0.89-1.08)	.72
Arterial stiffness measures			
Carotid-femoral PWV (per m/s)	124	1.14 (0.99-1.32)	.080
Carotid-radial PWV (per m/s)	124	1.02 (0.73-1.44)	.90
Vein function measures			
Capacitance slope (per %/10 mm Hg)	234	2.76 (1.07-6.52)	.021
Maximum venous outflow slope (per [mL/100 mL/min]/10 mm Hg)	234	1.13 (1.03-1.25)	.011

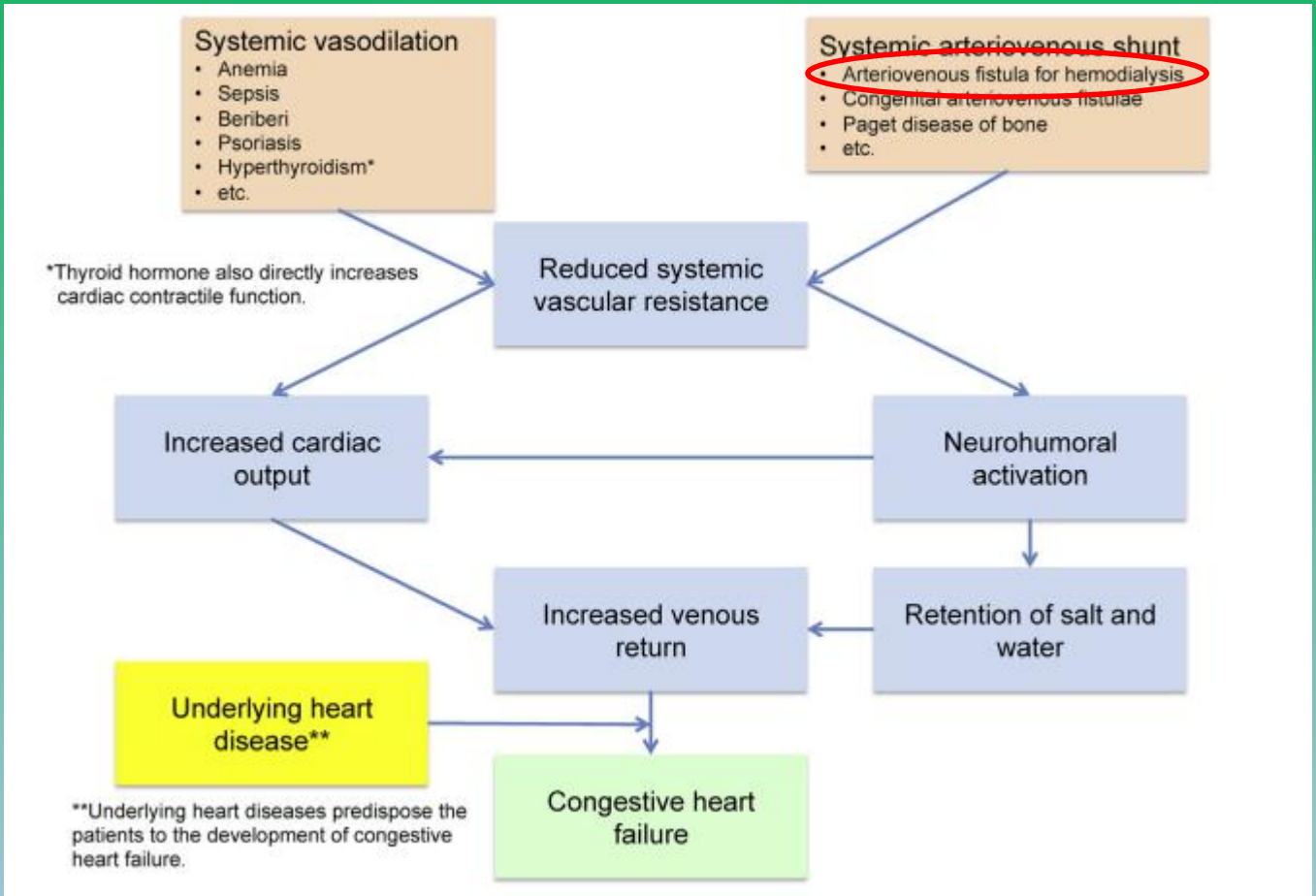
Huber TS, Larive B, Imrey PB, Radeva MK, Kaufman JM, Kraiss LW, Farber AM, Berceli SA; HFM Study Group. Access-related hand ischemia and the Hemodialysis Fistula Maturation Study. J Vasc Surg. 2016 Oct;64(4):1050-1058

Scelta dell’accesso vascolare per emodialisi

di fronte a paziente a rischio:
a cosa prestare attenzione per prevenire **steal syndrome**?

- tipo di accesso vascolare
- sede dell’accesso vascolare
- lunghezza dell’anastomosi
- stenosi critiche da trattare prima dell’allestimento

Scelta dell'accesso vascolare per emodialisi



Scompenso ad alta portata

Perché non tutti i pazienti?

Most patients tolerate the increased cardiac output and increased oxygen demand caused by fistula creation through various cardiac adaptations that increase filling pressures and cardiac performance. However, patients with underlying ischemic or valvular heart disease may not be able to sustain the cardiac remodeling requirements, making them more susceptible to developing heart failure.

Kagaya Y. Editorial: High-output state due to an arteriovenous fistula for hemodialysis access as a cause of the aggravation of congestive heart failure. J Cardiol Cases. 2015 Apr 2;11(5):136-138

Scelta dell'accesso vascolare per emodialisi

	All patients	Patients with CHF	Patients without CHF
No. patients	562	95	467
Age (years)	65±15	72±8[c]	64±15
Sex (male/female)	302/260	39/56[a]	263/204
Diabetic (%)	31	45[b]	29
Comorbidity index, absent/mild-moderate/severe	191/268/103	11/57/27[c]	180/211/76
Ischaemic heart disease (%)	17	32[c]	14
Cerebral ischaemia (%)	13	15	13
Peripheral ischaemia (%)	9	9	9
History of CHF (%)	15	36[c]	11
Atrial fibrillation (%)	10	25[c]	7
Body mass index (kg/m^2)	29.6±5.9	31.6±6.7[c]	29.2±5.7
Systolic blood pressure (mm Hg)	153±26	162±28[c]	152±25
Diastolic blood pressure (mm Hg)	86±14	85±12	86±14
Glomerular filtration rate (ml/min/1.73m^2)	15.1±5.0	15.9±4.9	14.9±5.0
Proteinuria (mg/g) creatinine	2376±2902	2985±2866[a]	2252±2896
Haemoglobin (g/dl)	11.7±1.7	11.6±1.7	11.7±1.8
Serum uric acid (mg/dl)	7.5±1.8	7.65±2.1	7.5±1.8
Serum albumin (g/dl)	3.86±0.47	3.75±0.42	3.88±0.48
Total cholesterol (mg/dl)	191±49	195±46	189±49
Triglycerides (mg/dl)	145±105	164±151	141±92
Total serum calcium (mg/dl)	9.24±0.81	9.19±0.75	9.24±0.82
Serum phosphorous (mg/dl)	4.59±1.06	4.54±1.15	4.60±1.04
Alkaline phosphatase (IU/l)	98±48	110±65[a]	95±44
Bicarbonate (mmol/l)	21.7±3.6	22.6±3.9[a]	21.6±3.6
Parathyroid hormone (pg/ml)	239±196	246±177	238±199
Diuretics (%)	58	80[c]	53
ACE inhibitor/ARB (%)	74	74	74
Beta blockers (%)	24	42[c]	20
Erythropoietin (%)	67	73	66
Functioning AVF (%)	28	50[c]	24
Distal AVF (%)	9	5	10
Proximal AVF (%)	19	45[c]	14

Scompenso ad alta portata

562 paziente con IRC avanzata
(stadio IV-V) seguiti dal 2004 al 2010
studio prospettico osservazionale

Martínez-Gallardo R, Ferreira-Morong F, García-Pino G, Cerezo-Arias I, Hernández-Gallego R, Caravaca F. Congestive heart failure in patients with advanced chronic kidney disease: association with pre-emptive vascular access placement. Nefrologia. 2012;32(2):206-12

Scelta dell'accesso vascolare per emodialisi

Scompenso ad alta portata

Table 2. Influential factors in the development of decompensated heart failure in our patients, as determined by multiple logistic regression

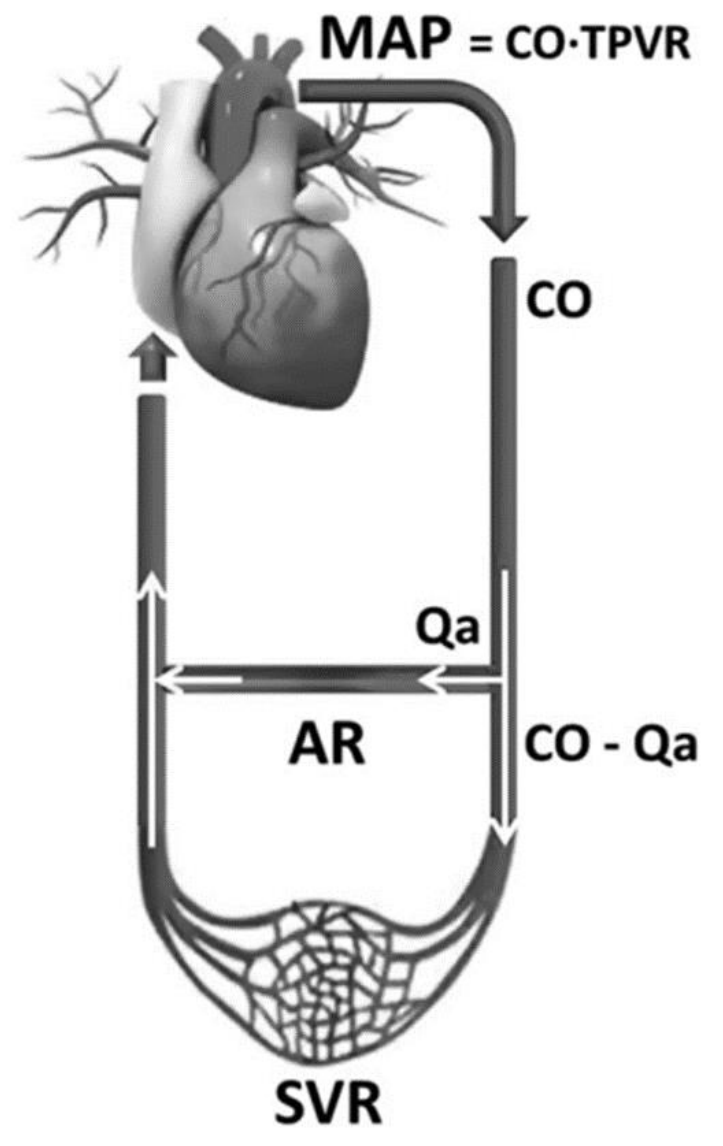
Variable	OR	95% CI OR	*P*
Age, years	1.052	1.022; 1.082	<0.0001
Sex (male 1, female 0)	0.523	0.308; 0.888	0.016
Systolic blood pressure (mm Hg)	1.013	1.002; 1.023	0.017
Baseline GFR (ml/min/1.73m^2)	1.101	1.039; 1.167	0.001
History of ischaemic heart disease (0.1)	2.488	1.276; 4.852	0.007
History of CHF (0.1)	2.517	1.283; 4.939	0.007
History of atrial fibrillation (0.1)	2.820	1.304; 6.101	0.008
Beta blockers (0.1)	1.805	1.010; 3.224	0.046
Functioning AVF (0.1)	9.541	4.841; 18.806	<0.0001

562 paziente con IRC avanzata (stadio IV-V) seguiti dal 2004 al 2010
studio prospettico osservazionale
160 allestimento FAV
endpoint un episodio di scompenso

Martínez-Gallardo R, Ferreira-Morong F, García-Pino G, Cerezo-Arias I, Hernández-Gallego R, Caravaca F. Congestive heart failure in patients with advanced chronic kidney disease: association with pre-emptive vascular access placement. Nefrologia. 2012;32(2):206-12

Scelta dell’accesso vascolare per emodialisi

Scompenso ad alta portata



86 pazienti
determinazione di Qa e CO mediante Transonic

ricircolo cardiopolmonare CPR = Qa/CO

carico di lavoro del ventricolo sinistro LLV = TPVR * CO2

Basile C, Vernaglione L, Casucci F, Libutti P, Lisi P, Rossi L, Vigo V, Lomonte C. The impact of haemodialysis arteriovenous fistula on haemodynamic parameters of the cardiovascular system. Clin Kidney J. 2016 Oct;9(5):729-34

Scelta dell'accesso vascolare per emodialisi

Scompenso ad alta portata

Table 1. Demographic, clinical and haemodynamic data for the 86 patients enrolled into the study (data are reported for both the entire cohort and for their categorization into lower and upper arm AVFs)

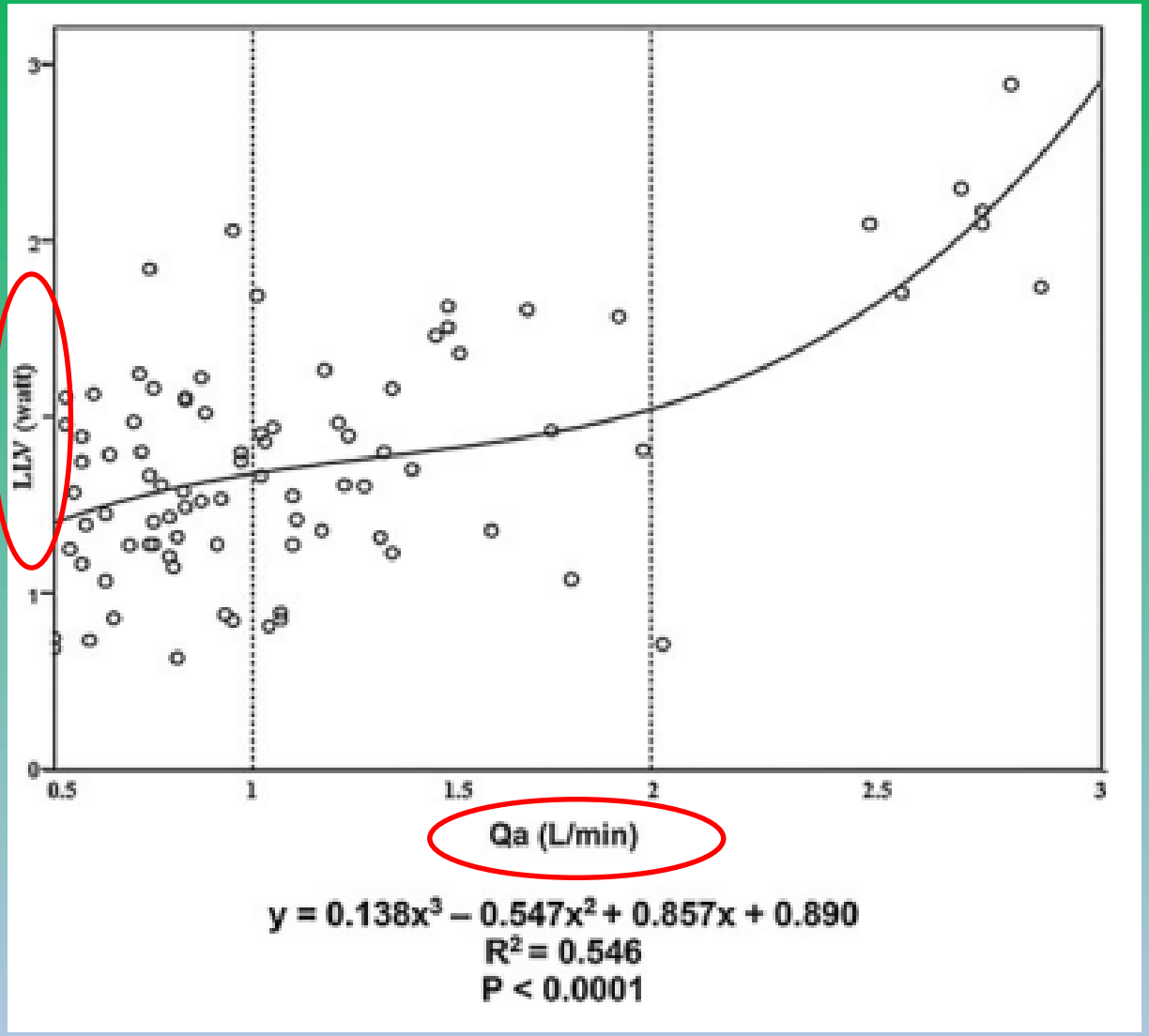
	All ($n = 86$)	Lower arm ($n = 56$)	Upper arm ($n = 30$)	P
Age (years)	61.0 (11.0)	58.6 (9.4)	63.4 (11.9)	0.453[a]
Gender (males) (%)	53.8	57.2	50.4	0.142[b]
Diabetes mellitus (%)	15.6	15.5	15.7	0.876[b]
Dialysis duration (months)	59.6 (22.9)	65.0 (18.4)	54.2 (21.9)	<0.0001[c]
Haemoglobin (g/dL)	11.6 (1.3)	11.2 (1.7)	12.0 (2.1)	0.654[a]
AVF vintage (months)	74.4 (65.4)	79.8 (62.6)	69.0 (65.7)	<0.0001[c]
MAP (mmHg)	92.7 (13.9)	92.0 (15.1)	93.4 (12.4)	0.320[c]
Heart rate (beats/min)	72.7 (9.5)	71.2 (11.5)	74.2 (8.4)	0.540[c]
CO (L/min)	6.3 (1.3)	5.7 (1.0)	6.8 (1.0)	<0.0001[a]
Qa (L/min)	1.3 (0.6)	0.9 (0.3)	1.6 (0.4)	<0.0001[c]
LLV (watt)	1.3 (0.6)	1.0 (0.3)	1.6 (0.4)	<0.0001[a]
CPR	0.2 (0.3)	0.1 (0.1)	0.3 (0.1)	<0.0001[c]
LLV_{AVF} (% of LLV)	19.7 (3.1)	15.8 (3.2)	23.5 (4.0)	<0.0001[a]
TPVR (mmHg·min/L)	14.9 (3.2)	16.1 (4.2)	13.7 (3.2)	<0.0001[a]
AR (mmHg·min/L)	80.3 (24.6)	102.2 (21.8)	58.3 (15.9)	<0.0001[c]
SVR (mmHg·min/L)	18.6 (4.1)	19.2 (5.3)	17.9 (5.1)	<0.0001[c]

Basile C, Vernaglione L, Casucci F, Libutti P, Lisi P, Rossi L, Vigo V, Lomonte C. The impact of haemodialysis arteriovenous fistula on haemodynamic parameters of the cardiovascular system. Clin Kidney J. 2016 Oct;9(5):729-34

Scelta dell'accesso vascolare per emodialisi

Scompenso ad alta portata

relazione tra portata e scompenso?



Basile C, Vernaglione L, Casucci F, Libutti P, Lisi P, Rossi L, Vigo V, Lomonte C. The impact of haemodialysis arteriovenous fistula on haemodynamic parameters of the cardiovascular system. Clin Kidney J. 2016 Oct;9(5):729-34

Scelta dell'accesso vascolare per emodialisi

Scompenso ad alta portata

perché alta portata?
•fattori demografici: età giovane, sesso maschile
•fattori legati all'intervento: sede della FAV, precedenti accessi, lunghezza dell'anastomosi
•altri fattori anatomo-fisiologici (?)

> Finally, we must always bear in mind that the wrong access choice in the HF patients can endanger their life. For this reason, it would be better to apply validated predictive models to estimate the flow rate that will have the fistula after its creation or, directly, its cardiac effects.[30]

Begin V, Ethier J, Dumont M, Leblanc M. Prospective evaluation of the intra-access flow of recently created native arteriovenous fistulae. Am J Kidney Dis. 2002 Dec;40(6):1277-82

Scelta dell'accesso vascolare per emodialisi

di fronte a paziente a rischio:
a cosa prestare attenzione per ridurre possibilità di **scompenso ad alta portata**?

When planning the best vascular access for each incident HF patient, the risk of HF worsening after AV access creation must be evaluated carefully together with the risk of catheter-related complications, but avoiding a non-selective 'catheter first' approach for all HF patients.

Clinical presentation	Type of vascular access proposed
Life-threatening heart failure	Catheter
Left ventricular ejection fraction <30%	Catheter
NYHA class IV and ACC/AHA stage D	Catheter
Most NYHA class III and ACC/AHA stage C	Catheter
ACC/AHA stage A, B and certain C	Distal arm AVF
NYHA class I, II and certain III	Distal arm AVF

NYHA: New York Heart Association heart failure classification; ACC/AHA: American College of Cardiology/American Heart Association heart failure classification; AVF: arteriovenous fistula.

- tipo di accesso vascolare
- sede dell'accesso vascolare
- lunghezza dell'anastomosi
- ottimizzazione della terapia cardiologica

After 2–3 months of progressive ultrafiltration during the HD sessions through a catheter, the cardiac function must be re-evaluated by means of a new echocardiography exam to identify those HF patients showing an improvement in cardiac performance, who will benefit from an AV access creation and catheter removal.

Malik J, Lomonte C, Rotmans J, Chytilova E, Roca-Tey R, Kusztal M, Grus T, Gallieni M. Hemodialysis vascular access affects heart function and outcomes: Tips for choosing the right access for the individual patient. J Vasc Access. 2021 Nov;22(1_suppl):32-41.

Scelta dell’accesso vascolare per emodialisi

1.anamnesi

età
razza
sesso
diabete mellito
tempo di dialisi
ipertensione arteriosa
cardiopatia
vasculopatia periferica
PM
precedenti CVC
precedenti accessi vascolari
neoplasia
disordini della coagulazione
fragilità
obesità
arto dominante

Scelta dell'accesso vascolare per emodialisi

Semin Dial. 2013 Nov-Dec;26(6):728-32. doi: 10.1111/sdi.12073. Epub 2013 Mar 5.

The impact of transvenous cardiac devices on vascular access patency in hemodialysis patients

Chieh Suai Tan [1], Cui Jie, Jennifer Joe, Zubin D Irani, Suvranu Ganguli, Sanjeeva Prasad Kalva, Stephan Wicky, Steven Wu

Comparing patients with arteriovenous (AV) access created ipsilateral to CIED placement (n=19) versus the contralateral side (n=17), the primary failure rate was 78.9% versus 35.3% (p=0.02).

studio retrospettivo

Scelta dell'accesso vascolare per emodialisi

› Ann Vasc Surg. 2003 Sep;17(5):526-9. doi: 10.1007/s10016-003-0048-4. Epub 2003 Sep 10.

Symptomatic subclavian vein stenosis and occlusion in hemodialysis patients with transvenous pacemakers

Theodore H Teruya [1], Ahmed M Abou-Zamzam Jr, Whitney Limm, Linda Wong, Livingston Wong

During the 10-year period 495 patients had transvenous pacemakers placed. Twenty patients were identified with renal failure requiring hemodialysis and 14 had hemodialysis access in the extremity ipsilateral to the pacemaker. Ten (10/14, 71%) patients developed symptoms of subclavian stenosis, including venous hypertension, high recirculation rate, arm swelling, pain, and neurologic symptoms. Eighty percent (8/10) of symptomatic patients had subclavian vein occlusion. All 10 symptomatic patients required ligation of the hemodialysis access to control symptoms.

Scelta dell'accesso vascolare per emodialisi

Patency rates	Ipsilateral (n = 13)	Contralateral (n = 15)	P value
Primary	20.2 months	22.2 months	
Primary assisted	21.2	38.0	
Secondary	39	48.8	
Six-month patency rate	69.2%	86.6%	0.375
One-year patency rate	53.8%	60%	0.62

analisi retrospettiva dal 2008 al 2016
44 pz in follow up 28

Sgroi MD, McFarland G, Itoga NK, Sorial E, Garcia-Toca M. Arteriovenous Fistula and Graft Construction in Patients with Implantable Cardiac Devices: Does Side Matter? Ann Vasc Surg. 2019 Jan;54:66-71

Scelta dell'accesso vascolare per emodialisi

After short-term catheter placement, focal areas of endothelial injury were seen in the vein wall adjacent to the catheter. Associated thrombus may or may not be present. Long-term catheters displayed vein wall thickening and bridges from the vein wall to the catheter.

Forauer AR, Theoharis C. Histologic changes in the human vein wall adjacent to indwelling central venous catheters. J Vasc Interv Radiol. 2003 Sep;14(9 Pt 1):1163-8

Table 2. Primary outcomes

AVF function, months, *n* (%)	No Tunneled Vascular Catheter	Tunneled Vascular Catheter	Odds Ratio	95% Confidence Interval	*P* Value[a]
6	48 out of 70 (68.6)	70 out of 129 (54.3)	1.84	1.00 to 3.39	0.05
12	70 out of 83 (84.3)	73 out of 115 (63.5)	3.10	1.53 to 6.26	0.002
	Contralateral TVC	Ipsilateral TVC	Odds Ratio	95% Confidence Interval	*P* Value[b]
6	56 out of 94 (59.6)	14 out of 35 (40.0)	2.21	1.01 to 4.88	0.05
12	54 out of 82 (65.9)	19 out of 33 (57.6)	1.42	0.62 to 3.25	0.40

AVF, arteriovenous fistula; TVC, tunneled vascular catheter.
[a]Backward conditional logistical regression applied to adjust for baseline variables (age, sex, diabetes, hypertension, and hypercholesterolemia).
[b]Backward conditional logistical regression applied to adjust for baseline variables, days from TVC insertion to AVF creation, and left-sided TVC.

> necessità di procedure

studio retrospettivo osservazionale
287 HD pz -> 142 CVC:
102 controlaterale
40 omolaterale

criterio clinico

Diep J, Makris A, De Guzman I, Wong J, Aravindan A, Nandakoban H, Narayanan G. Impact of Previous Tunneled Vascular Catheters and their Location on Upper Limb Arteriovenous Fistula Function. Kidney360. 2021 Oct 7;2(12):1953-1959

Scelta dell’accesso vascolare per emodialisi

1.anamnesi

età
razza
sesso
diabete mellito
tempo di dialisi
ipertensione arteriosa
cardiopatia
vasculopatia periferica
PM
precedenti CVC
precedenti accessi vascolari
neoplasia
disordini della coagulazione
fragilità
obesità
arto dominante

Scelta dell'accesso vascolare per emodialisi

2.esame obiettivo

Statements: Patient Clinical Examination

7.1 **KDOQI recommends that a physical examination focused on vascular anatomy be the basis for the initial assessment and planning of vascular access creation.** (*Conditional Recommendation, Very Low Quality of Evidence*)

7.2 **KDOQI considers it reasonable to have greater emphasis on and more training in preoperative clinical examination to assess patients and their vessels to determine the type and location of their vascular access.** (*Expert Opinion*)

- Physical examination of arterial system
  - Character of peripheral pulses
  - Allen test
  - Bilateral upper extremity blood pressures
- Physical examination of venous system
  - Evaluation for edema
  - Assessment of arm sizes comparability
  - Examination for collateral veins
  - Evaluation of veins:
- Augmented palpation
  - Examination for evidence of prior central or peripheral venous catheterization
  - Examination for evidence of arm, chest, or neck surgery/ trauma
- Cardiovascular evaluation
  - Examination for evidence of heart failure

Lok CE, Huber TS, Lee T, Shenoy S, Yevzlin AS, Abreo K, Allon M, Asif A, Astor BC, Glickman MH, Graham J, Moist LM, Rajan DK, Roberts C, Vachharajani TJ, Valentini RP; National Kidney Foundation. KDOQI Clinical Practice Guideline for Vascular Access: 2019 Update. Am J Kidney Dis. 2020 Apr;75(4 Suppl 2):S1-S16

Scelta dell'accesso vascolare per emodialisi

3.ecocolordoppler

Statements: Vessel Mapping for Vascular Access

7.3 KDOQI suggests selective preoperative ultrasound in patients at high risk of AV access failure (Table 7.2) rather than routine vascular mapping in all patients (*Conditional Recommendation, Low Quality of Evidence*).

7.4 KDOQI considers it reasonable to use various imaging studies as needed to evaluate the suitability of vessels for AV access creation such as ultrasonography for peripheral vessels (including intraoperative ultrasound) and venography for suspected central vein occlusion, while considering the patient's clinical circumstances and residual kidney function. (*Expert Opinion*)

Variabilità legata all'operatore, che potrebbe essere diverso da chi allestisce l'accesso, costi, disagio del paziente, allungamento dei tempi,...

Table 7.2. Examples of Risk Factors For Which Vessel Mapping May Be Beneficial

Clinical Problem	Risk Factors
Fistula failure	Elderly age, female, comorbidities (eg, peripheral vascular disease, coronary artery disease), small pediatric patients
Peripheral vessel damage	Ipsilateral: PICC insertion, other iatrogenic (eg, venipuncture), self-inflicted (eg, IVDU), disease states (eg, vasculitis), radial artery harvesting for CABG
Central venous stenosis	Multiple CVCs; prolonged CVC duration; cardiac implantable electronic device; PICC; surgery or trauma to neck, chest, upper extremity
Limitations to physical examination	Morbid obesity, suboptimal conditions (eg, patient dehydrated or vasoconstricted), poor skin integrity, patient refusal

Lok CE, Huber TS, Lee T, Shenoy S, Yevzlin AS, Abreo K, Allon M, Asif A, Astor BC, Glickman MH, Graham J, Moist LM, Rajan DK, Roberts C, Vachharajani TJ, Valentini RP; National Kidney Foundation. KDOQI Clinical Practice Guideline for Vascular Access: 2019 Update. Am J Kidney Dis. 2020 Apr;75(4 Suppl 2):S1-S16

Scelta dell'accesso vascolare per emodialisi

3.ecocolordoppler

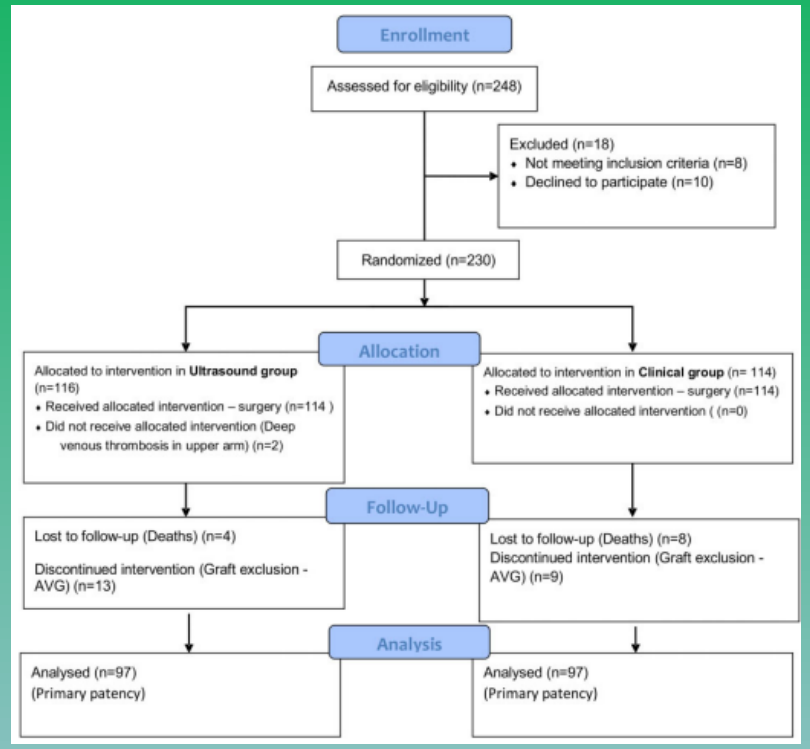


Table 2. Site of AVF (in all patients who underwent surgery n = 206).

Site of AVF	Clinical (n = 105)	Ultrasound (n = 101)	*p* value*
Radiocephalic	37 (35.2%)[a]	29 (28.7%)[a]	< 0.001
Ulnobasilic	1 (1.0%)[a]	0 (0.0%)[a]	
Brachiocephalic	50 (47.6%)[a]	49 (48.5%)[a]	
Brachiobasilic (superficialization/ transposition)	8 (7.6%)[a]	23 (22.8%)[b]	
Negative surgical exploration**	9 (8.6%)[a]	0 (0.0%)[b]	

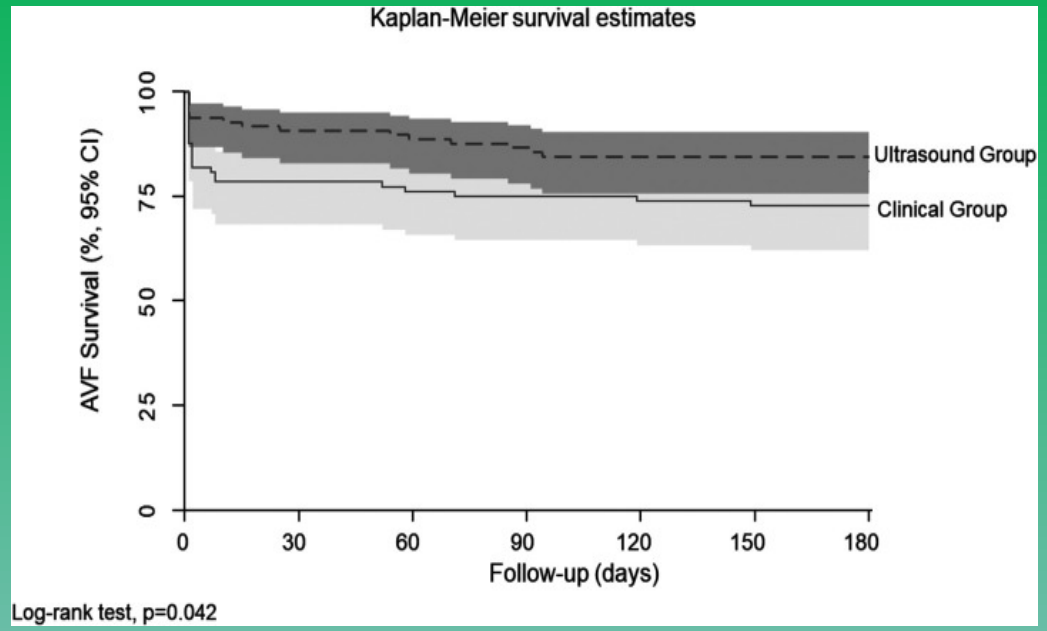
AVF: arteriovenous fistulas.
Source: Own authorship (2019). *Chi-square test. ** 1 Radiocephalic, 6 Brachiocephalics and 2 Brachiobasilics.
Different letters on the same line indicate difference in frequency between groups by analysis of residues at 5% significance.

studio randomizzato e controllato
popolazione brasiliana in dialisi
diametro vena ≥ 2.5 mm
arteria ≥ 2 mm
sopravvivenza primaria (non assistita)
criterio clinico

Lopes JRA, Marques ALB, Correa JA. Randomised clinical study of the impact of routine preoperative Doppler ultrasound for the outcome of autologous arteriovenous fistulas for haemodialysis. J Vasc Access. 2021 Jan;22(1):107-114

Scelta dell'accesso vascolare per emodialisi

3.ecocolordoppler



Kaplan–Meier curve for primary unassisted patency. Kaplan–Meier curve for primary patency survival (days) in the ultrasound group – 97 patients (dotted line) and clinical group – 97 patients (straight line). p = 0.042 (log-rank analysis).

Table 4. Primary failure subtypes (n = 206).

		Clinical group (n = 105)		Ultrasound group (n = 101)		Logistic regression	
Variable	All cases (%)	Cases	Odds	Cases	Odds	OR (CI 95%)	*p* value*
Primary failure	37 (18.0)	28	0.39	9	0.10	0.27 (0.12–0.61)	0.002
Negative surgical exploration	9 (4.4)	9	0.09	0	–	–	–
Immediate failure	22 (10.7)	16	0.18	6	0.06	0.35 (0.13–0.93)	0.037
Early thrombosis	6 (2.9)	3	0.029	3	0.031	1.04 (0.20–5.28)	0.961

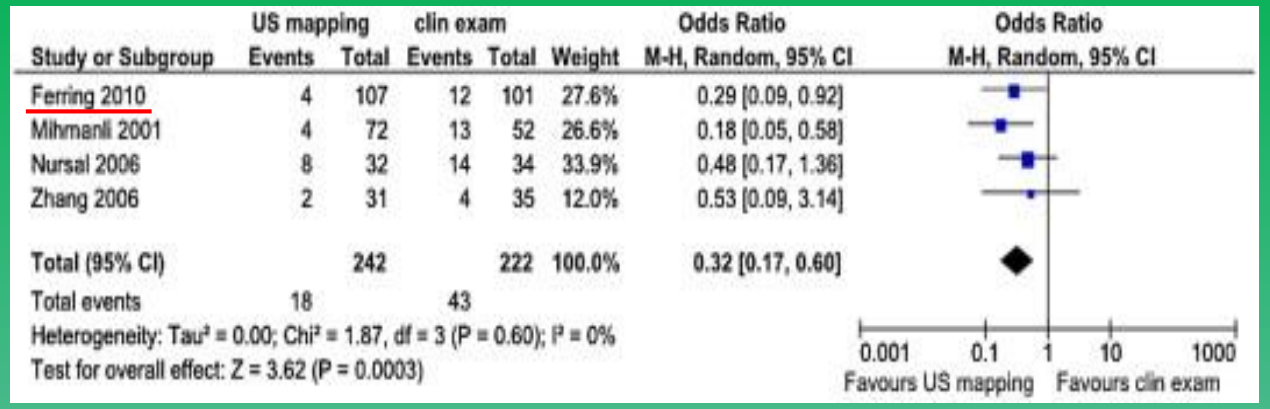
Table 5. Cost-effectiveness between groups (n = 206).

Groups	Average cost (US$)	Effectiveness (primary patency) (days)	Incremental cost-effectiveness (US$/day of the fistula)	Functional dialysis use time (days of dialysis/AVF)
Clinical	155.44	120.37	1.29	97.95
Doppler	196.47	153.63	1.28	125.75

AVF: arteriovenous fistulas.
*Except grafts. Source: Own authorship (2019). Dollar quotation (US$1.00 = R$3.86).

Lopes JRA, Marques ALB, Correa JA. Randomised clinical study of the impact of routine preoperative Doppler ultrasound for the outcome of autologous arteriovenous fistulas for haemodialysis. J Vasc Access. 2021;22(1):107-114.

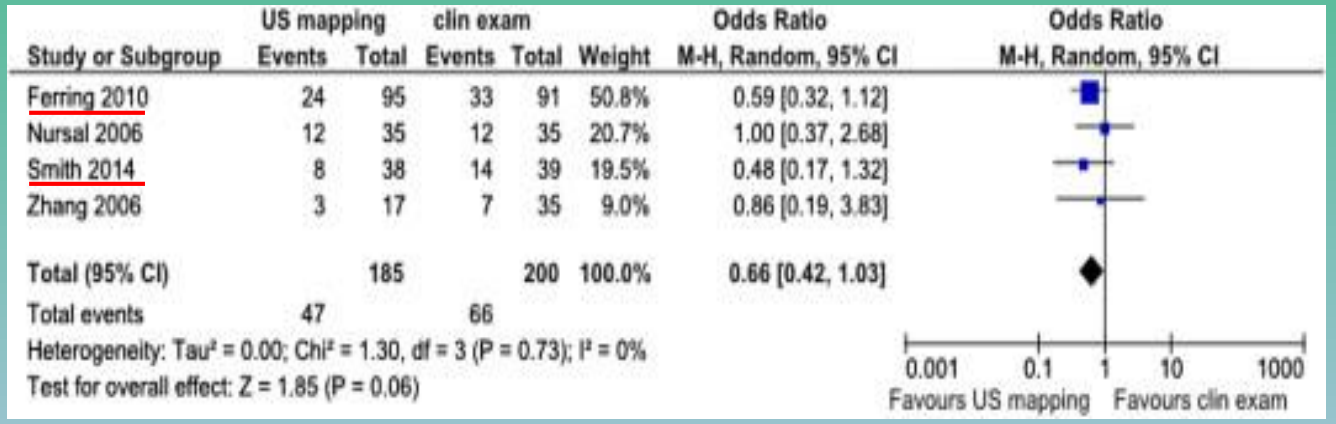
Scelta dell'accesso vascolare per emodialisi



Forest plot illustrating the pooled estimate of the immediate arteriovenous fistulae failure rate in patients with pre-operative routine Doppler ultrasound mapping (US) vs. patients evaluated with clinical examination or selective US. Odds ratio (OR) is shown with 95% confidence intervals (CI).

3.ecocolordoppler

meta-analisi di studi randomizzati



Forest plot illustrating the pooled estimate of the early/midterm adequacy for hemodialysis in patients with pre-operative routine Doppler ultrasound mapping (US) vs. patients evaluated with clinical examination or selective US. Odds ratio (OR) is shown with 95% confidence intervals (CI)

solo due sopravvivenza ad un anno

Georgiadis GS, Charalampidis DG, Argyriou C, Georgakarakos EI, Lazarides MK. The Necessity for Routine Pre-operative Ultrasound Mapping Before Arteriovenous Fistula Creation: A Meta-analysis. Eur J Vasc Endovasc Surg. 2015 May;49(5)

Scelta dell’accesso vascolare per emodialisi

3.Ecocolordoppler

Posizione seduta di fronte all'operatore con arto superiore appoggiato su un tavolino o supina,
solo canottiera o manica corta,
ambiente non troppo freddo (anche il gel andrebbe scaldato), con possibilità di oscuramento

Ecocolordoppler richiede certa esperienza dell'esaminatore, adeguato ecografo, sonda (lineare)
non invasivo, sicuro, e ripetibile
unica tecnica diagnostica che valuta contemporaneamente anatomia dei vasi (B-mode) e flussi (colordoppler), può essere effettuato dallo stesso operatore che eseguirà l'intervento

Scelta dell'accesso vascolare per emodialisi

3.Ecocolordoppler

Statements: Optimal Vessel Size of Artery and Vein for AV Access Creation

7.5 KDOQI considers it reasonable that while there is no minimum diameter threshold to create an AVF, arteries and veins of <2 mm in diameter should undergo careful evaluation for feasibility and quality to create a functioning AVF. (Expert Opinion)

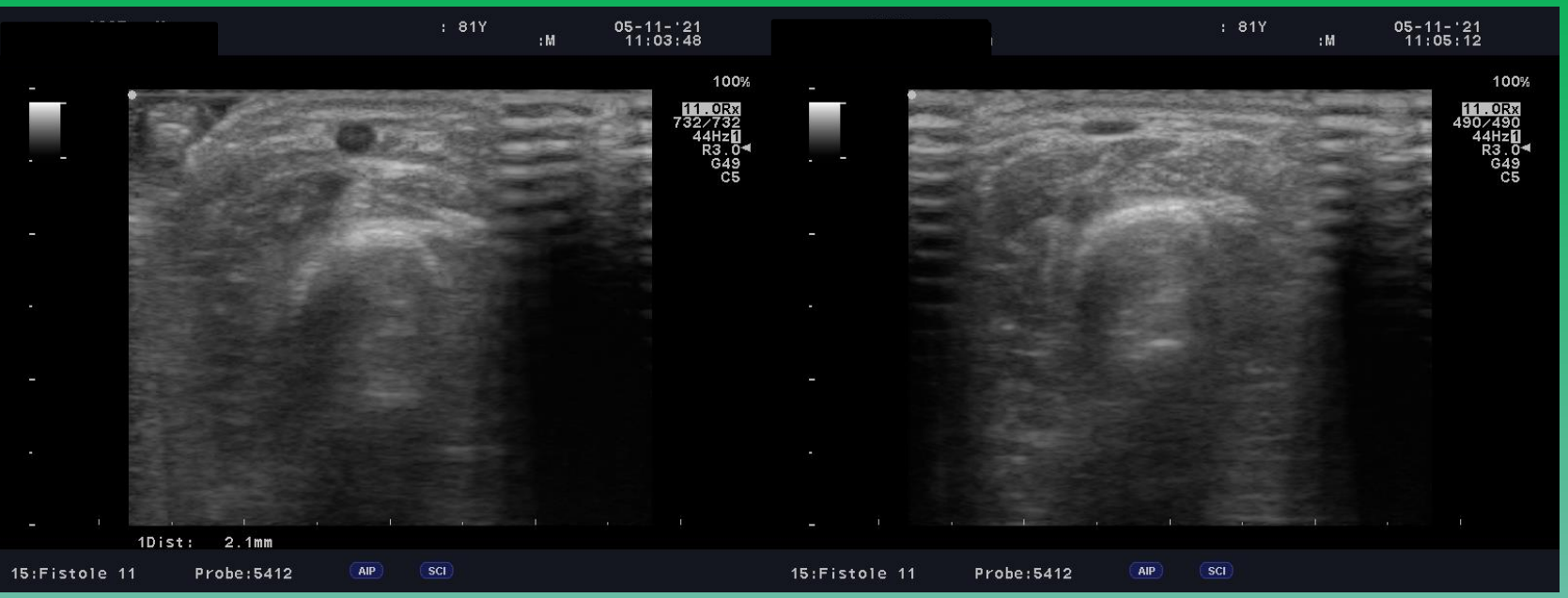
7.6 KDOQI considers it reasonable to evaluate multiple characteristics of vessel quality for AVF creation (size, distensibility, flow, etc). (Expert Opinion)

distretto venoso
(da distale a prossimale)

pervietà vasale (lume anecogeno, comprimibile, flusso)
diametro (> 2 mm?)
distensibilità vasale (laccio per 2' ?)
aspetto della parete (sottile e regolare)
decorso del vaso (rettilineo, profondità < 6 mm)
presenza di circoli collaterali

Lok CE, Huber TS, Lee T, Shenoy S, Yevzlin AS, Abreo K, Allon M, Asif A, Astor BC, Glickman MH, Graham J, Moist LM, Rajan DK, Roberts C, Vachharajani TJ, Valentini RP; National Kidney Foundation. KDOQI Clinical Practice Guideline for Vascular Access: 2019 Update. Am J Kidney Dis. 2020 Apr;75(4 Suppl 2):S1-S16

Scelta dell’accesso vascolare per emodialisi



3.Ecocolordoppler

vena

Pervietà del vaso

Scelta dell’accesso vascolare per emodialisi

3.Ecocolordoppler

Decorso del vaso

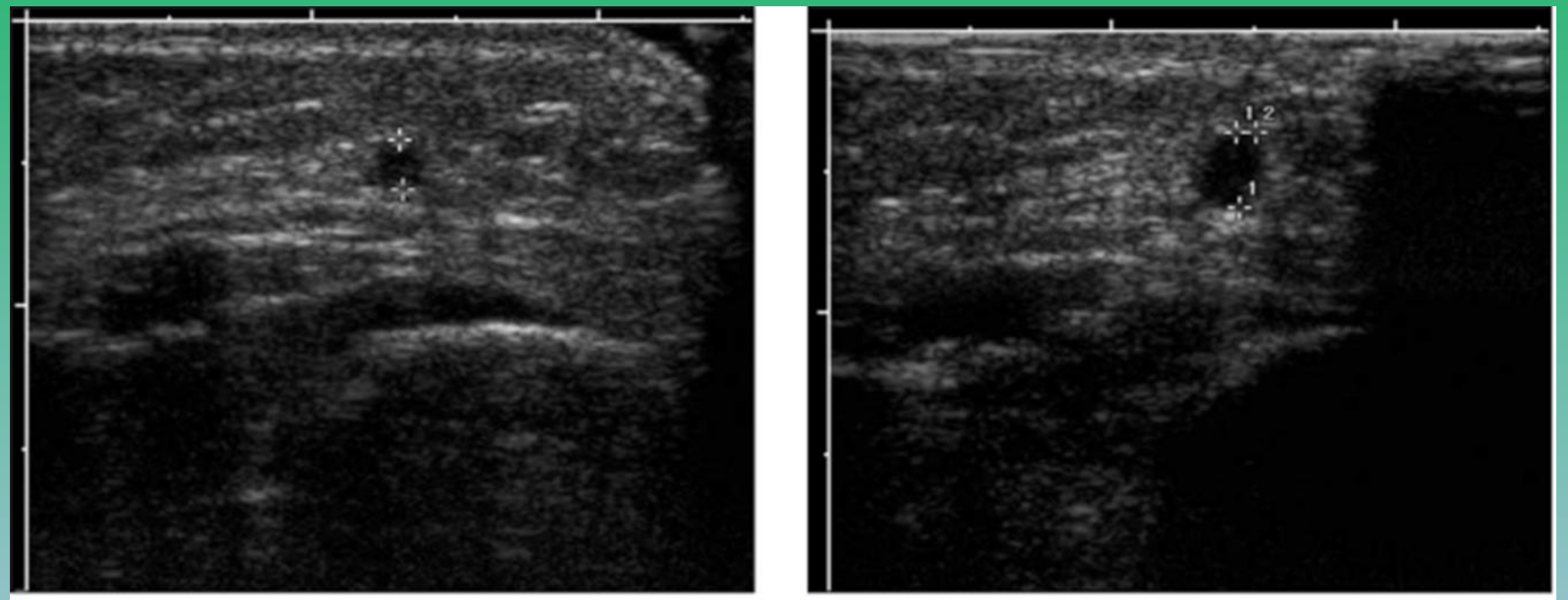
vena

Diametro del vaso

Scelta dell’accesso vascolare per emodialisi

Distensibilità del vaso

3.Ecocolordoppler



A B

Figure 1. Transverse gray scale sonograms of the cephalic vein (cursors) at the wrist before placement of a forearm tourniquet (**A**) and after placement of the tourniquet (**B**) show dilatation of the vein from a subthreshold diameter of 0.17 cm (**A**) to a diameter of 0.27 cm (**B**), which met the threshold for recommendation of a forearm fistula. The subsequently placed fistula was successful in this patient.

vena

Scelta dell'accesso vascolare per emodialisi

3.Ecocolordoppler

Doppler

vena

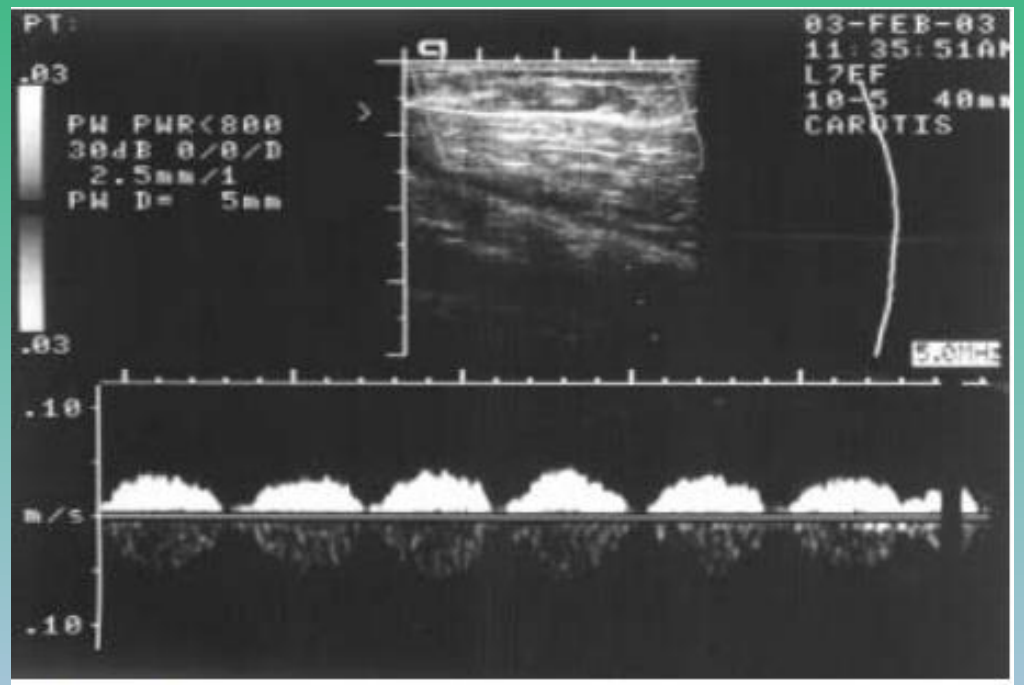


FIG. 2. Normal Doppler waveform of a vein.

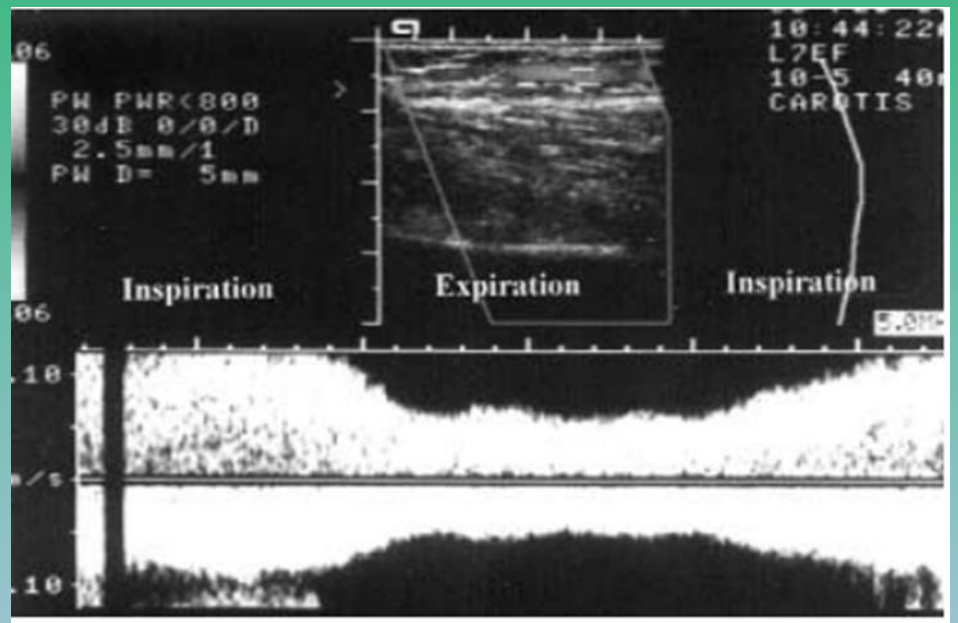


FIG. 3. Increasing of venous flow during deep inspiration and decreasing during expiration.

Malovrh M. The role of sonography in the planning of arteriovenous fistulas for hemodialysis. Semin Dial. 2003 Jul-Aug;16(4):299-303

Scelta dell'accesso vascolare per emodialisi

3.Ecocolordoppler

Statements: Optimal Vessel Size of Artery and Vein for AV Access Creation

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7.6 KDOQI considers it reasonable to evaluate multiple characteristics of vessel quality for AVF creation (size, distensibility, flow, etc). (Expert Opinion)

distretto arterioso
da prossimale a distale:
succlavia, ascellare, brachiale, radiale ed ulnare

diametro > 2 mm?
spessore miointimale
alterazioni della parete
anomalie di decorso (biforcazione alta)
lesioni steno-ostruttive
flussi ematico
capacità di dilatazione

minor attenzione data all'arteria

Lok CE, Huber TS, Lee T, Shenoy S, Yevzlin AS, Abreo K, Allon M, Asif A, Astor BC, Glickman MH, Graham J, Moist LM, Rajan DK, Roberts C, Vachharajani TJ, Valentini RP; National Kidney Foundation. KDOQI Clinical Practice Guideline for Vascular Access: 2019 Update. Am J Kidney Dis. 2020 Apr;75(4 Suppl 2):S1-S16

Scelta dell’accesso vascolare per emodialisi

3.Ecocolordoppler

arteria

Diametro del vaso

Scelta dell’accesso vascolare per emodialisi

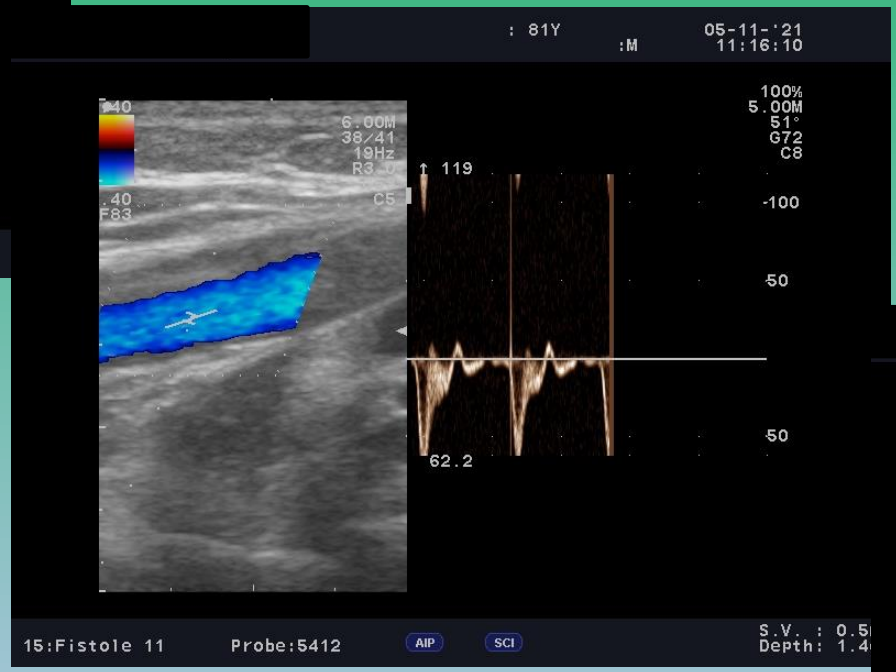
3.Ecocolordoppler

arteria

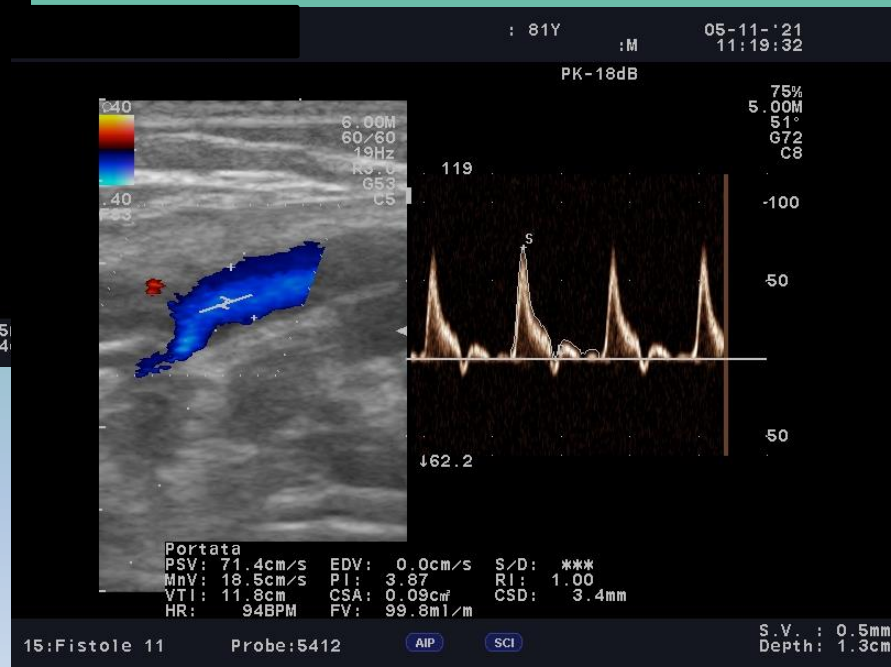
Flusso

Scelta dell’accesso vascolare per emodialisi

3.Ecocolordoppler



arteria



Flusso

Scelta dell’accesso vascolare per emodialisi

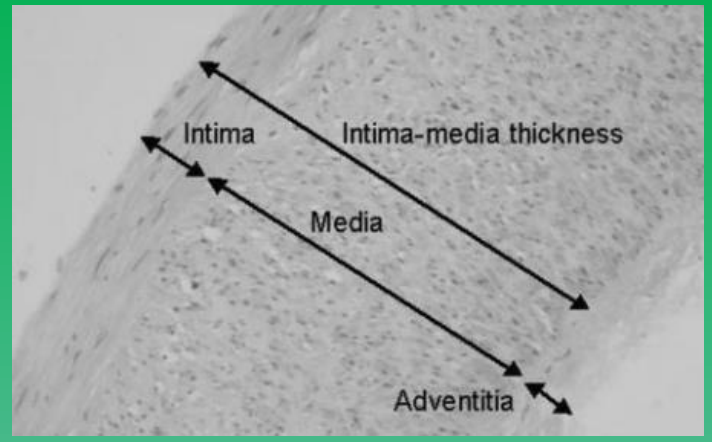
3.Ecocolordoppler

arteria

Aspetto della parete

calcificazioni aree di iperecogenicità nella parete del vaso, rendendo irregolare l'aspetto della parete

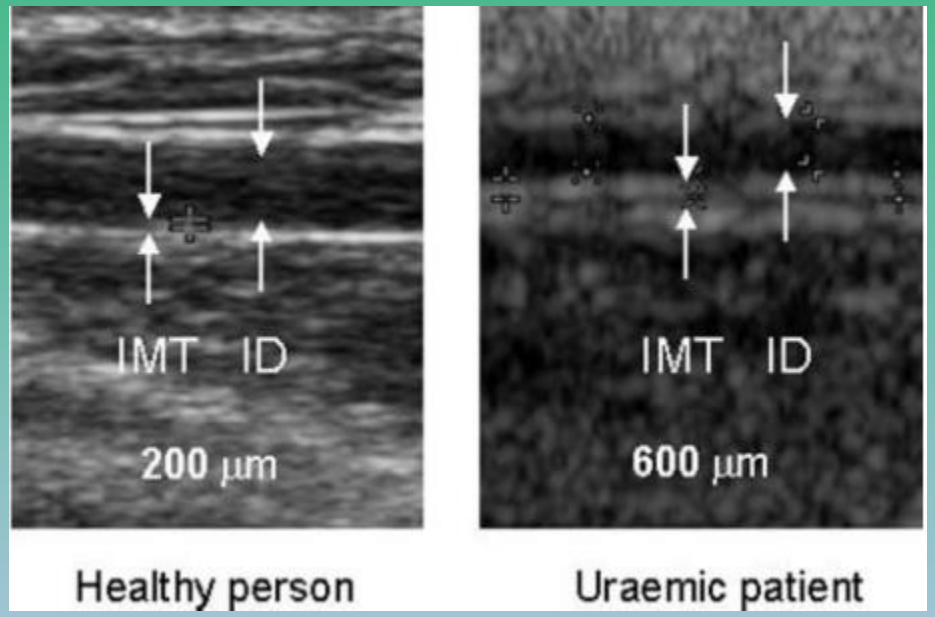
Scelta dell'accesso vascolare per emodialisi



3.Ecocolordoppler

arteria

Spessore miointimale



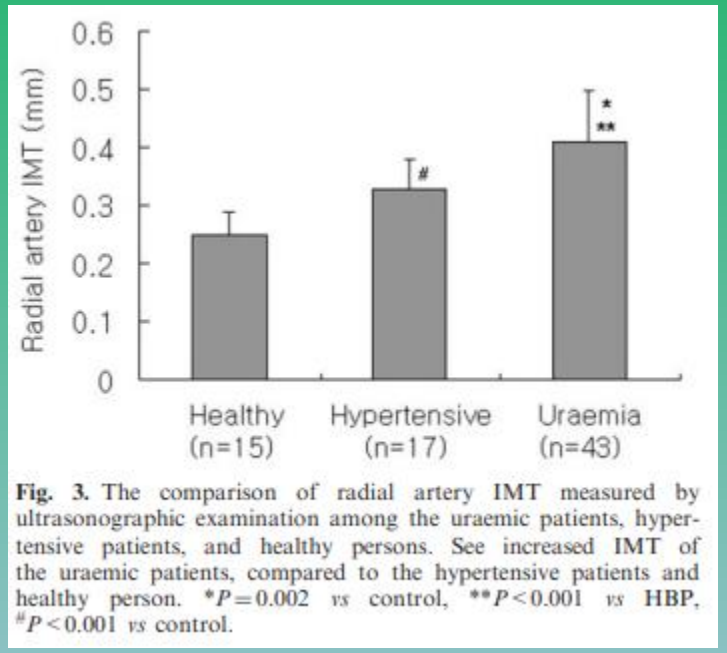


Fig. 3. The comparison of radial artery IMT measured by ultrasonographic examination among the uraemic patients, hypertensive patients, and healthy persons. See increased IMT of the uraemic patients, compared to the hypertensive patients and healthy person. $^{*}P = 0.002$ *vs* control, $^{**}P < 0.001$ *vs* HBP, $^{\#}P < 0.001$ *vs* control.

lo spessore mio-intimale è misurato analizzando l'arteria in senso longitudinale

failure group (14)	patent group (24)
0.46 ± 0.08 mm	0.40 ±0.09 mm

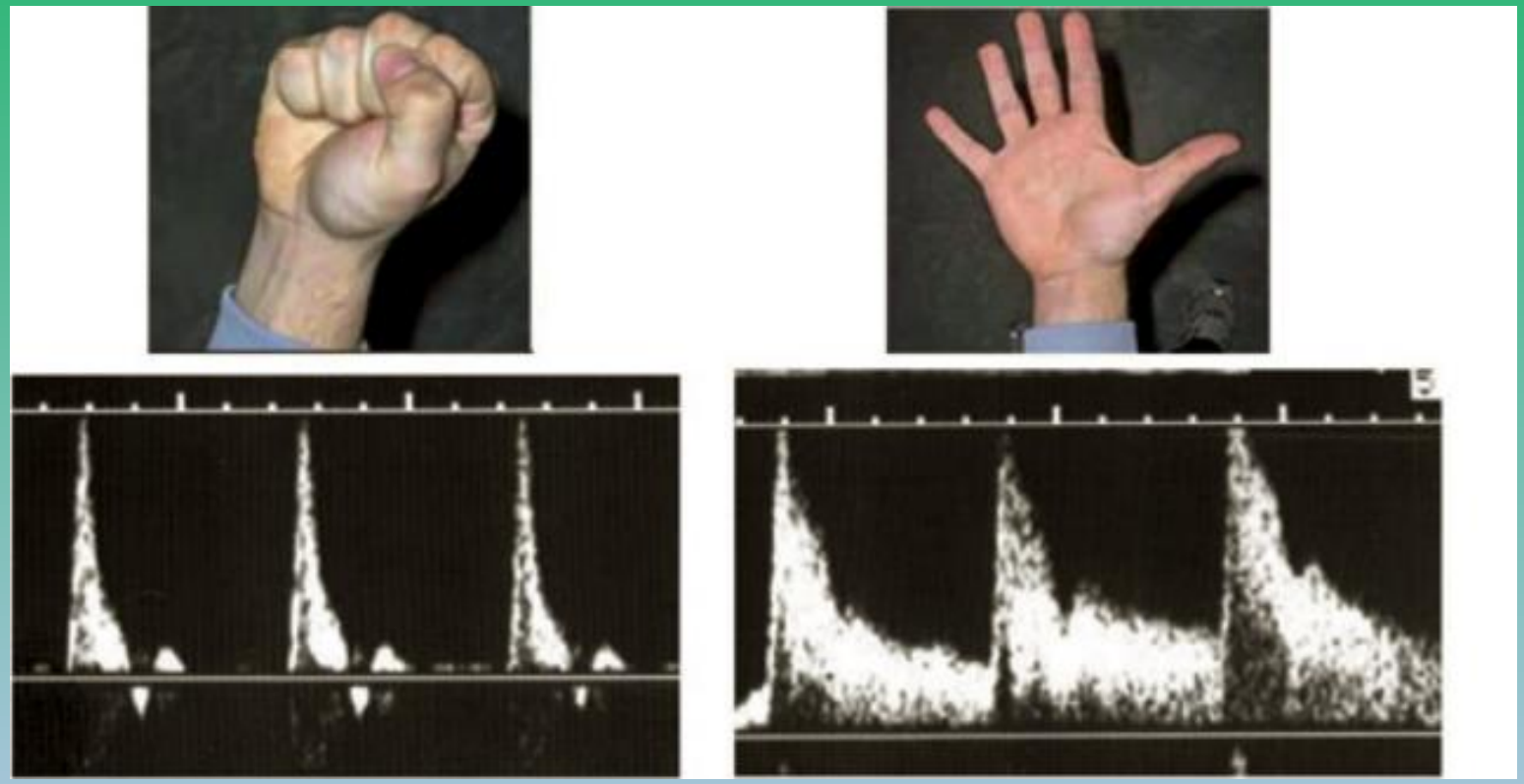
p = 0.032

Ku YM, Kim YO, Kim JI, Choi YJ, Yoon SA, Kim YS, Song SW, Yang CW, Kim YS, Chang YS, Bang BK. Ultrasonographic measurement of intima-media thickness of radial artery in pre-dialysis uraemic patients: comparison with histological examination. Nephrol Dial Transplant. 2006 Mar;21(3):715-20

Scelta dell’accesso vascolare per emodialisi

3.Ecocolordoppler

Test dell’iperemia reattiva



arteria

buona compliance vascolare

Scelta dell'accesso vascolare per emodialisi

3.Ecocolordoppler

Indice di resistanza

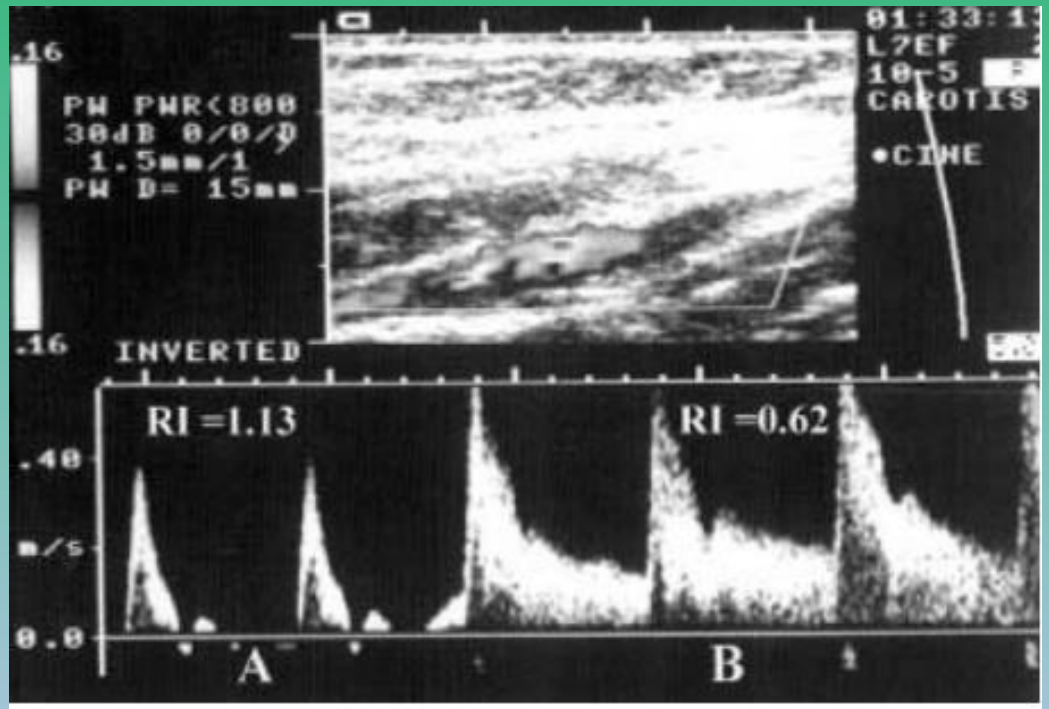


FIG. 6. Doppler "high-resistance" waveform at clenched fist (A) and Doppler "low resistance" waveform after releasing the fist (B) (reactive hyperemia).

arteria

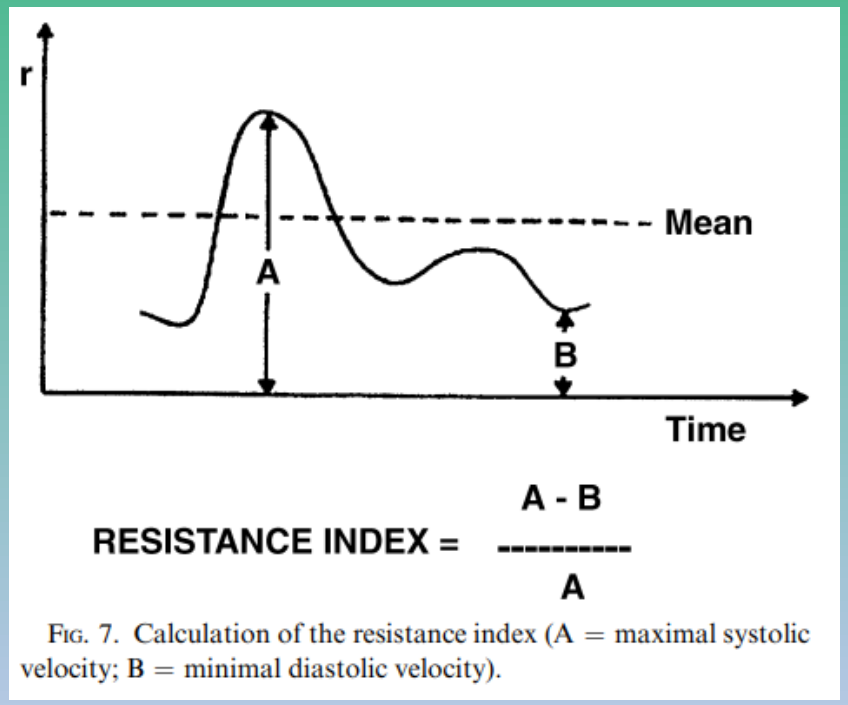


FIG. 7. Calculation of the resistance index (A = maximal systolic velocity; B = minimal diastolic velocity).

Malovrh M. The role of sonography in the planning of arteriovenous fistulas for hemodialysis. Semin Dial. 2003 Jul-Aug;16(4):299-303

3. Ecocolordoppler

diametri

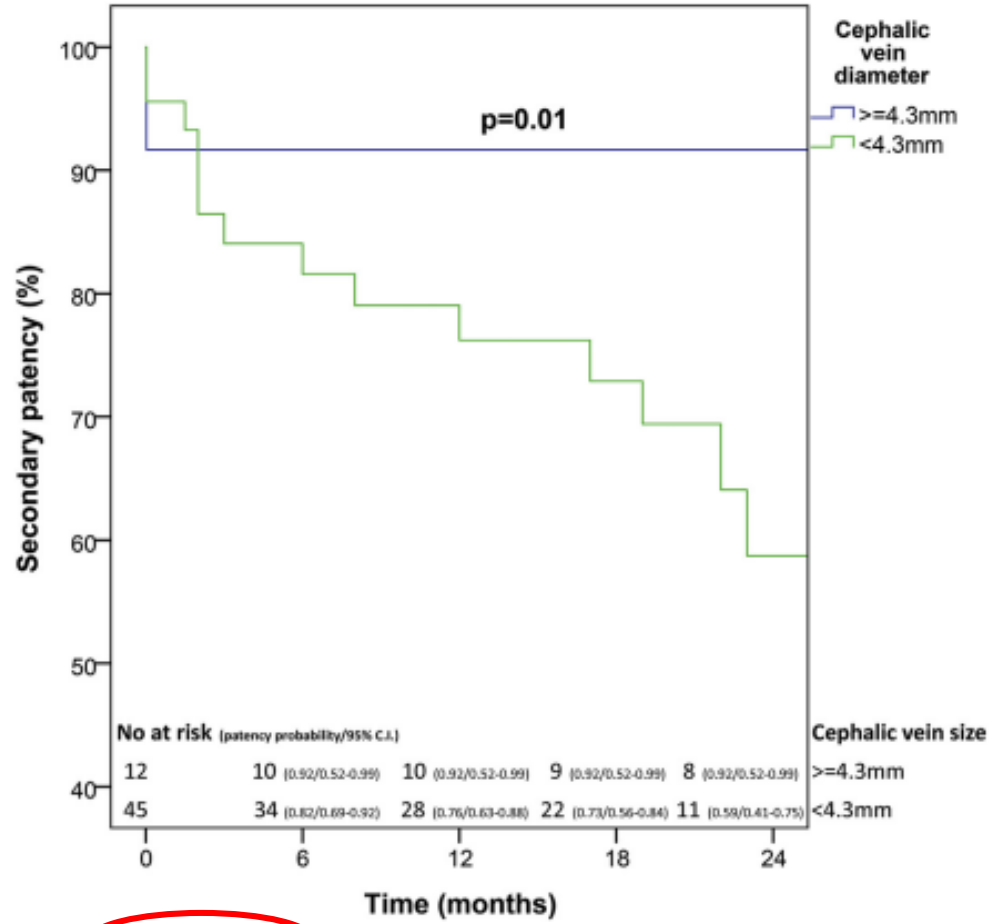


Figure 1. Secondary patency of radiocephalic AVFs in relation to cephalic vein diameter. Results were significantly inferior in the presence of a cephalic vein diameter <4.3 mm (lower three quartiles) compared with larger veins. Kaplan-Meier curves are truncated at 24 months. The number of patients at risk, patency probability, and 95% CI at each follow-up interval are shown at the bottom of the figure.

127 pz valutati prospettivamente ed analizzati retrospettivamente
135 FAV: 57 radio (arteriotomia 10-15 mm)
78 brachiocefaliche (arteriotomia 7-8 mm)
6-8 settimane, clinico -> eco

Criteri:
arteria radiale ≥ 2 mm
vena cefalica ≥ 3 mm

diametro minimo della vena dopo 1' con laccio

No predictors of primary patency
Age for primary assisted patency

+ sesso

80.4% successo

Kakkos SK, Kaplanis N, Papachristou EC, Papadoulas SI, Lampropoulos GC, Tsolakis IA, Goumenos DS. The Significance of Inflow Artery and Tourniquet Derived Cephalic Vein Diameters on Predicting Successful Use and Patency of Arteriovenous Fistulas for Haemodialysis. Eur J Vasc Endovasc Surg. 2017 Jun;53(6):870-878

3. Ecocolordoppler

diametri

76% successo

Table 3. Predictors of brachiocephalic AVF patency on univariate and multivariate analysis.

Patency predictors	Results Patency results[a]	Univariate analysis[b]	Multivariate analysis[b]
Primary patency			
BA Ø ≤4.1 mm (LQ)	**21.9% vs. 49.4% @ 3 years, $p = .002$**	**HR 2.69, 95% CI 1.39–5.2, $p = .003$**	**HR 2.65, 95% CI 1.37–5.15, $p = .004$**
CV Ø ≤3.8 mm (LQ)	27.6% vs. 46.6% @ 3 years, $p = .066$	HR 1.81, 95% CI 0.94–3.50, $p = .078$	NS
Dyslipidaemia	**11.3% vs. 45.2% @ 5 years, $p = .029$**	**HR 2.00, 95% CI 1.04–3.85, $p = .037$**	**HR 1.97, 95% CI 1.02–3.80, $p = .043$**
Primary assisted patency			
BA Ø ≤4.1 mm (LQ)	**21.9% vs. 55.9% @ 3 years, $p = .001$**	**HR 3.38, 95% CI 1.65–6.90, $p = .001$**	**HR 3.1, 95% CI 1.5–6.4, $p = .002$**
CV Ø ≤3.8 mm (LQ)	**29.6% vs. 51.9% @ 4 years, $p = .021$**	HR 1.97, 95% CI 0.97–4.00, $p = .061$	NS
Dyslipidaemia	**21.2% vs. 64.9% @ 4 years, $p = .015$**	**HR 2.36, 95% CI 1.15–4.87, $p = .020$**	**HR 2.23, 95% CI 1.08–4.61, $p = .002$**
Hypertension	36.1% vs. 82.1% @ 5 years, $p = .053$	HR 3.68, 95% CI 0.88–15.44, $p = .075$	NS
Antithrombotic agents	31.0% vs. 56.7% @ 4 years, $p = .069$	HR 1.93, 95% CI 0.93–3.99, $p = .078$	NS
Dual antithrombotic agents	**27.8% vs. 77.4% @ 6 months, $p = .031$**	**HR 3.52, 95% CI 1.01–12.24, $p = .048$**	NS
Secondary patency			
BA Ø ≤4.1 mm (LQ)	**27.8% vs. 54.0% @ 3 years, $p = .011$**	**HR 2.62, 95% CI 1.20–5.72, $p = .015$**	**HR 2.6, 95% CI 1.17–5.6, $p = .019$**
Dual antithrombotic agents	**27.8% vs. 85.2% @ 6 months, $p = .007$**	**HR 4.99, 95% CI 1.36–4.99, $p = .015$**	**HR 4.64, 95% CI 1.27–16.94, $p = .020$**
Functional secondary patency			
BA Ø ≤4.1 mm (LQ)	**26.9% vs. 47.5% @ 4 years, $p = .007$**	**HR 2.44, 95% CI 1.23–4.81, $p = .010$**	**HR 3.43, 95% CI 1.66–7.07, $p = .001$**
Peripheral arterial disease	**33.3% vs. 57.0% @ 2 years, $p = .021$**	**HR 2.73, 95% CI 1.11–6.75, $p = .029$**	**HR 3.47, 95% CI 1.35–8.88, $p = .010$**
Dual antithrombotic agents	**22.2% vs. 57.8% @ 6 months, $p = .009$**	**HR 3.80, 95% CI 1.27–11.36, $p = .017$**	**HR 3.41, 95% CI 1.14–10.19, $p = .028$**

Kakkos SK, Kaplanis N, Papachristou EC, Papadoulas SI, Lampropoulos GC, Tsolakis IA, Goumenos DS. The Significance of Inflow Artery and Tourniquet Derived Cephalic Vein Diameters on Predicting Successful Use and Patency of Arteriovenous Fistulas for Haemodialysis. Eur J Vasc Endovasc Surg. 2017 Jun;53(6):870-878

3. Ecocolordoppler
2. riferimenti forniti dalla letteratura

diametri

Methods: A prospective, observational study was performed on 122 patients (66 men) who underwent primary RCAVF creation. Internal diameters of cephalic vein (CVd) and radial artery (ARd), venous distensibility (VD), resistance index (RI) and endothelial function by flow mediated dilatation (FMD) were determined by ultrasound examination before AVF placement. AVF maturation was observed by measuring blood flow (Qa) and CVd 0, 14 and 28 days after creation. Depending on the time when AVFs attained maturity (Qa ≥500 mL/min, CVd ≥5 mm), patients were divided into three groups: (i) successful maturation (after four weeks), (ii) prolonged maturation (within eight weeks) and (iii) failure to mature.

Results: Only 11% of patients failed to achieve a mature RCAVF. Successful AVF maturation occurred in 53% of patients and prolonged maturation in 36% of patients. ROC analysis defined the limits of variables relevant for RCAVF success (CVd >1.8 mm, ARd >1.6 mm, VD >0.4 mm). Female sex was associated with prolonged maturation (OR 0.35, 95% CI=0.17-0.72; P=0.005) having a significantly smaller ARd (1.83 vs. 2.01 mm, P=0.01) but better FMD (2981.5 vs. 2689.5, P=0.02) compared to men.

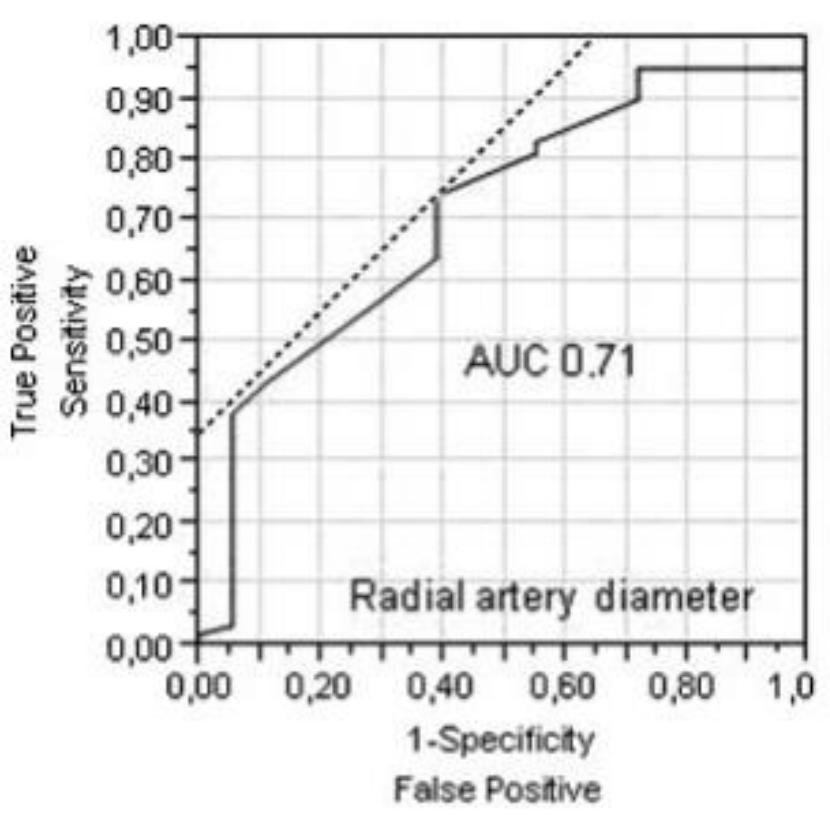
Conclusions: ARd ≤1.6 mm, CVd ≤1.8 mm and VD ≤0.4 mm are exact cut-off points, which best predict nonmaturation of RCAVF. Women need extended time for adequately matured AVF.

Jemcov TK. Morphologic and functional vessels characteristics assessed by ultrasonography for prediction of radiocephalic fistula maturation. J Vasc Access. 2013 Oct-Dec;14(4):356-63

3. Ecocolordoppler

diametri

studio retrospettivo 80 pz
primo allestimento
FAV radiocefaliche
arteriotomia 10 mm
6 settimane
criterio clinico -> eco



cut-off 2.3 mm

Table 2 Pre- and intraoperative vessel parameters

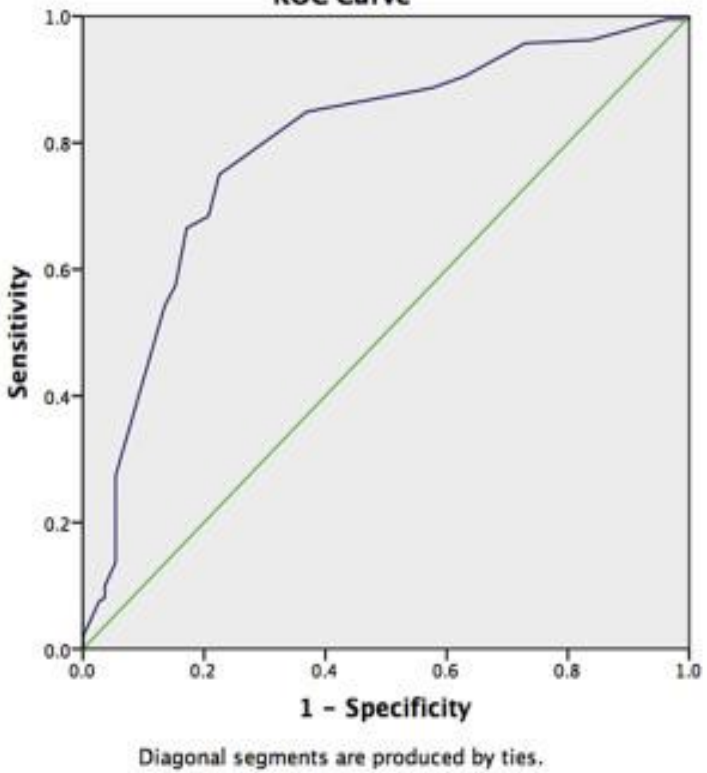
Variable	Total patients ($n = 80$)	Group functioning AVF ($n = 62$)	Group nonfunctioning AVF ($n = 18$)	χ^2	p value
Preoperative diameter radial artery, mm, mean ± SEM	2.4 ± 0.1	2.5 ± 0.1	2.19 ± 0.1	5.23	0.01
Preoperative diameter cephalic vein, mm, mean ± SEM	3.1 ± 0.1	3.2 ± 0.1	2.8 ± 0.8	3.7	0.07
Intraoperative AVF flow, mL/min, mean ± SEM	180 ± 15	201 ± 18	111 ± 17	7.09	0.01
Intraoperative AVF PI, mean ± SEM	0.9 ± 0.1	0.77 ± 0.1	1.21 ± 0.2	6.5	0.04
Postoperative AVF flow, mL/min, mean ± SEM	327 ± 26	401 ± 27	87 ± 24	16.29	0.01

Abbreviations: AVF, arteriovenous fistula; PI, pulsating index; SEM, standard error of mean.

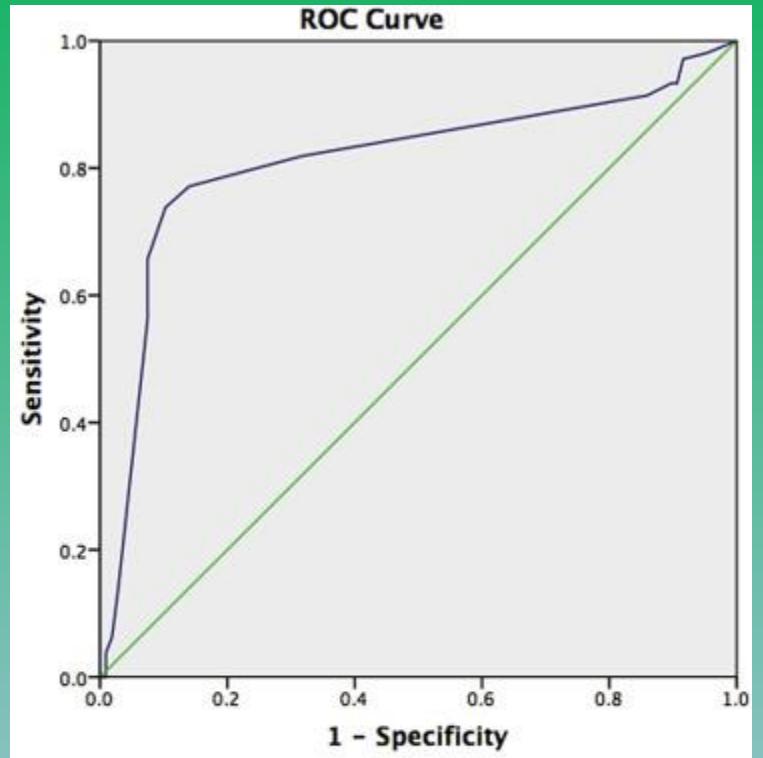
Usta E, Elkrinawi R, Salehi-Gilani S, Adili S, Sonnentag T, Alscher M, Artunc F, Franke U. Risk factors predicting the successful function and use of autogenous arteriovenous fistulae for hemodialysis. Thorac Cardiovasc Surg. 2013 Aug;61(5):438-44

3. Ecocolordoppler
2. riferimenti forniti dalla letteratura

diametri



Cephalic vein cutoff diameter ≤ 1.55mm				
Area	SE	p value	95% CI	
.795	.027	.000	.741	.848



Radial Artery Cut off diameter ≤1.65 mm				
Area	SE	P value	95% CI	
.811	.026	.000	.760	.863

Studio prospettico di coorte 324 pz
FAV radiocefaliche (primo)
1/4/6 settimane
criterio dei 6

66% maturazione FAV

Kordzadeh A, Askari A, Hoff M, Smith V, Panayiotopoulos Y. The Impact of Patient Demographics, Anatomy, Comorbidities, and Peri-operative Planning on the Primary Functional Maturation of Autogenous Radiocephalic Arteriovenous Fistula. Eur J Vasc Endovasc Surg. 2017 May;53(5):726-732

Table 2. Chi-square analysis of between two groups (primary functional maturation versus non-maturation).

	No maturation		Maturation		*p*
	n	%	*n*	%	
Gender					
Female	39	48.8	41	51.2	.001
Male	71	29.1	173	70.9	
Age at surgery					
18–65 years	54	37.8	89	62.2	.401
66–75 years	25	32.9	51	67.1	
> 75 years	27	29.3	65	70.7	
Diabetes mellitus					
No diabetes mellitus	61	33.0	124	67.0	.648
Diabetes mellitus	36	35.6	65	64.4	
Hypertension					
No Hypertension	13	33.3	26	66.7	.885
Hypertension	67	34.5	127	65.5	
IHD					
No IHD	68	32.9	139	67.1	.605
IHD	18	36.7	31	63.3	
CHF					
No CHF	85	34.7	160	65.3	.079
CHF	1	9.1	10	90.9	
Local or general anaesthetic					
Local anaesthetic	100	33.1	202	66.9	.455
General anaesthetic	9	40.9	13	59.1	
Cephalic vein diameter (mm)					
Up to 1.55	86	61.9	53	38.1	< .001
> 1.55	25	13.6	159	86.4	
Radial artery diameter (mm)					
Up to 1.65	92	65.7	48	34.3	< .001
> 1.65	15	8.5	162	91.5	

Note. Total *n* = 324. CHF = congestive heart failure; IHD = ischaemic heart disease.

diametri

Table 5. The univariate and multivariate binary logistic regression results for independence of variables (*n* = 324).

	Univariate			Multivariate		
	Odds ratio	95% CI	*p*	Odds ratio	95% CI	*p*
Gender						
Female	Ref			Ref		
Male	2.32	1.38–3.89	.001	1.66	.82–3.38	.161
Age (years)						
18–65	Ref					
> 65	1.35	0.85–2.17	.207			
General/local anaesthetic						
Local	Ref					
General	0.72	0.30–1.73	.457			
Diabetes mellitus						
No diabetes	Ref					
Diabetes	0.89	0.53–1.48	0.648			
IHD						
No IHD	Ref					
IHD	0.84	0.44–1.61	.605			
CHF						
No CHF	Ref					
CHF	5.31	0.67–42.20	.114			
Hypertension						
No hypertension	Ref					
Hypertension	0.95	0.46–1.96	.885			
Vein diameter (mm)						
Up to 1.55	Ref			Ref		
> 1.55	10.30	6.00–17.76	< .001	4.57	2.42–8.63	< .001
Artery diameter (mm)						
Up to 1.65	Ref			Ref		
> 1.65	20.70	10.98–39.01	< .001	12.26	6.27–23.97	< .001

CHF = congestive heart failure; IHD = ischaemic heart disease.

Kordzadeh A, Askari A, Hoff M, Smith V, Panayiotopoulos Y. The Impact of Patient Demographics, Anatomy, Comorbidities, and Peri-operative Planning on the Primary Functional Maturation of Autogenous Radiocephalic Arteriovenous Fistula. Eur J Vasc Endovasc Surg. 2017 May;53(5):726-732

3. Ecocolordoppler

diametri

Table 7. Stepwise regression analysis demonstrating cutoff points (cephalic vein and radial artery diameter) and ranges with their subsequent maturation success and test of probability.

		Univariate *p*	Multivariate Odds ratio	95% CI	Maturation (%)	*p*
Cephalic vein diameter (mm)	< 1.55	< .001	Ref		38.1	
	1.56–1.99		4.29	1.80–10.23	81.5	.001
	2.00+		4.57	2.15–9.73	88.5	< .001
Radial artery diameter (mm)	< 1.65	< .001	Ref		34.3	
	1.66–1.99		7.91	3.17–19.76	86.3	< .001
	2.00+		15.95	6.89–36.95	93.7	< .001

Kordzadeh A, Askari A, Hoff M, Smith V, Panayiotopoulos Y. The Impact of Patient Demographics, Anatomy, Comorbidities, and Peri-operative Planning on the Primary Functional Maturation of Autogenous Radiocephalic Arteriovenous Fistula. Eur J Vasc Endovasc Surg. 2017 May;53(5):726-732

3. Ecocolordoppler

Diametro della vena con o senza laccio?
possibile aumento del diametro > 30%

vena
diametro

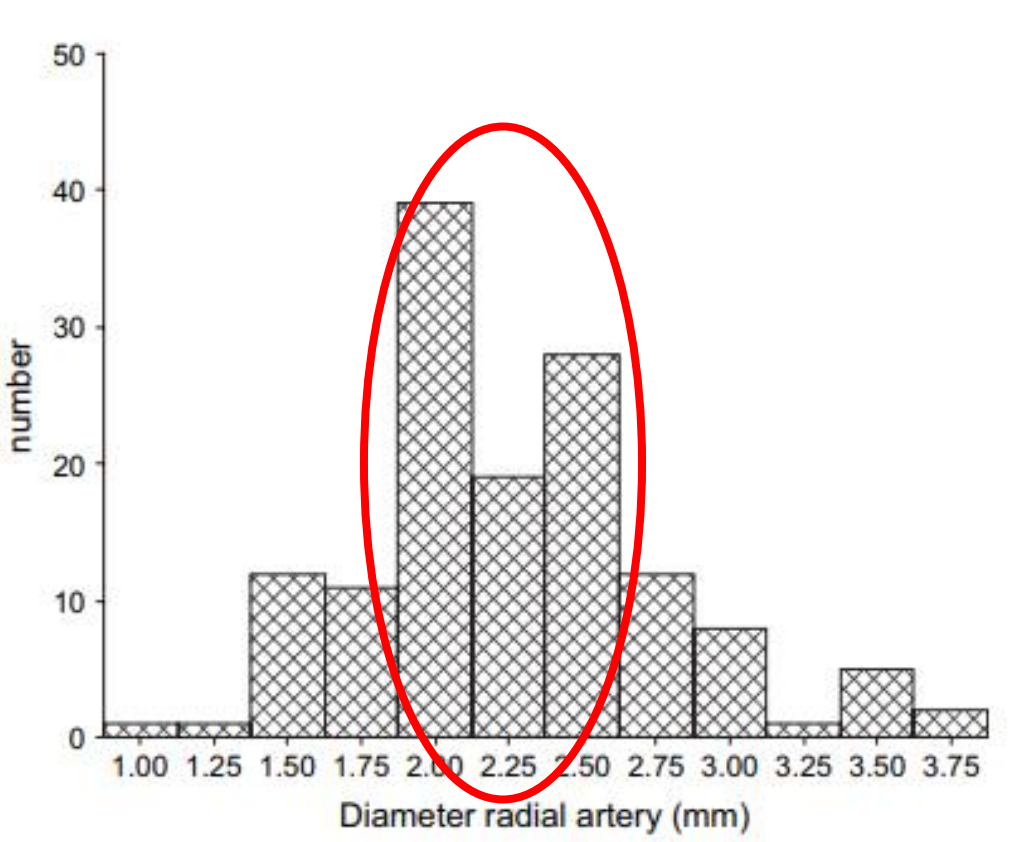
Dove misurare il diametro della vena?
diametro minimo del tratto di efflusso della FAV
diametro del tratto perianastomotico
diametro medio del tratto di efflusso
...non specificato come o quale diametro misurato

Indicare un cutoff per il diametro probabilmente non è corretto, pensando che all'aumentare del diametro maggior è la probabilità di fistola funzionante

Zamboli P, Fiorini F, D'Amelio A, Fatuzzo P, Granata A. Color Doppler ultrasound and arteriovenous fistulas for hemodialysis. J Ultrasound. 2014 Jul 11;17(4):253-63

Kosa SD, Al-Jaishi AA, Moist L, Lok CE. Preoperative vascular access evaluation for haemodialysis patients. Cochrane Database Syst Rev. 2015 Sep 30;2015(9)

Cornacchiari M, Mudoni A, Borin F, Stasi A, Ponticelli MG, Visciano B, Guastoni C. [Evaluation via ecocolordoppler before creating a vascular access for hemodyalisis: a monocentric experience]. G Ital Nefrol. 2020 Jun 10;37(3)



moda 2 mm
media 2.3 mm } vena

analisi retrospettiva di dati raccolti prospetticamente
148 pz radiocefaliche clinico a 1 aa
diametro arteria e vena con laccio al polso

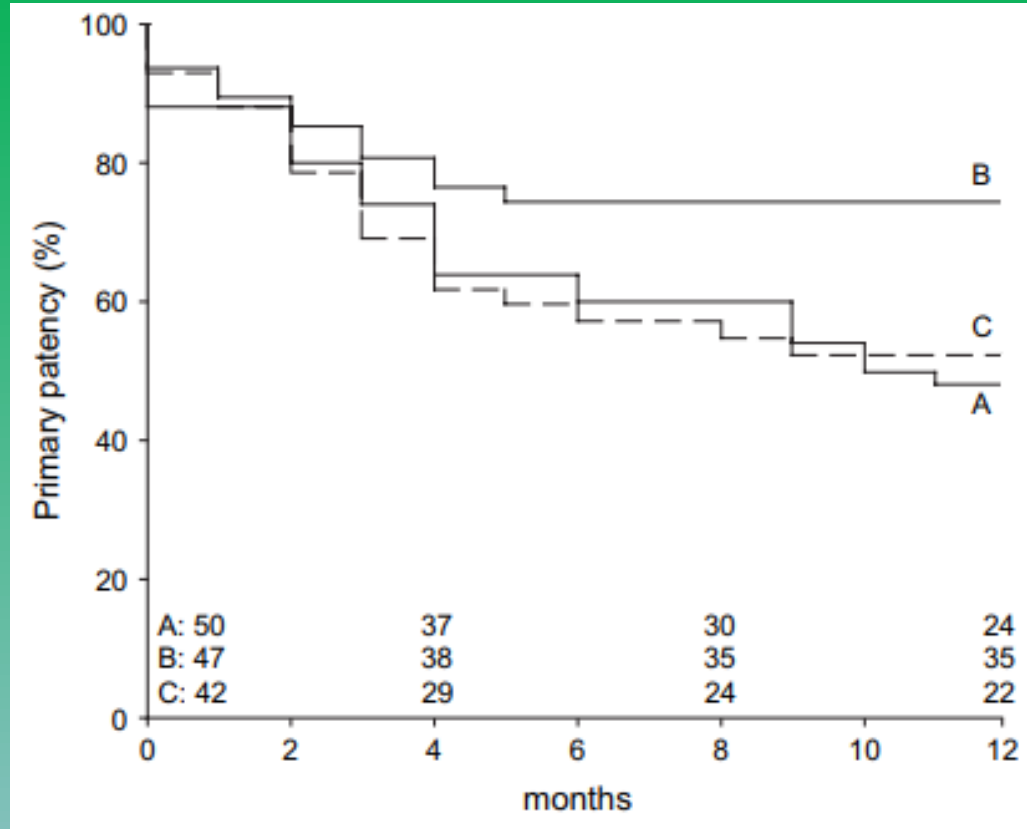


Fig. 4. Primary patency by tertiles of radial artery diameter: Kaplan Meier curves. Curve A: ≤2.0 mm, B: ≥2.1 mm and ≤2.5 mm, C: ≥2.6 mm (overall $P = 0.042$). Numbers at risk are given below.

primary failure (criterio clinico 6 settimane) 11%

Korten E, Toonder IM, Schrama YC, Hop WC, van der Ham AC, Wittens CH. Dialysis fistulae patency and preoperative diameter ultrasound measurements. Eur J Vasc Endovasc Surg. 2007 Apr;33(4):467-71

vena
distensibilità

Table 1. Fistula Outcomes Sorted by Pretourniquet Cephalic Vein Diameter and Sex

Vein Diameter, cm	Fistulas, n	Adequate, n (%)	Inadequate, n (%)
Female	31	6/31 (19)*	25/31 (81)
Pretourniquet <0.25	23	4/23 (17)†	19/23 (83)
Pretourniquet ≥0.25	8	2/8 (25)†	6/8 (75)
Male	42	20/42 (48)*	22/42 (52)
Pretourniquet <0.25	22	11/22 (50)†	11/22 (50)
Pretourniquet ≥0.25	20	9/20 (45)†	11/20 (55)

Table 3. Preoperative Sonographic Measurements by Fistula Outcome

Preoperative Parameter	Inadequate Fistulas (n = 47)	Adequate Fistulas (n = 26)	*P*
Artery diameter, cm	0.26 ± 0.01	0.30 ± 0.01	.001
Vein diameter, cm			
Before tourniquet	0.22 ± 0.01	0.23 ± 0.01	.962
After tourniquet	0.30 ± 0.01	0.33 ± 0.01	.006
PSV, cm/s	0.55 ± 0.03	0.60 ± 0.04	.360
EDV, cm/s	0.019 ± 0.004	0.011 ± 0.006	.296

Values are mean ± SEM. EDV indicates end-diastolic velocity; and PSV, peak systolic velocity.

64% failure

analisi retrospettiva di dati raccolti prospetticamente
FAV radiocefaliche
In 97 pz dei quali 73 disponibile follow up
Criteri:
arteria radiale ≥ 2 mm
vena cefalica al polso ≥ 2.5 mm
6 mesi clinico

Lockhart ME, Robbin ML, Fineberg NS, Wells CG, Allon M. Cephalic vein measurement before forearm fistula creation: does use of a tourniquet to meet the venous diameter threshold increase the number of usable fistulas? J Ultrasound Med. 2006 Dec;25(12):1541-5

3. Ecocolordoppler

flusso ematico

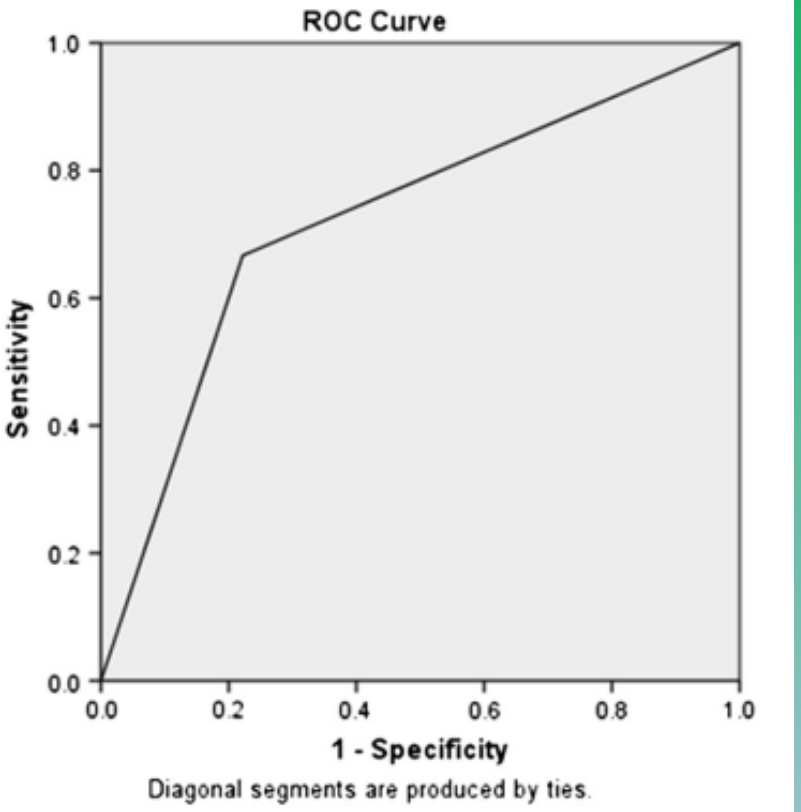


Fig 1. Receiver operating characteristic (*ROC*) curve of minimum vein diameter (MVD) of <2.7 mm as a predictor of native arteriovenous fistula (AVF) failure to mature (FTM; area under the curve [AUC], 0.72; 95% confidence interval [CI], 0.60-0.85; $P = .002$).

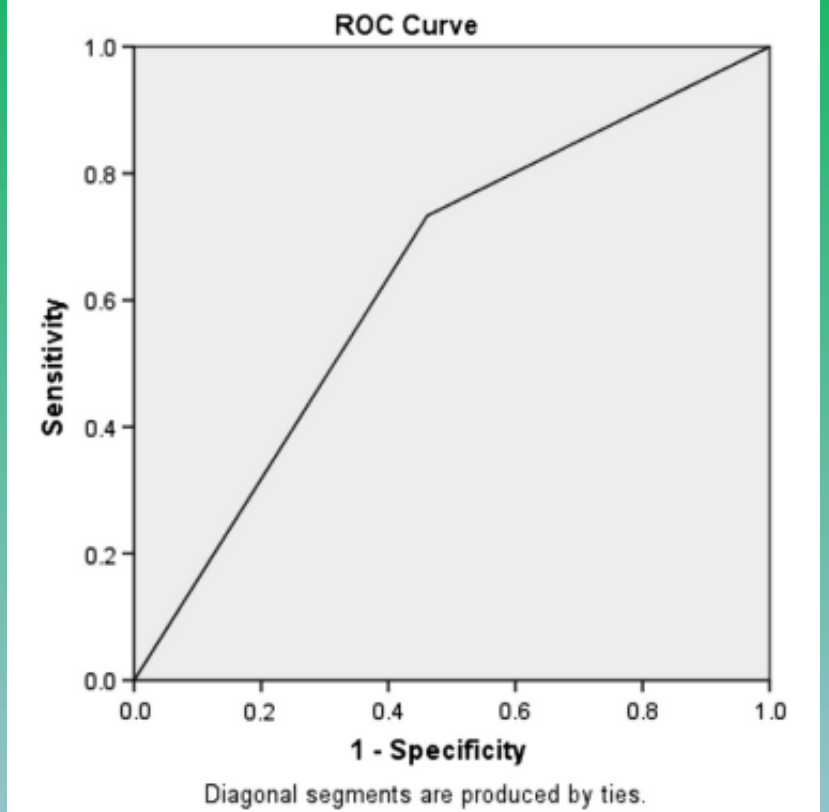


Fig 2. Receiver operating characteristic (*ROC*) curve of radial artery volume flow (VF) of <50 mL/min as a predictor of native arteriovenous fistula (AVF) failure to mature (FTM; area under the curve [AUC], 0.64; 95% confidence interval [CI], 0.50-0.78; $P = .054$).

studio retrospettivo
152 pz -> 149 -> 47 (32%)
failure to mature

diametro vena senza laccio
3 misure a distanza di 5 cm
criterio clinico

69 FAV radiocefaliche

Masengu A, McDaid J, Maxwell AP, Hanko JB. Preoperative radial artery volume flow is predictive of arteriovenous fistula outcomes. J Vasc Surg. 2016 Feb;63(2):429-35

3. Ecocolordoppler

Vessel characteristics	*Mean; standard deviation (range)*	P *(95% CI)*
Artery		
Diameter, mm		
Radial artery (n = 67)	3.7; 1.2 (1.9-5.9)	
Brachial artery (n = 76)	3.6; 1.3 (1.5-6.7)	.6 (−0.6 to −0.3)
Peak systolic velocity, cm/s		
Radial artery (n = 62)	75; 20 (35.7-147.8)	<.001 (−20.4 to −6.0)
Brachial artery (n = 72)	89; 22 (47.2-159.9)	
VF, mL/min		
Radial artery (n = 66)	64; 39 (7-175)	<.001 (−180.9 to −131.7
Brachial artery (n = 79)	220; 94 (62-501)	
Vein		
Average vein diameter, mm		
Lower cephalic	3.0; 0.8 (1.5-4.7)	
Upper cephalic	3.6; 1.1 (1.1-6.1)	
Basilic vein	4.9; 1.3 (3.2-7.3)	
MVD, mm		
Lower cephalic	2.7; 0.7 (1.2-4.3)	
Upper cephalic	3.3; 1.1 (0.9-5.9)	
Basilic vein	4.6; 1.1 (3.2-6.7)	

CI, Confidence interval; *MVD*, minimum vein diameter; *VF*, volume flow.

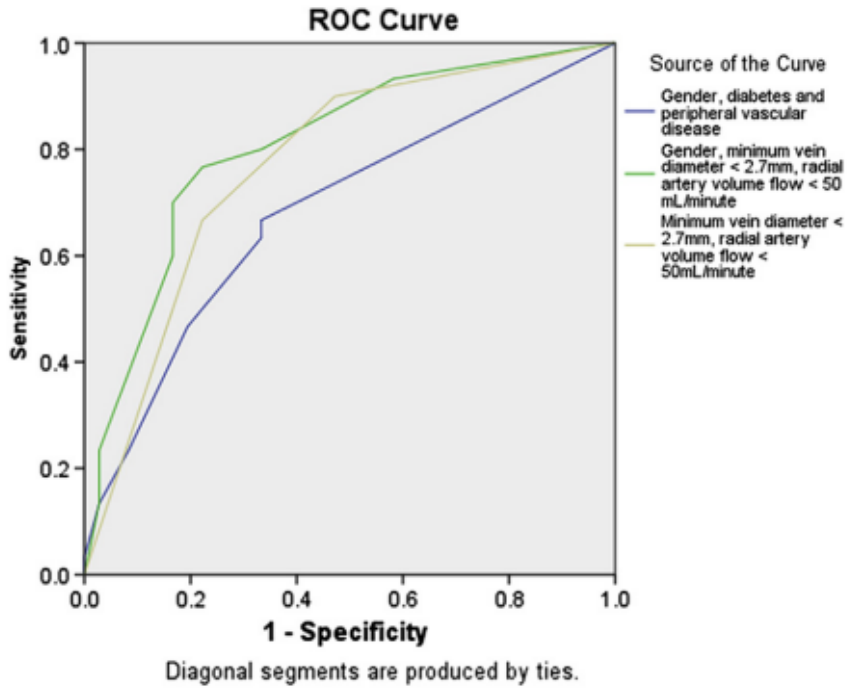


Fig 3. Receiver operating characteristic (*ROC*) curve of model 1: gender, radial artery VF <50 mL/min, and MVD <2.7 mm; model 2: gender and history of peripheral vascular disease and diabetes; and model 3: MVD <2.7 mm and a radial artery VF <50 mL/min. Model 1: area under the curve (AUC), 0.81; 95% confidence interval (CI), 0.70-0.91; $P < .01$. Model 2: AUC, 0.68; 95% CI, 0.55-0.81; $P = .011$. Model 3: AUC, 0.77; 95% CI, 0.66-0.88; $P < .01$.

flusso ematico

radiocefaliche →

età non significativa

Masengu A, McDaid J, Maxwell AP, Hanko JB. Preoperative radial artery volume flow is predictive of arteriovenous fistula outcomes. J Vasc Surg. 2016 Feb;63(2):429-35

Scelta dell'accesso vascolare per emodialisi

4. Flebografia

Statements: Vessel Mapping for Vascular Access

7.3 KDOQI suggests selective preoperative ultrasound in patients at high risk of AV access failure (Table 7.2) rather than routine vascular mapping in all patients (*Conditional Recommendation, Low Quality of Evidence*).

7.4 KDOQI considers it reasonable to use various imaging studies as needed to evaluate the suitability of vessels for AV access creation such as ultrasonography for peripheral vessels (including intraoperative ultrasound) and venography for suspected central vein occlusion, while considering the patient's clinical circumstances and residual kidney function. (*Expert Opinion*)

Sgroi MD, McFarland G, Itoga NK, Sorial E, Garcia-Toca M. Arteriovenous Fistula and Graft Construction in Patients with Implantable Cardiac Devices: Does Side Matter? Ann Vasc Surg. 2019 Jan;54:66-71

Scelta dell'accesso vascolare per emodialisi

4. Flebografia

Consecutive patients with chronic kidney disease (n = 137) after an initial estimation of the AV access type, based on physical examination, had USVM and UEV to detect vascular pathology that could potentially alter the original plan. USVM changed the preoperative plan in 31 (22.6%) patients; this was 36.7% (n = 18) in diabetics compared with 14.8% (n = 13) in nondiabetics (p < .001). Patients for whom USVM changed the type of planned AV access had been on hemodialysis significantly longer (2.7 years vs 0.9 years; p < .001). Venography identified 18 patients with central vein stenosis that led to a site change in 12 of them. Significant venous stenosis in patients with a history of two or more central catheters placed and patients without such a history was 93% and 1%, respectively. In eight patients, intraoperative findings dictated AV graft placement or creation of a central AVF. The original plan was revised in 31%, and this rate was similar for distal AVF, central AVF, and AV grafts (38%, 26%, and 43%, respectively; all p > .05). The 30-day patency rate was 92.2%. A significant proportion of patients have vascular pathology severe enough to alter the access type as suggested by physical examination alone. USVM should be routinely performed, whereas UEV should be selectively performed in patients with a history of surgery or instrumentation of their central veins.

Lampropoulos G, Papadoulas S, Katsimperis G, Ieronimaki AI, Karakantza M, Kakkos SK, Tsolakis I. Preoperative evaluation for vascular access creation. Vascular. 2009 Mar-Apr;17(2):74-82

Scelta dell'accesso vascolare per emodialisi

4. Flebografia

J Vasc Access. 2006 Jul-Sep;7(3):123-8. doi: 10.1177/112972980600700306.

Impact of pre-operative venography on the planning and outcome of vascular access for hemodialysis patients

M A Elsharawy [1], K M Moghazy

Patients and methods: A prospective study was performed on all patients with end-stage renal disease (ESRD) who had HD access procedures and pre-operative venography between October 2003 and November 2005. Upper limb venography was done for all patients except those that required primary access and had visible veins. All patients had HD immediately after the venography. Access procedure selection was based on the result of the venography. The complications of venography, the surgical procedure and the outcome were recorded.

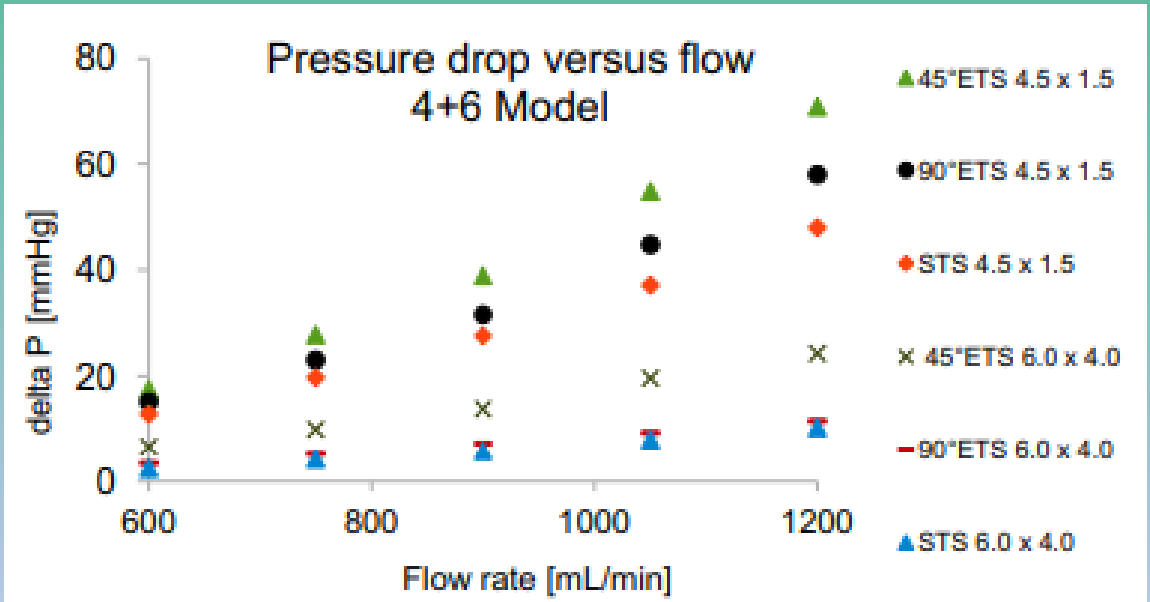
Results: One hundred and twenty-nine patients with ESRD who had pre-operative venography were included in this study. They were mostly middle age (mean age +/- SD = 41 +/- 15.5 yrs) with a high rate of diabetes mellitus (53%). No single complication was reported. A graft was placed in six patients (5%) only. Unsuccessful surgical exploration was 0%. Early failure was in 10 patients (8%).

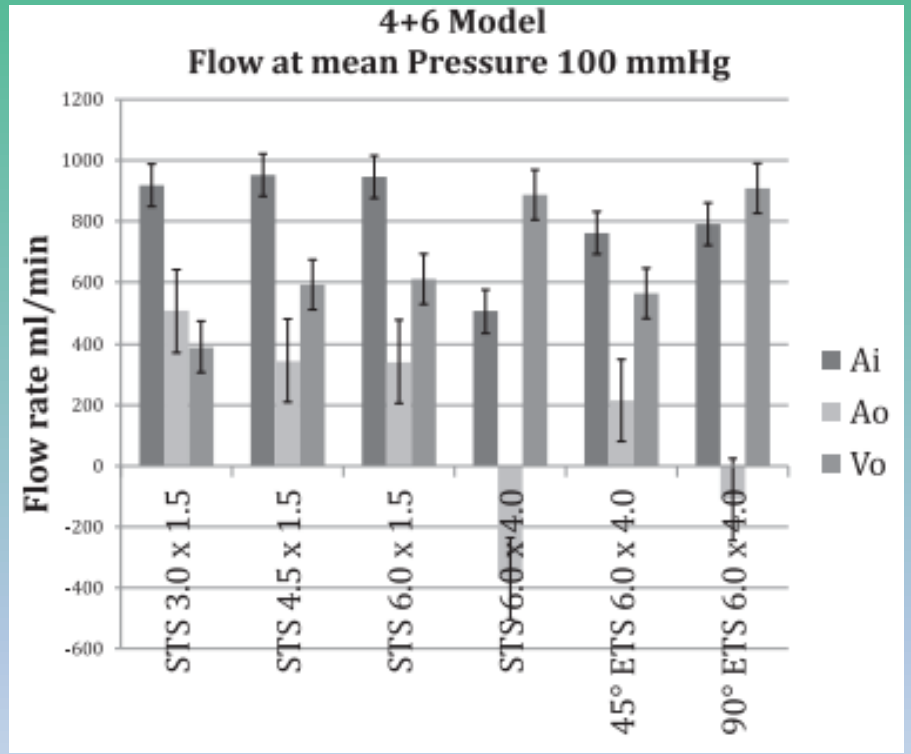
Conclusion: Pre-operative venography resulted in an increase in the number of AVFs. It can improve the results of HD access procedures by selecting the most suitable veins.

Scelta dell'accesso vascolare per emodialisi

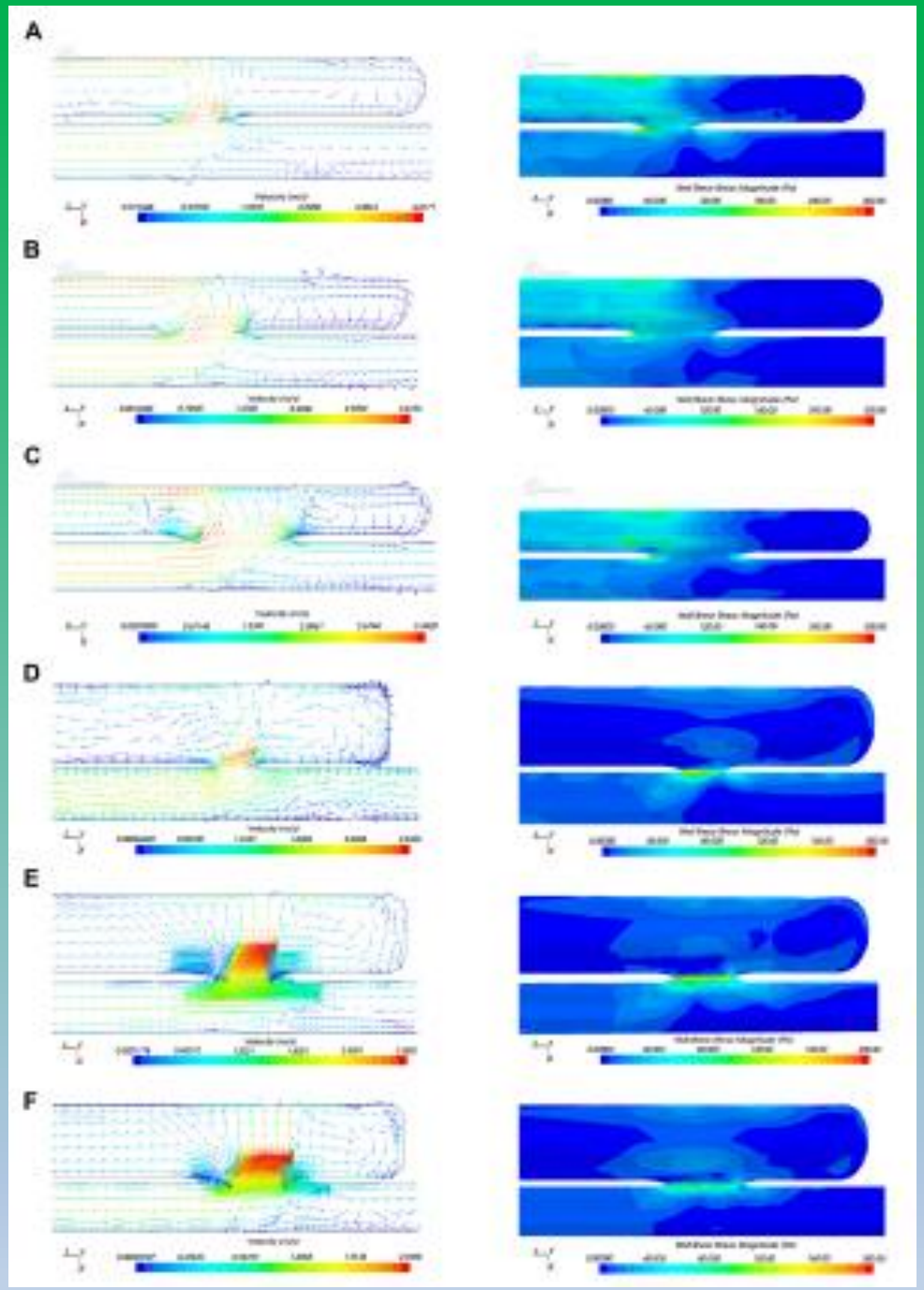
Quale anastomosi?

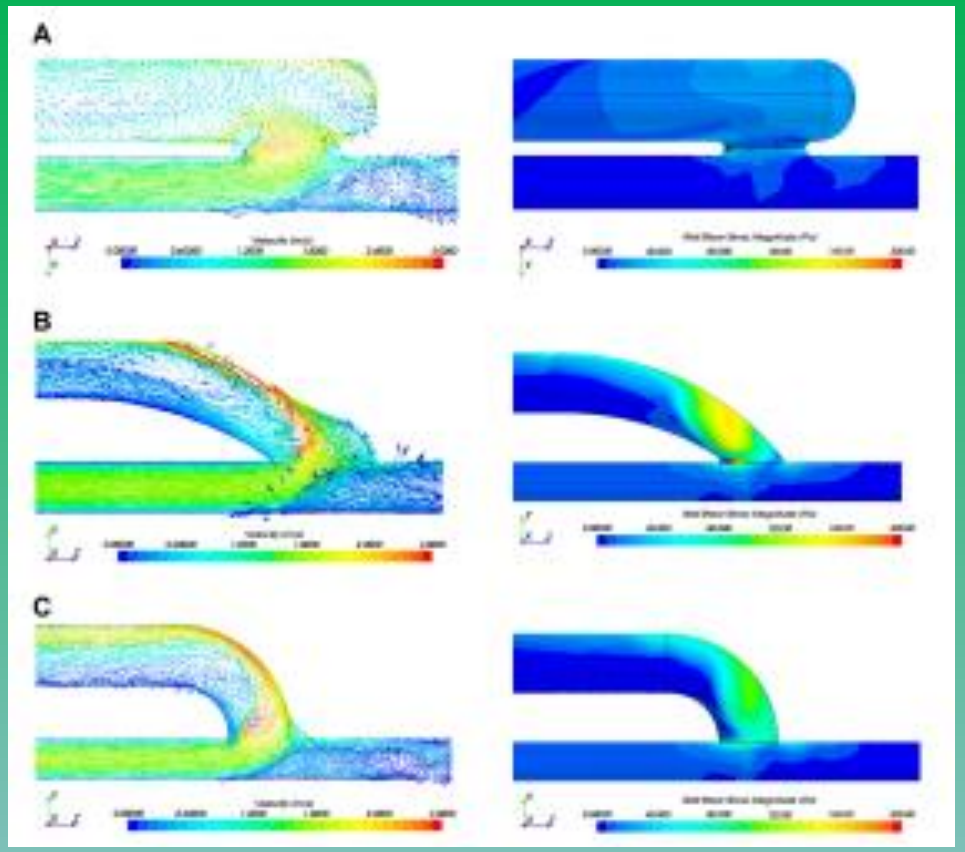
Model (artery + vein)	*Size, mm*	*STS*	*Short STS*	*Open STS*	*45° ETS*	*90° ETS*
3 + 3	3.0 × 1.5	X				
3 + 3	4.5 × 1.5	X	X	X	X	X
3 + 3	6.0 × 1.5	X				
4 + 6	3.0 × 1.5	X				
4 + 6	4.5 × 1.5	X	X	X	X	X
4 + 6	6.0 × 1.5	X				
4 + 6	6.0 × 4.0	X			X	X





Hull JE, Balakin BV, Kellerman BM, Wrolstad DK. Computational fluid dynamic evaluation of the side-to-side anastomosis for arteriovenous fistula. J Vasc Surg. 2013 Jul;58(1):187-93



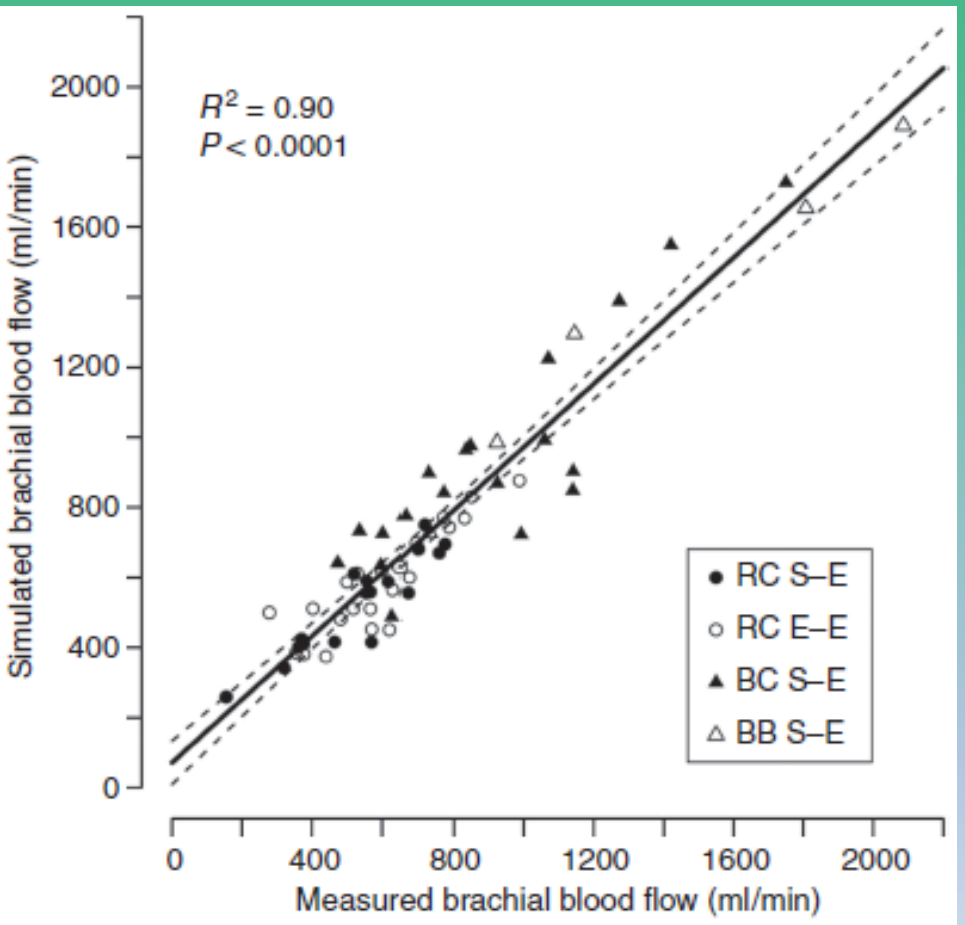


Hull JE, Balakin BV, Kellerman BM, Wrolstad DK. Computational fluid dynamic evaluation of the side-to-side anastomosis for arteriovenous fistula. J Vasc Surg. 2013 Jul;58(1):187-93

Scelta dell'accesso vascolare per emodialisi

Validation of a patient-specific hemodynamic computational model for surgical planning of vascular access in hemodialysis patients

Anna Caroli[1,10], Simone Manini[1,10], Luca Antiga[2], Katia Passera[1], Bogdan Ene-Iordache[1], Stefano Rota[3], Giuseppe Remuzzi[3], Aron Bode[4], Jaap Leermakers[4], Frans N. van de Vosse[5,6], Raymond Vanholder[7], Marko Malovrh[8], Jan Tordoir[4] and Andrea Remuzzi[1,9] on behalf of the ARCH project Consortium[11]



Kidney Int. 2013 Dec;84(6):1237-45.

Scelta dell’accesso vascolare per emodialisi

FAV nativa

PRO	CONTRO
↑ sopravvivenza	↑ trombosi precoce mancata maturazione
↓ infezioni	
↓ ospedalizzazione	
↓ costi	
↓ mortalità	

Murad MH, Elamin MB, Sidawy AN, Malaga G, Rizvi AZ, Flynn DN, Casey ET, McCausland FR, McGrath MM, Vo DH, El-Zoghby Z, Duncan AA, Tracz MJ, Erwin PJ, Montori VM. Autogenous versus prosthetic vascular access for hemodialysis: a systematic review and meta-analysis. J Vasc Surg. 2008 Nov;48(5 Suppl):34S-47S

Scelta dell’accesso vascolare per emodialisi

ecocolordoppler

PRO	CONTRO
↓ poco costosa	operatore dipendente
↓ non invasiva (no radiazioni ionizzanti, non mezzo di contrasto iodato)	↓ campo visivo (acquisire molte immagini)
↕ facilmente disponibile	immagine bi-dimensionale
valutazione morfologica e dinamica dell'accesso	non da immagini del sistema venoso centrale (sterno, clavicola, coste)
presenza di valvole	

Scelta dell’accesso vascolare per emodialisi

flebografia

PRO	CONTRO
gold standar per la valutazione del sistema venoso	↑ più costosa
permette di identificare stenosi dei vasi centrali	↑ più invasiva (radiazioni inizanti, mezzo di contrasto iodato_ tossicità, allergia_)
	non disponibile in tutti gli ospedali
	richiede più tempo per preparare il paziente
	necessaria sala adeguata (asettica, schermata)

Scelta dell’accesso vascolare?

Proporre al paziente giusto
l’accesso vascolare giusto
al momento giusto

GRAZIE!!!