International Pediatric Nephrology Association

Hemodialysis access
- current recommendations
(and reality)

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CENTRUM ZDROWIA DZIECKA

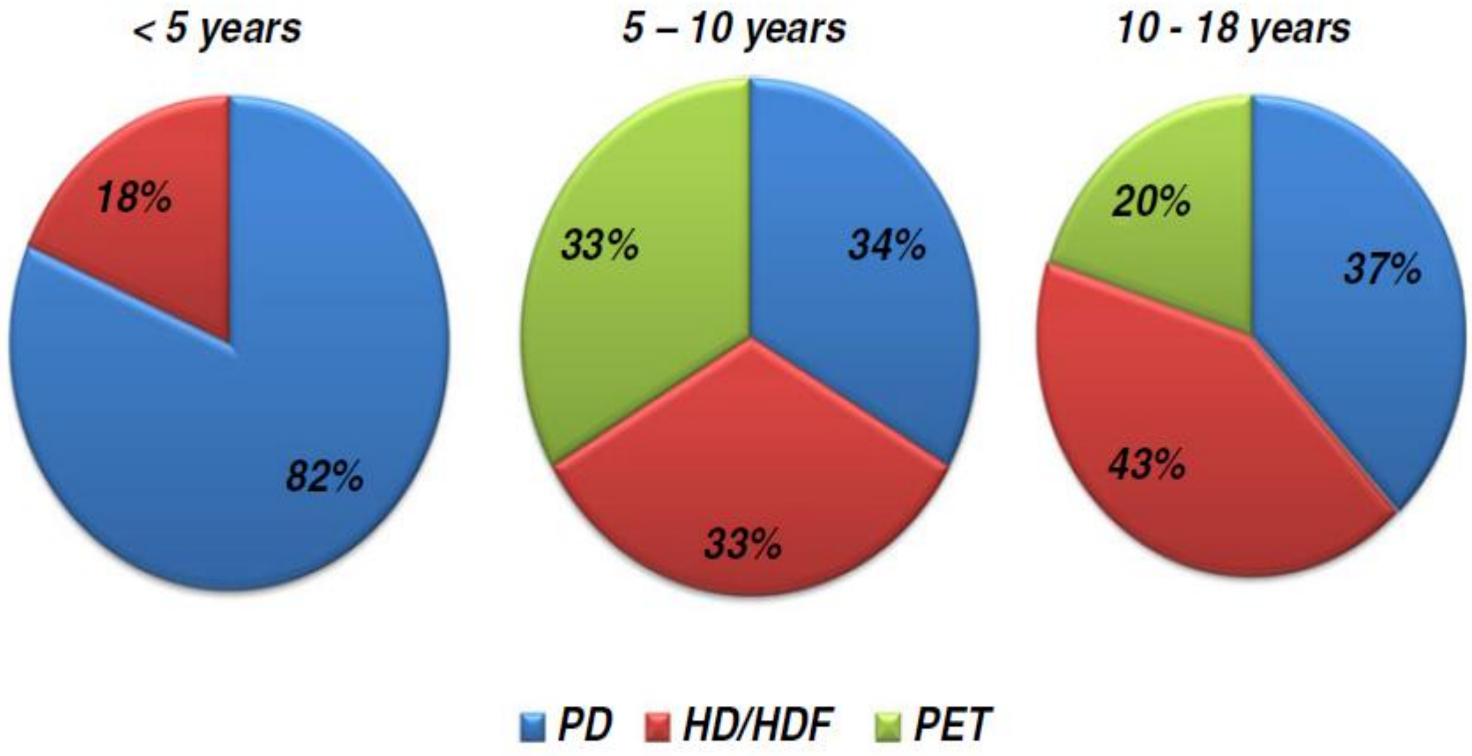
Pediatr Nephrol (2013) 28:2361–2368
DOI 10.1007/s00467-013-2555-z

ORIGINAL ARTICLE

Factors influencing choice of renal replacement therapy in European Paediatric Nephrology Units

Alan R. Watson · Wesley N. Hayes · Karel Vondrak · Gema Ariceta · Claus Peter Schmitt · Mesiha Ekim · Michel Fischbach · Alberto Edefonti · Rukshana Shroff · Tuula Holta · Aleksandra Zurowska · Gunter Klaus · Sevan Bakkaloglu · Constantinos Stefanidos · Johan Van de Walle · European Paediatric Dialysis Working Group

Fig. 2 Proportion of patients (%) commencing each modality by age group. *PD* Peritoneal dialysis, *HD/HDF* haemodialysis/ haemodiafiltration, *PET* pre-emptive transplantation



Definitions

Seminars in Dialysis

Seminars in Dialysis—Vol 24, No 5
2011 pp. 515–524

Special Article

Standardized Definitions for Hemodialysis Vascular Access

Timmy Lee,* Michele Mokrzycki,† Louise Moist,‡ Ivan Maya,§ Miguel Vazquez,¶ and Charmaine E. Lok**; From the North American Vascular Access Consortium (NAVAC)

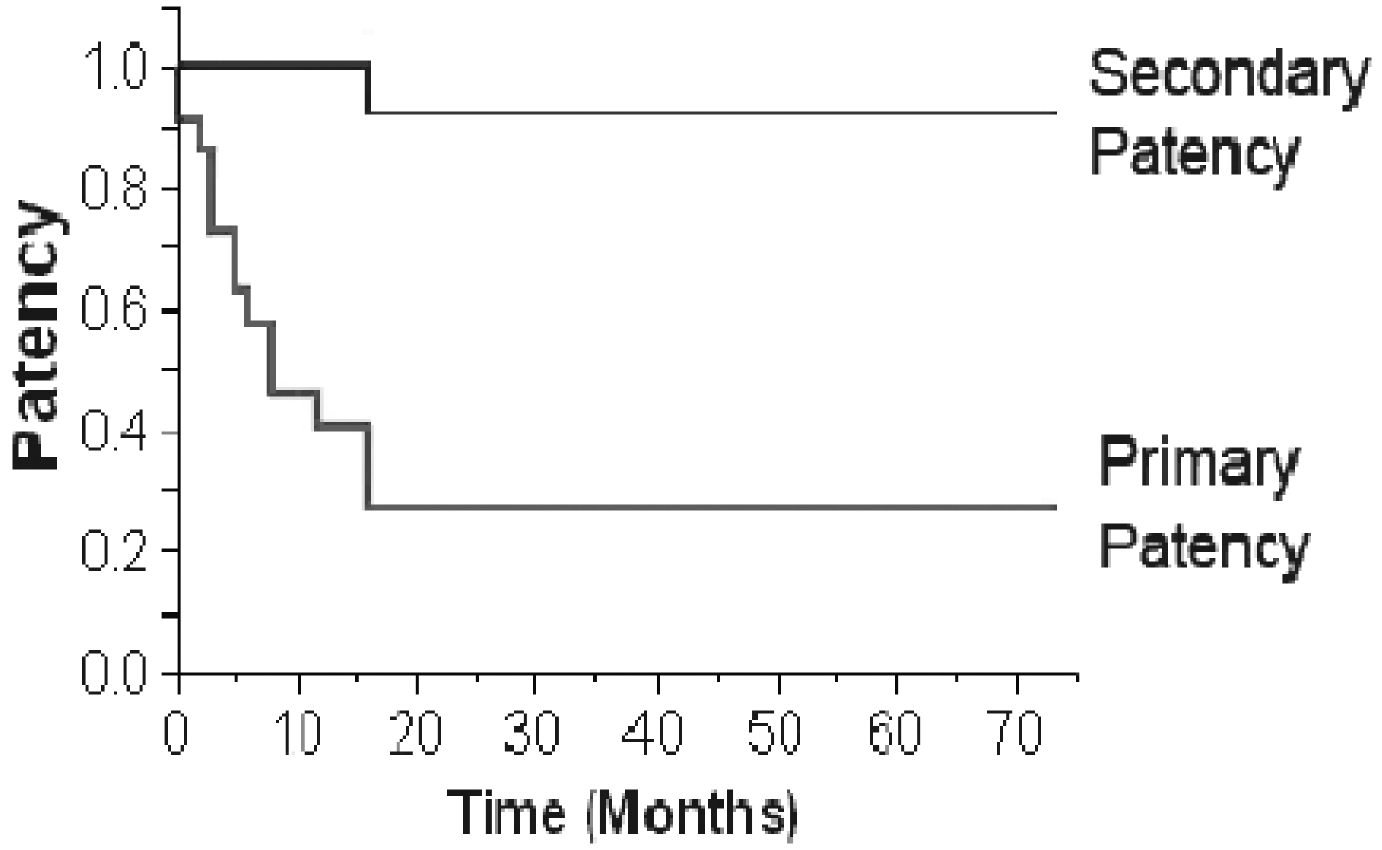
Primary Catheter Patency This is the time period commencing from catheter insertion to the time of first intervention for that same catheter. First intervention includes the administration of thrombolytic therapy, mechanical thrombectomy, or fibrin sheath stripping.

Cumulative (Secondary) Catheter Patency This is the time period commencing from catheter insertion to the time of exchange or removal of that same catheter for any reason, including the time after the use of interventions to maintain catheter function. Interventions include the use of thrombolytic therapy, mechanical thrombectomy, or fibrin sheath stripping.

A Vascular Access Team Can Increase AV Fistula Creation in Pediatric ESRD Patients: A Single Center Experience

Seminars in Dialysis—Vol 22, No 6
2009 pp. 679–683

Deepa H. Chand,* Dale Bednarz,† Matthew Eagleton,‡ and Leonard Krajewski‡



Seminars in Dialysis—Vol 24, No 5
2011 pp. 515–524

B. Catheter Exit Site Infection

1 **Definite**: The presence of a purulent discharge; or erythema, induration, and/or tenderness at the catheter exit site with a positive culture of serous discharge.
2 **Probable**: The presence of erythema, induration, or tenderness at the catheter exit site without a positive culture of serous discharge and no other sources of findings, such as irritation from gauze, stitches, or cleansing agent.

C. Catheter Tunnel Infection

1 **Definite**: The presence of a purulent discharge from the tunnel, or erythema, induration, and/or tenderness over the catheter tunnel, with a positive culture of the discharge.
2 **Probable**: The presence of a purulent discharge from the tunnel; or erythema, induration, and/or tenderness over the catheter tunnel, without a positive culture result of the serous discharge, and no other sources of findings.

A. Catheter-related Bacteremia

1 **Definite**:
   (a) The same organism grown from at least one percutaneous blood culture and from a culture of the catheter tip (31); or
   (b) A blood culture drawn from a catheter that has a ≥3-fold greater colony count of microbiologic isolates than those drawn from a peripheral vein (31).
2 **Probable**: Positive blood cultures obtained from a catheter and/or a peripheral vein in a symptomatic patient when there is no clinical evidence for an alternative source of infection (31).

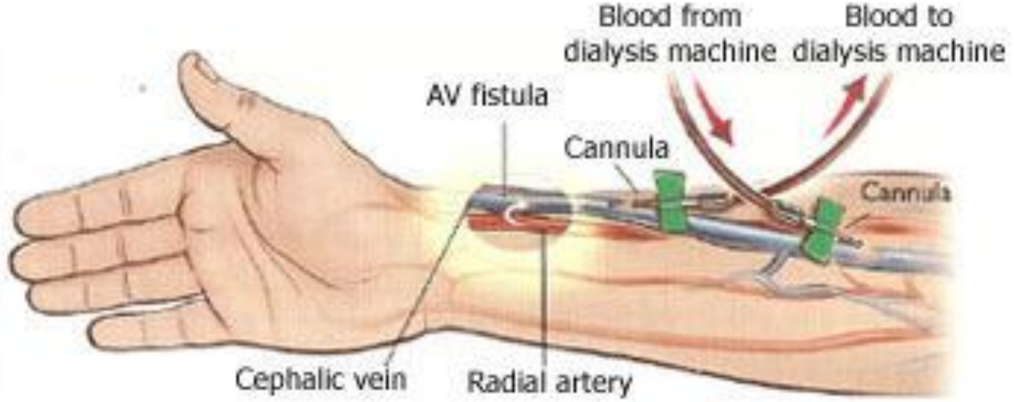
Seminars in Dialysis—Vol 24, No 5
2011 pp. 515–524

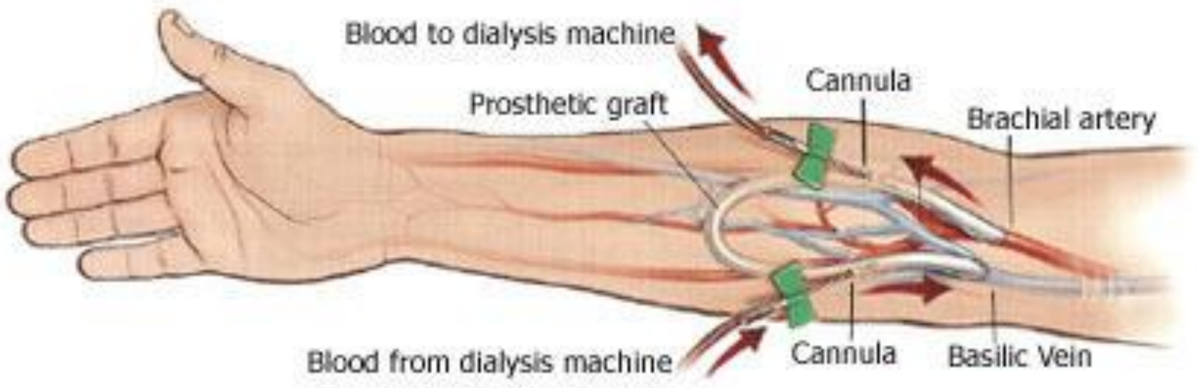
E. Catheter Thrombosis This is catheter dysfunction occurring after a successful first usage, without a mechanical cause.

(a) Intrinsic Catheter Thrombosis: This is the case when the thrombus forms and is attached to the internal or external surface of the catheter lumen. Thrombi present intralumenally or at the catheter tip and a fibrin sheath thrombus are included in this category.

(b) Extrinsic Catheter Thrombosis: This is the case when the thrombus is caused by the presence of a catheter, but is formed on the wall of a vein, or atrium. Intra-atrial, mural, and central vein thrombi are included in this category.

AV fistula or graft





Pediatr Nephrol (2005) 20:1054–1066
DOI 10.1007/s00467-005-1876-y

REVIEW

M. Fischbach · A. Edefonti · C. Schröder · A. Watson ·
The European Pediatric Dialysis Working Group

Hemodialysis in children: general practical guidelines

Guideline 6: extracorporeal blood access and circulation

- fistula vascular access is preferred for long-term chronic hemodialysis
- in young children, less than 15 kg, the time needed to develop a fistula before it can be used could be some months

nephron Clinical Practice

Nephron Clin Pract 2011;118(suppl 1):c225–c240
DOI: 10.1159/000328071

Received: May 4, 2010
Accepted: January 5, 2011
Published online: May 6, 2011

Renal Association Clinical Practice Guideline on Vascular Access for Haemodialysis

Dr Richard Fluck[a] and Dr Mick Kumwenda[b]

1. Preferred type of vascular access (Guidelines 1.1–1.3)

Guideline 1.1 – Incident patient vascular access

We recommend that any individual who commences haemodialysis should do so with an arteriovenous fistula as first choice, an arteriovenous graft as second choice, a tunnelled venous catheter as third choice and a non tunnelled catheter as an option of necessity. (1B)

5. Prevention of catheter related infections (Guidelines 5.1–5.4)

Guideline 5.1 – Minimise the use of venous catheters

We recommend that venous catheters should be employed as a method of last resort for longer term vascular access to reduce the overall risk of infectious complications in haemodialysis patients. (1B)

Pediatr Nephrol (2013) 28:885–893
DOI 10.1007/s00467-012-2328-0

EDUCATIONAL REVIEW

Practical aspects of arteriovenous fistula formation in the pediatric population

Miriam Manook · Francis Calder

Table 1 General principles of fistula formation

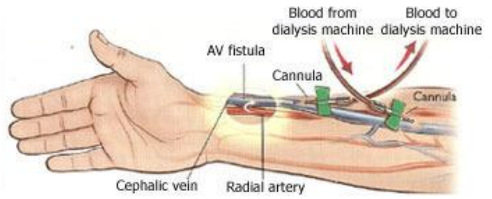
General principles of fistula formation
Early referral
Vein preservation
Non-dominant arm first
Start distally, work proximally
Upper limb before lower limb
Avoid grafts (AVG)
Avoid central venous catheters (CVC)

Pediatr Nephrol (2009) 24:1121–1128
DOI 10.1007/s00467-008-0812-3

EDUCATIONAL REVIEW

Hemodialysis vascular access options in pediatrics: considerations for patients and practitioners

Deepa H. Chand · Rudolph P. Valentini ·
Elaine S. Kamil



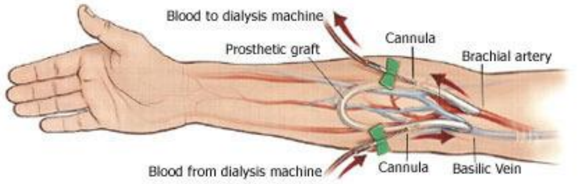


Table 1 Permanent vascular access options: AV fistula versus AV graft

AV fistula	AV graft
Lower infection rate	Higher infection rate
Lower thrombosis rate	Higher thrombosis rate
May take 3–6 months to mature	Usually able to be used within a few weeks
Primary failure rate is higher	Primary failure rate is lower
Secondary failure rates lower	Secondary failure rates higher

Pediatr Nephrol
DOI 10.1007/s00467-016-3382-9

ORIGINAL ARTICLE

Published online: 25 April 2016

Timing of first arteriovenous fistula cannulation in children on hemodialysis

Veronika Almási-Sperling[1] · Matthias Galiano[2] · Werner Lang[1] · Ulrich Rother[1] · Wolfgang Rascher[2] · Susanne Regus[1]

Message:

Better do not use the fistula ≤ 30 days after it's creation; wait until 45 days

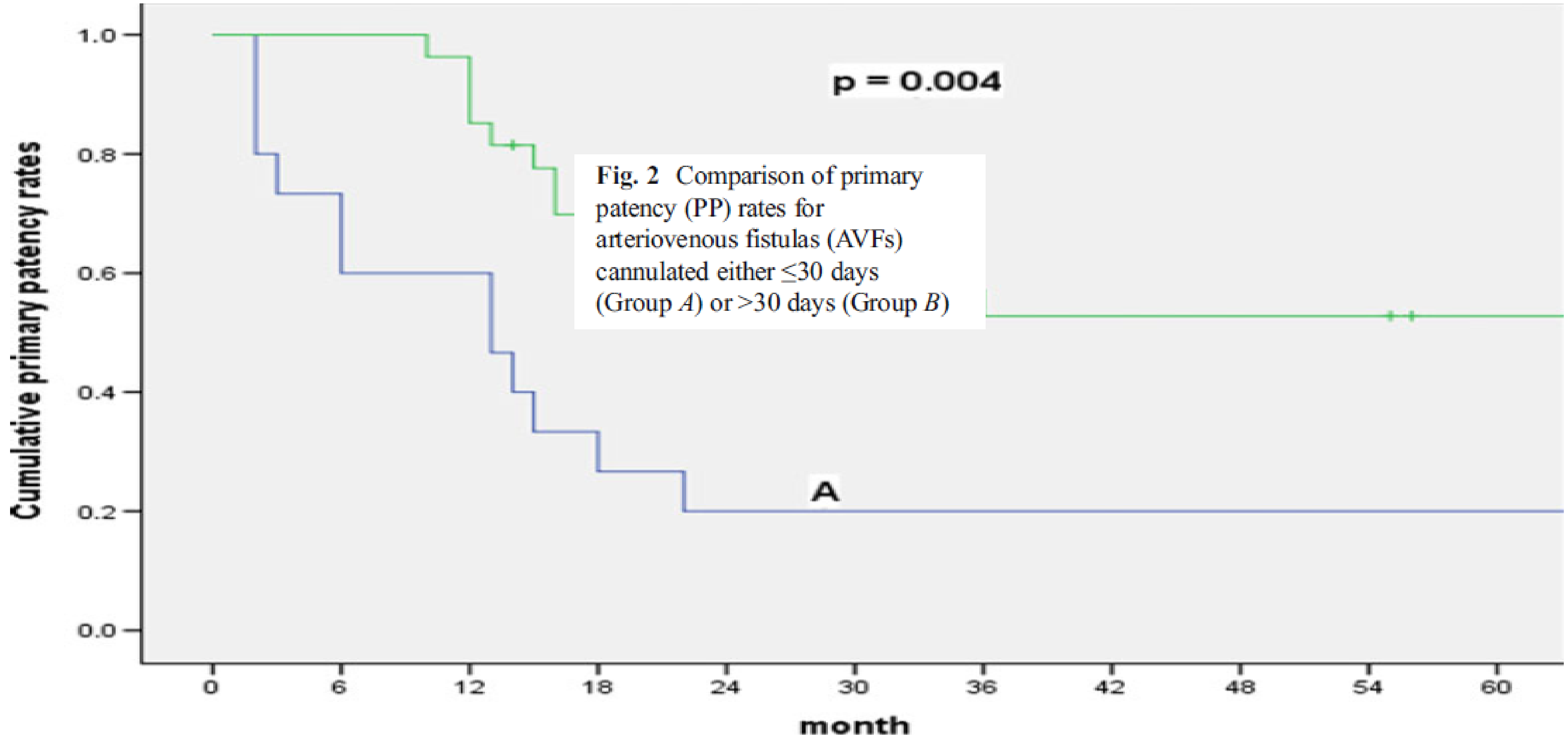


Fig. 2 Comparison of primary patency (PP) rates for arteriovenous fistulas (AVFs) cannulated either ≤30 days (Group *A*) or >30 days (Group *B*)

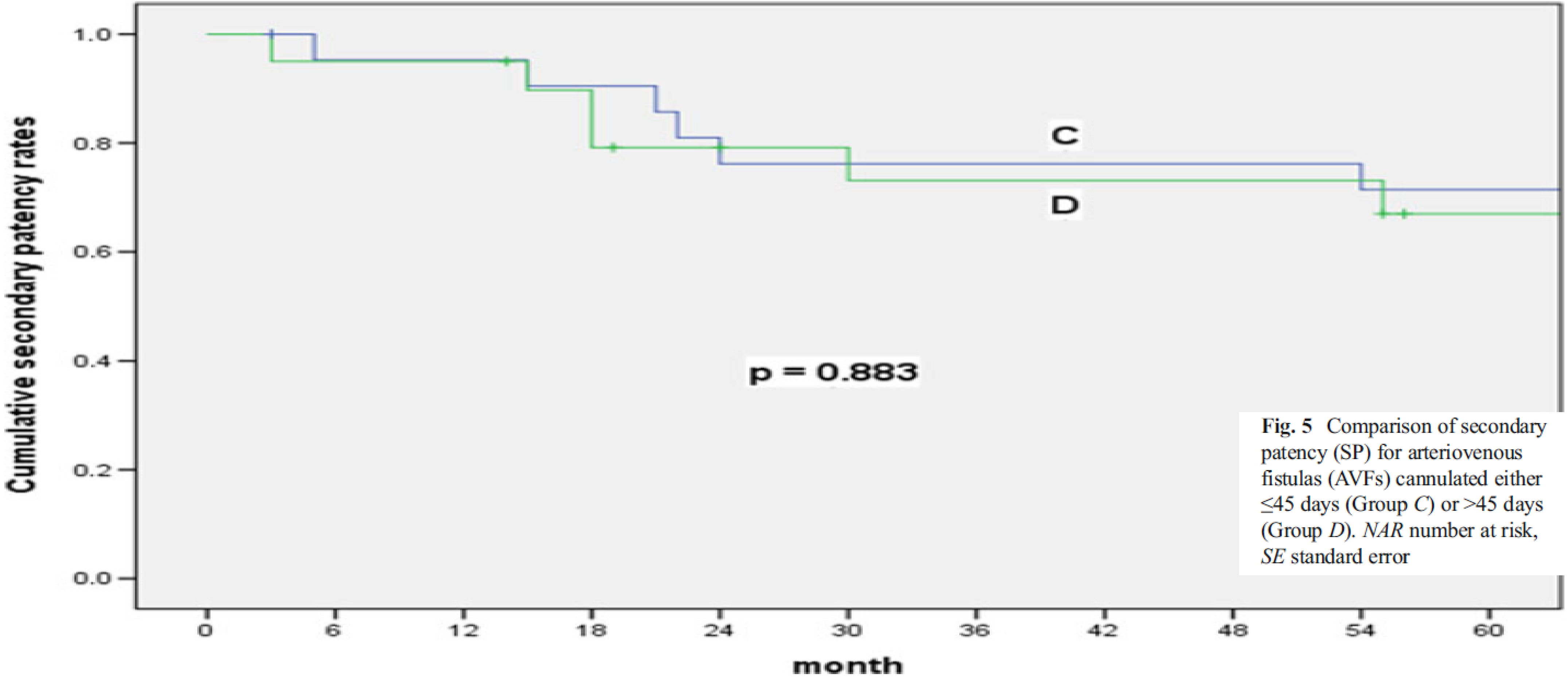


Fig. 5 Comparison of secondary patency (SP) for arteriovenous fistulas (AVFs) cannulated either ≤45 days (Group *C*) or >45 days (Group *D*). *NAR* number at risk, *SE* standard error

Message:

Overall survival of the fistula does not depend on time interval between creation and first use

McCann M., Einarsdóttir H., Van Waeleghem J. P., Murphy F., Sedgewick J. (2008). Vascular access management 1: an overview. *Journal of Renal Care* **34**(2), 77-84.

Patient education on management of VA

- Postoperative arm exercise to accelerate maturation (use either rubber ball or tennis ball and squeeze four to five minutes several times a day once suture line is healed)
- Learn to palpate for thrill and bruit
- Recognise and report signs and symptoms of infection
- Report changes in VA
- Avoid sleeping on side of access
- Avoid clothes that might hamper VA blood flow
- Should learn the flow direction in AVG and the correct needle placement
- Learn how to stop bleeding that may occur
- Ensure that no healthcare worker inserts an IV cannula or takes blood or blood pressure measurements in AVF arm
- Ensure that healthcare staff clean site prior to cannulation
- As AVG consists of synthetic material. Patient is taught about the need for prophylactic antibiotics prior to dental surgery and any invasive procedures

Pediatr Nephrol (2009) 24:1121–1128
DOI 10.1007/s00467-008-0812-3

EDUCATIONAL REVIEW

Hemodialysis vascular access options in pediatrics: considerations for patients and practitioners

Deepa H. Chand · Rudolph P. Valentini ·
Elaine S. Kamil

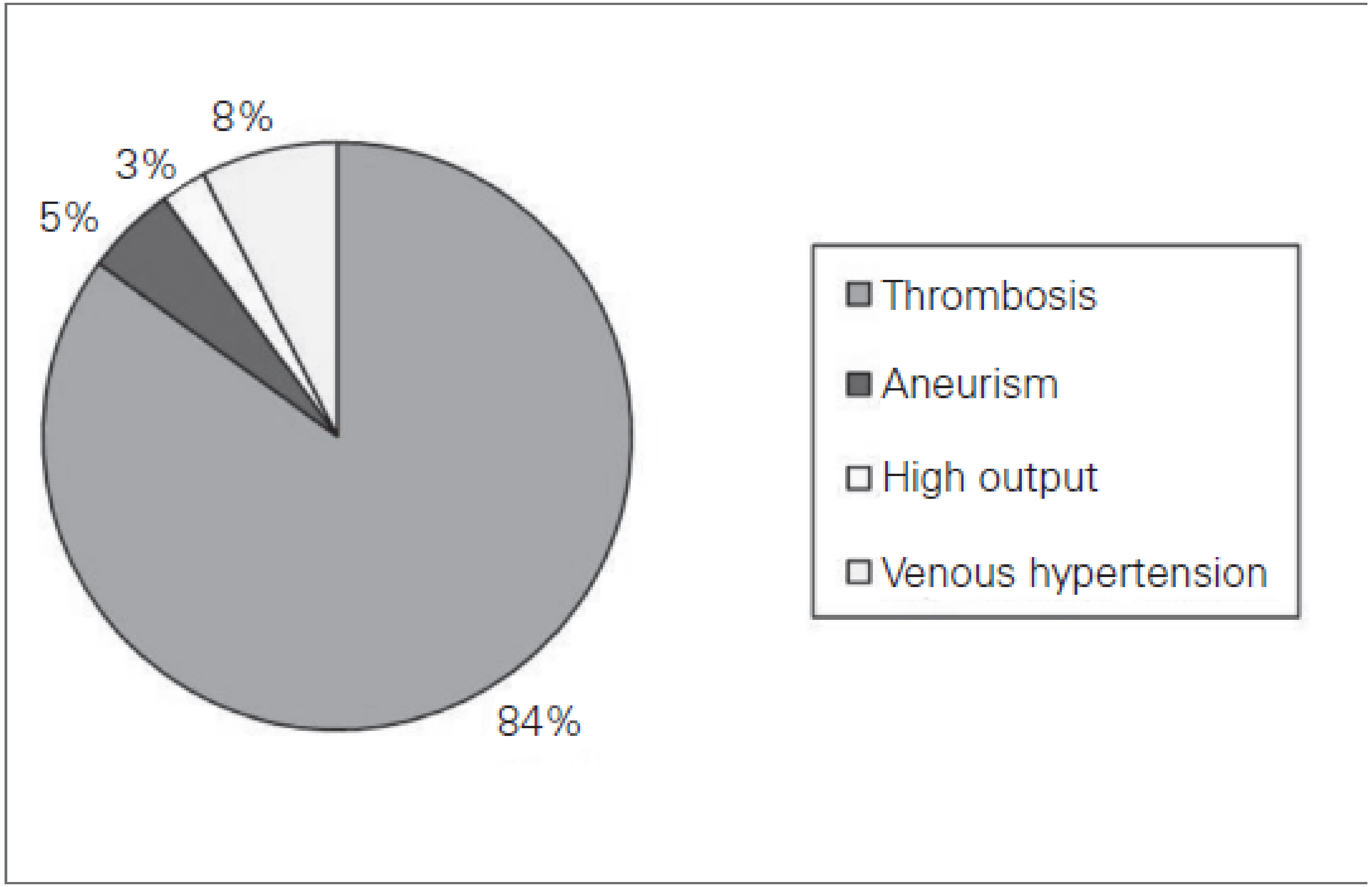
1. Inspection: the access should be assessed weekly via inspection, palpation, and auscultation by the nursing staff, with specific attention to arm swelling, prolonged bleeding after needle removal, or change in thrill or bruit. The nephrologist should also inspect the access at each physical examination. Any difficulties in needle cannulation or decreases in blood flow due to elevated negative arterial pump pressures should be noted, as well.
2. Surveillance: decreases in Kt/V or urea reduction ratios should be noted. Determination of access recirculation should be documented on a monthly basis, as well. An adjunct should be used to determine blood flow through the vascular access. If the equipment is available, ultrasound dilution measurements should be performed by a consistent person each month. If such equipment is not available, a Doppler ultrasound can be performed each month.
3. Referral: referral for fistulogram with possible angioplasty should be made if there is (1) inadequate blood flow, thereby compromising adequacy, (2) elevated access recirculation (>20% after correction of the needle position), (3) corrected access flow less than 650 ml/min per $1.73m^2$ body surface area by ultrasound dilution techniques, (4) consistent abnormality on Doppler ultrasound, or (5) pseudoaneurysm has formed (note: rotation of puncture sites can help minimize risk of pseudoaneurysm formation).

J Bras Nefrol 2011;33(4):422-430

Hemodialysis vascular access in children and adolescents: a ten-year retrospective cohort study

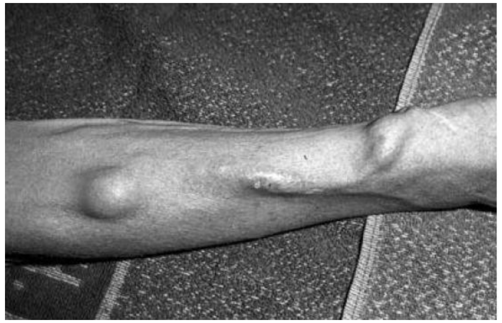
Regina Araujo de Souza[1]
Eduardo Araujo Oliveira[1]
José Maria Penido Silva[1]
Eleonora Moreira Lima[1]

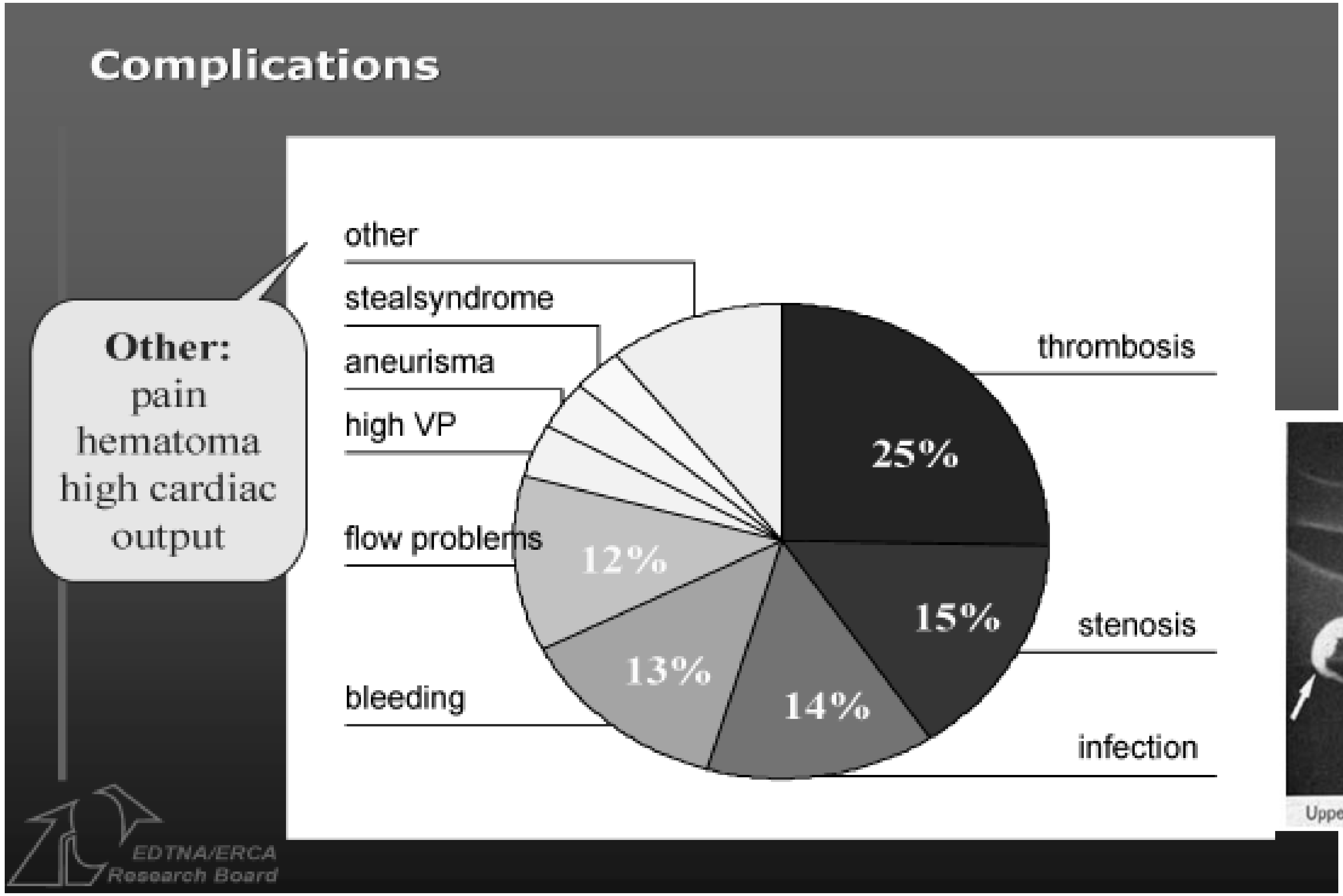
Figure 2. Causes of AVF loss.



AVF: Arteriovenous fistula

McCann M., Einarsdottir H., Van Waeleghem J.P., Murphy F., Sedgewick J. (2009).Vascular access management II: AVF/AVG cannulation techniques and complications. *Journal of Renal Care* **35**(2), 90–98.





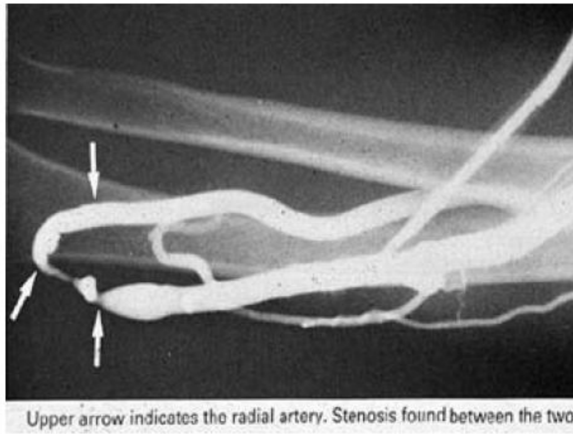


Figure 3: Overview of VA complications in a European population

Pediatr Transplantation 2004: 8: 249–254
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Amr A. El-Husseini, Hussein A. Sheashaa, Nabil A. Hassan, Fawzia M. El-Demerdash, Mohamed A. Sobh and Mohamed A. Ghoneim

Pediatric Transplantation

Echocardiographic changes and risk factors for left ventricular hypertrophy in children and adolescents after renal transplantation

Table 5. The significant risk factors for LVH by multivariate analysis (logistic regression model)

Variable	Regression estimate (B)	s.e.	Relative risk Exp (B) (95% CI)	p-value
Pretransplant dialysis				
Preemptive	0.000	0.000	1.000	0.000
Peritoneal dialysis	0.931	0.382	2.538 (1.2, 5.4)	0.015
Hemodialysis	3.105	0.641	22.311 (6.3, 78.3)	<0.001

Cardiac impact of the arteriovenous fistula after kidney transplantation: a case-controlled, match-paired study

Transplant International

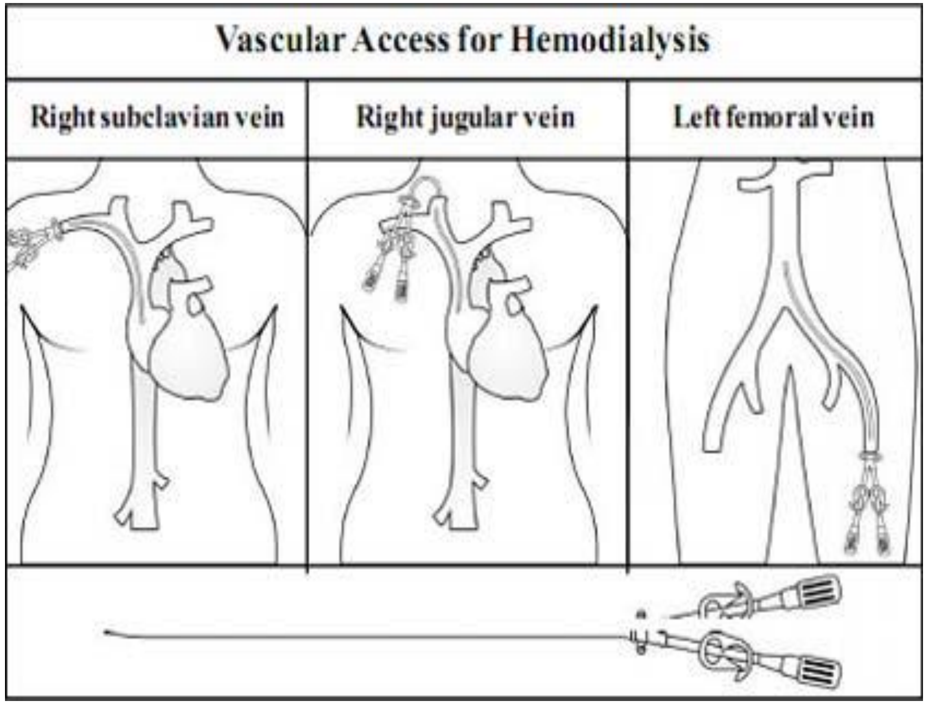
Joëlle Cridlig,[1] Christine Selton-Suty,[2] François Alla,[3] Anne Chodek,[2] Alice Pruna,[2]
Michèle Kessler[1] and Luc Frimat[1,3]

2008 European Society for Organ Transplantation **21** (2008) 948–954

Table 2. Comparison of echocardiographic characteristics according to arteriovenous fistula (AVF) exposure.

	Patients with AVF(N = 38)	Patients without AVF(N = 38)	P-value
LVMI (g/m^2)	135.1 ± 30.3	112.4 ± 28.0	0.001
LVD (mm)			
LVEDD	52.1 ± 7.1	48.5 ± 6.0	0.02
LVESD	34.3 ± 6.3	30.4 ± 5.3	0.004
W (mm)			
LVEDSW	11.1 ± 1.7	10.5 ± 1.6	0.1
LVEDPW	12.2 ± 1.7	11.5 ± 1.8	0.007
Ejection fraction (%)			
Teicholz	62.4 ± 8.6	66.5 ± 10.1	0.06
4 cavities	57.7 ± 8.8	61.4 ± 9.7	0.15
Cardiac index (l/min/m^2)	2.9 ± 0.6	2.4 ± 0.5	0.002

Central double-lumen venous catheter for HD



Pediatr Nephrol (2009) 24:1121–1128
DOI 10.1007/s00467-008-0812-3

EDUCATIONAL REVIEW

Hemodialysis vascular access options in pediatrics: considerations for patients and practitioners

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Table 2 Pros and cons of central venous catheters for hemodialysis in children

Pros	Cons
Easily placed	Infection rates high
Can be used immediately	Failure rates and replacement rates high
Painless to the patient	Blood flow rates are variable, leading to potentially poor clearance
Requires little planning prior to placement	Permanent damage to central venous system (stenosis/thrombosis) may occur
Easily removed if used as "transitional" access for future PD or transplant patients	Damage to central vessels can prohibit future AVF/AVG placement in ipsilateral extremity
No vascular steal	Possible Arrhythmia
Decreased risk of high-output cardiac failure	

Pediatr Nephrol (2013) 28:321–326
DOI 10.1007/s00467-012-2318-2

ORIGINAL ARTICLE

A comparison of arteriovenous fistulas and central venous lines for long-term chronic haemodialysis

Alison Ma • Rukshana Shroff • Daljit Hothi •
Marina Munoz Lopez • Faidra Veligratli •
Francis Calder • Lesley Rees

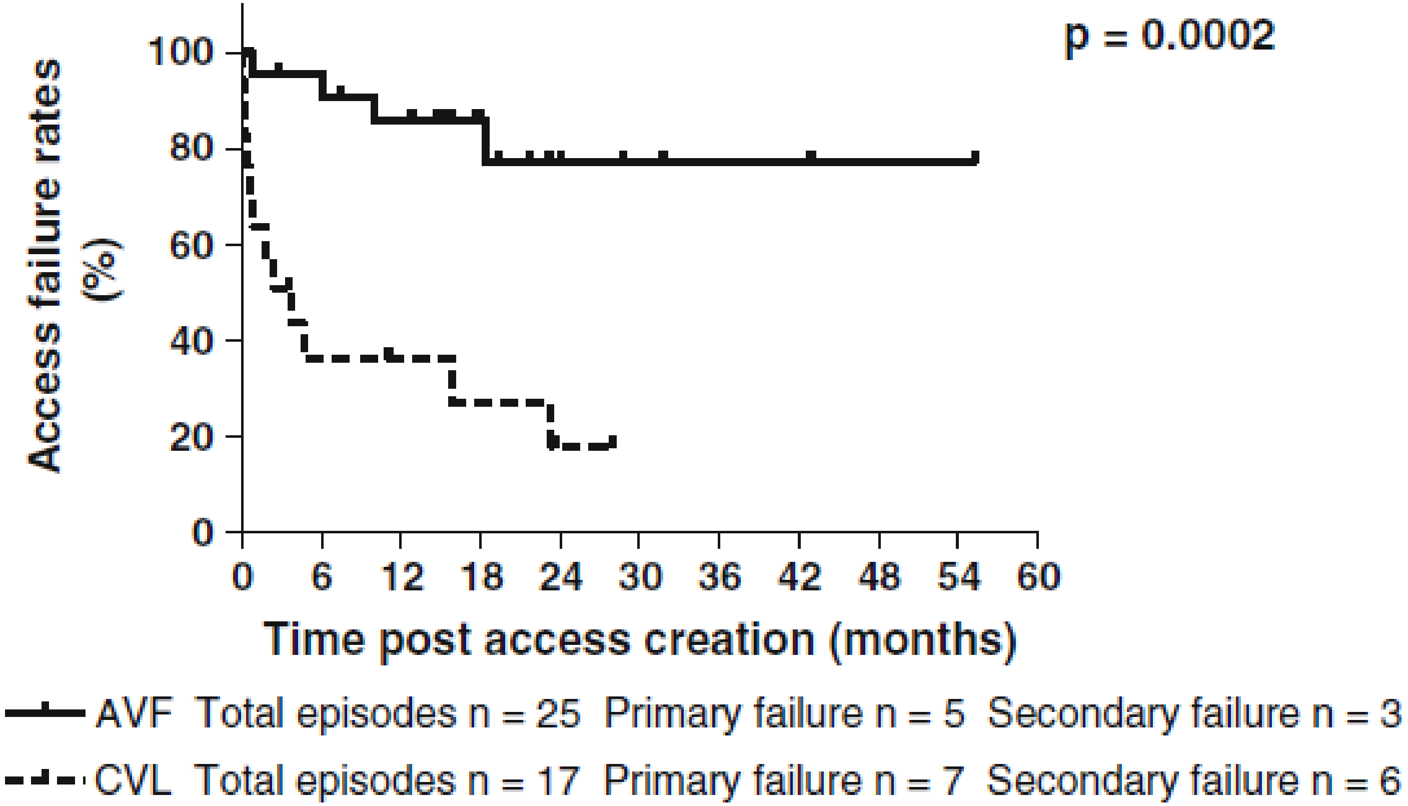


Fig. 1 Kaplan–Meier analysis of access survival in children on chronic haemodialysis (arteriovenous fistulas (AVF) versus central venous lines (CVL))

Complications of Central Venous Access Devices: A Systematic Review

PEDIATRICS Volume 136, number 5, November 2015

Amanda J. Ullman, RN, MAppSci[a,b,c], Nicole Marsh, RN, MAdvPrac[b,c,d], Gabor Mihala, MEng, GCert(Biostat)[c,e,f], Marie Cooke, RN, PhD[a,b,c], Claire M. Rickard, RN, PhD[a,b,c]

TABLE 1 Studies Included, With Patient Population and CVAD Type

CVAD Type	NICU	PICU	Hematology/ Oncology	General Pediatrics	Outpatients (Including Gastroenterological Failure)	Total
PICC	16	—	6	8	3	33
Umbilical	5	—	—	1	—	6
Nontunneled, percutaneous	3	5	—	2	—	10
Hemodialysis	—	—	—	4	4	8
Tunneled, partially implanted	—	1	13	5	1	20
Totally implantable	—	—	19	4	1	24
Total	24	6	38	24	9	

RESULTS: Seventy-four cohort studies met the inclusion criteria, with mixed quality of reporting and methods. Overall, 25% of CVADs failed before completion of therapy (95% confidence interval [CI] 20.9%–29.2%) at a rate of 1.97 per 1000 catheter days (95% CI 1.71–2.23). The failure per CVAD device was highest proportionally in hemodialysis catheters (46.4% [95% CI 29.6%–63.6%]) and per 1000 catheter days in umbilical catheters (28.6 per 1000 catheter days [95% CI 17.4–39.8]). Totally

Clinical Course Associated with Vascular Access Type in a National Cohort of Adolescents Who Receive Hemodialysis: Findings from the Clinical Performance Measures and US Renal Data System Projects

Clin J Am Soc Nephrol 1: 987–992, 2006.

Jeffrey J. Fadrowski,* Wenke Hwang,† Diane L. Frankenfield,‡ Barbara A. Fivush,*
Alicia M. Neu,* and Susan L. Furth*§

Characteristic	Total Population (n = 418)	Stratified Population	
		Catheter (n = 175)	Permanent Access (n = 243)
Mean age (yr [SD])	15.6 (1.6)	15.4 (1.6)	15.7 (1.5)

Table 3. RR (catheter *versus* permanent access) of dialysis outcomes in adolescent patients who received hemodialysis[a]

Parameter	Hospitalization, All-Cause		Hospitalization, Infection-Related		Access Complication	
	RR[b]	95% CI	RR	95% CI	RR	95% CI
Vascular catheter *versus* permanent access	1.84[d]	1.38 to 2.44	4.74[d]	2.02 to 11.14	2.72[d]	2.00 to 3.69

Pediatr Nephrol (2008) 23:2061–2065
DOI 10.1007/s00467-008-0956-1

ORIGINAL ARTICLE

Vascular access complications in long-term pediatric hemodialysis patients

Joshua J. Zaritsky · Isidro B. Salusky · Barbara Gales · Georgina Ramos · James Atkinson · Amelia Allsteadt · Mary L. Brandt · Stuart L. Goldstein

Table 2 Comparison of complication rates for central venous catheter (CVC) versus arteriovenous graft/arteriovenous fistula (AVG/AVF)

	CVC	AVG/AVF	P value
Hospital days for infection/100 treatments	3.7	0.2	<0.01
Hospital days for access revision/100 treatments	2.7	0.2	<0.01
Outpatient antibiotic treatments/100 treatments	9.1	0.06	<0.01

Table 3 Pediatric Quality-of-Life Inventory (PedsQL™) data[a]

	CVC	AVG/AVF	P value
Patient Physical	69.4±19	77.4±20	NS
Parent Physical	60.9±20	68.2±21	NS
Patient Emotional	66.4±19	73.4±17	NS
Parent Emotional	59.1±19	66.9±21	NS
Patient Social	74.5±18	78.9±15	NS
Parent Social	63.9±19	68.9±20	NS
Patient School	60.4±26	62.0±20	NS
Parent School	51.8±26	60.3±26	NS
Patient Total	67.7±17	72.9±14	NS
Parent Total	58.9±15	66.1±19	NS

NS not significant

Vascular Access in Children on Chronic Hemodialysis: A Slovenian Experience

Ther Apher Dial, Vol. 15, No. 3, 2011

Rina R Rus,[1] Gregor Novljan,[1] Jadranka Buturović-Ponikvar,[2] Janko Kovač,[2] Vladimir Premru,[2] and Rafael Ponikvar[2]

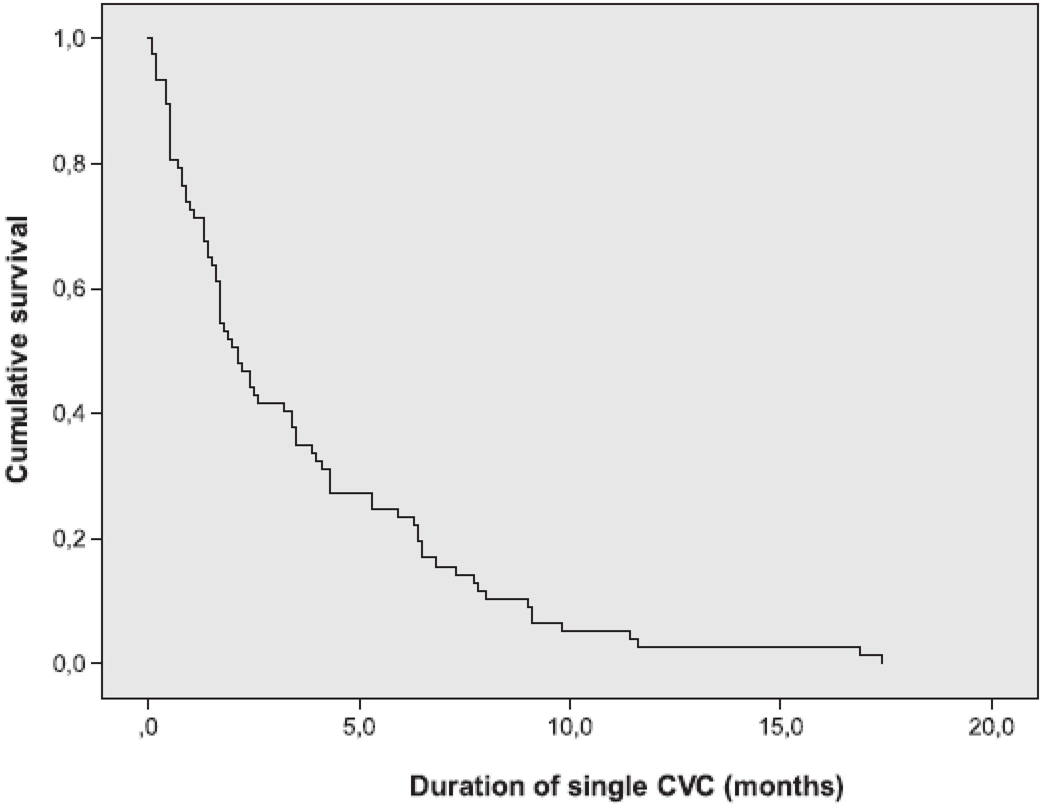


FIG. 3. Kaplan–Meier survival curve illustrating the survival of a single central venous catheter (CVC).

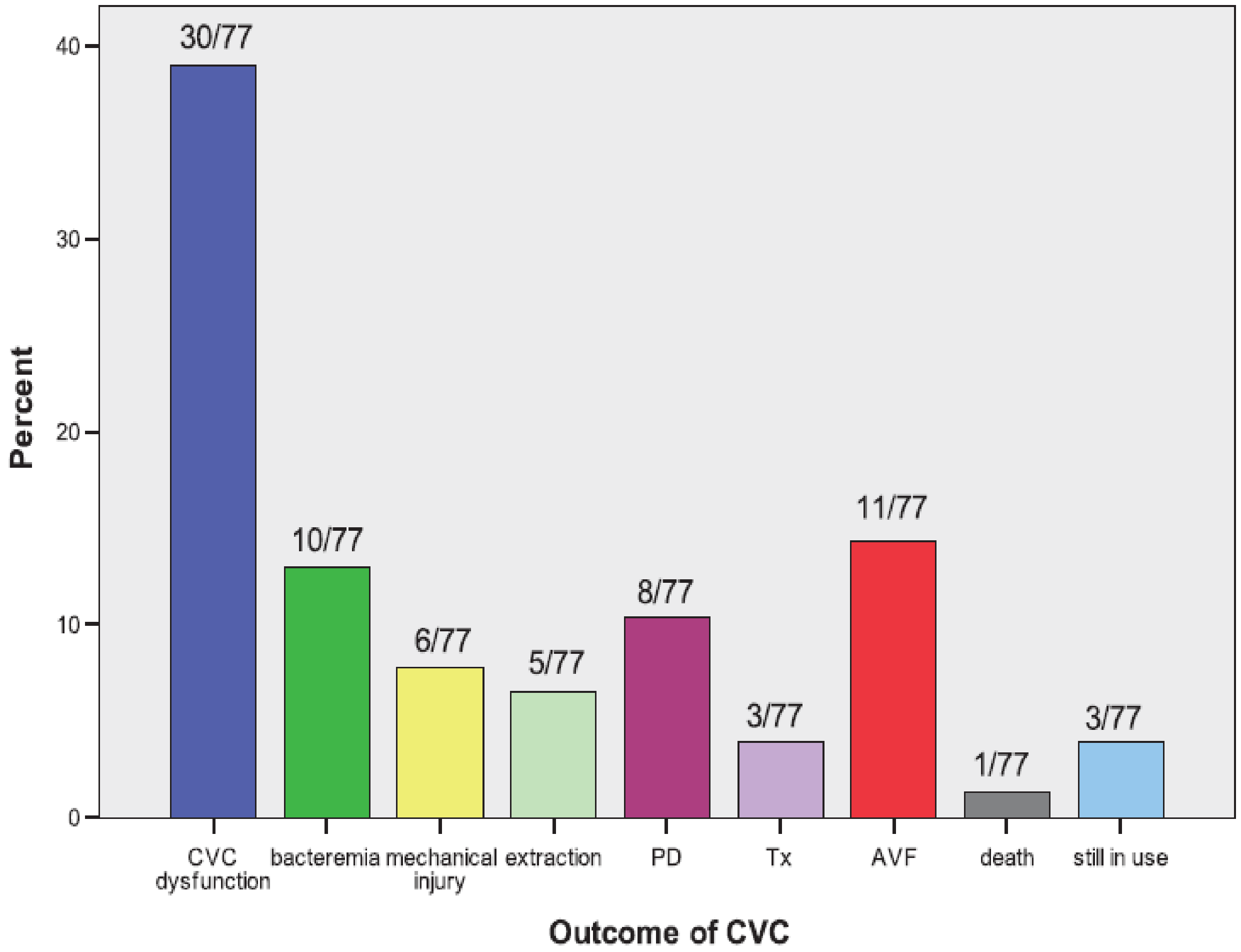


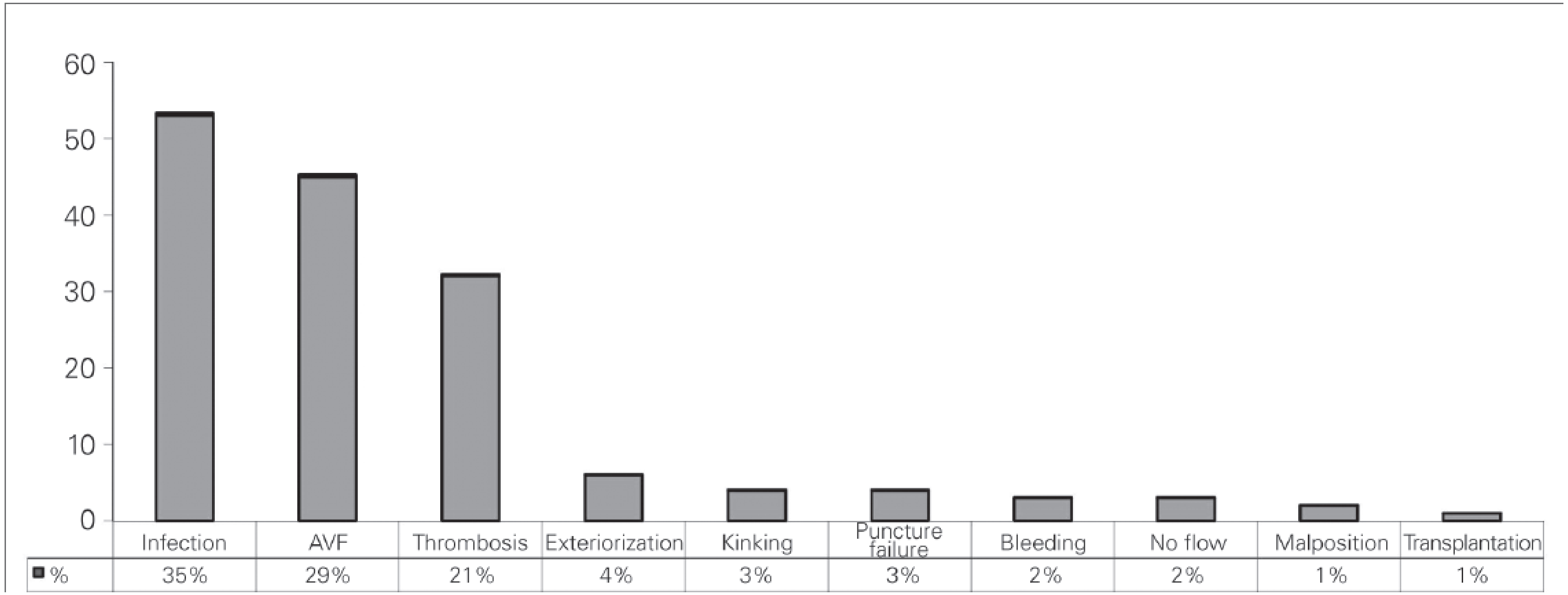
Table 1	Patients` clinical features in relation to the initial vascular access		
	Start with CVC	Start with AVF	TOTAL
N	31 (51%)	30 (49%)	61
Sex			
F	15 (48%)	13 (43%)	28 (46%)
M	16 (52%)	17 (57%)	33 (54%)
Age			
< 10	10 (32%)	4 (13%)	14 (23%)
> 10	21 (68%)	26 (57%)	47 (77%)
Weight			
≤ 20 kg	7 (23%)	7 (23%)	14 (23%)
> 20 kg	24 (77%)	23 (77%)	47 (77%)

J Bras Nefrol 2011;33(4):422-430

Hemodialysis vascular access in children and adolescents: a ten-year retrospective cohort study

Regina Araujo de Souza[1]
Eduardo Araujo Oliveira[1]
José Maria Penido Silva[1]
Eleonora Moreira Lima[1]

Figure 1. Reasons for CVC removal.



Pediatr Nephrol (2016) 31:833–841
DOI 10.1007/s00467-015-3272-6

ORIGINAL ARTICLE

Chronic haemodialysis in small children: a retrospective study of the Italian Pediatric Dialysis Registry

Fabio Paglialonga[1] · Silvia Consolo[1] · Carmine Pecoraro[2] · Enrico Vidal[3] · Bruno Gianoglio[4] · Flora Puteo[5] · Stefano Picca[6] · Maria Teresa Saravo[2] · Alberto Edefonti[1] · Enrico Verrina[7]

Eight episodes of catheter-related bloodstream infection were observed in the overall population, resulting in an incidence of 0.6/1000 CVC days. The bacteria isolated were *Staphylococcus aureus* (4 episodes), *S. epidermidis* (2), *Pseudomonas aeruginosa* (1) and unknown (1).

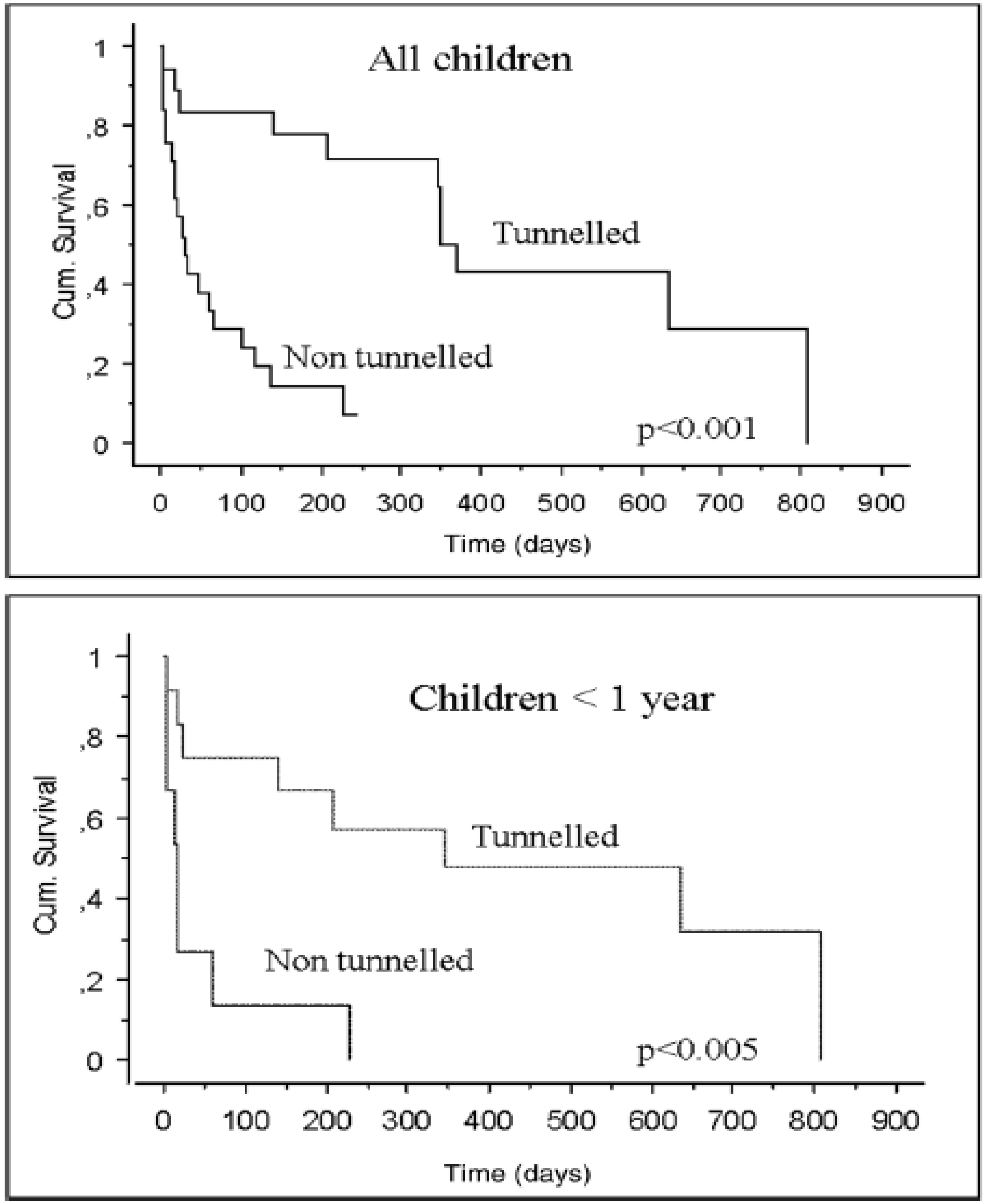


Fig. 2 Survival curve of tunnelled and non-tunnelled central venous catheters in the entire population on chronic dialysis and in those starting hemodialysis during the first year of life

McCann M., Einarsdóttir H., Van Waeleghem J. P., Murphy F., Sedgewick J. (2008). Vascular access management 1: an overview. *Journal of Renal Care* **34**(2), 77-84.

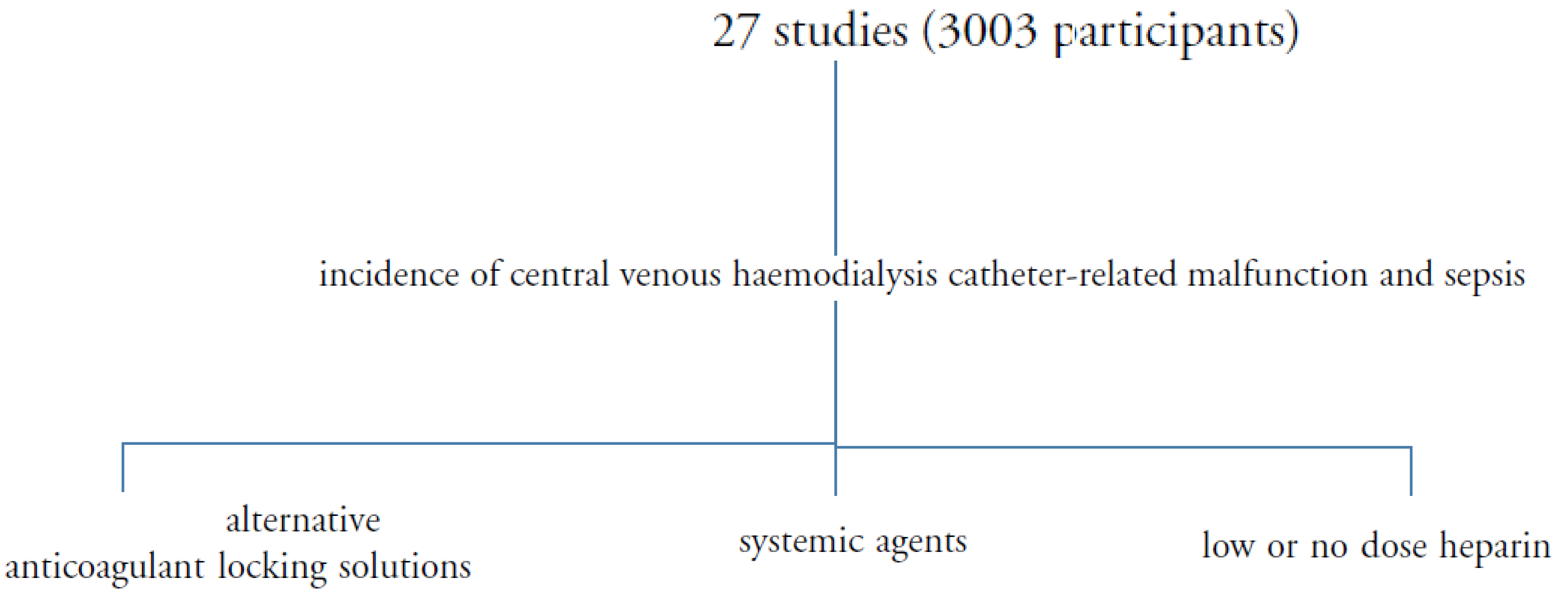
Interventions preventing CVC infection	
• Only trained personnel allowed to manipulate and change haemodialysis catheter dressings	• Chlorhexidine 2% with 70% alcohol (KD)[1] to clean exit site
• Correct hand hygiene	• Chlorhexidine aqueous or povidone solution for patients with skin sensitivity
• Clean gloves for all connections, disconnections and dressing procedures	• Clean caps and ports with chlorhexidine/betadine [1]
• Aseptic no touch technique for all connections, disconnections and dressing procedures	• Apply chlorhexidine/mupirocin or povidone iodine ointment to exit site[2]
• Change of dressing at the end of each treatment	• Catheter should be fixed to avoid unnecessary traction
• Dry gauze or transparent dressing can be used	• Surgical masks for staff and patients at time of CVC dressing change
	• Debate continuous on use of locking solutions with both antithrombotic and antimicrobial properties and the use of antimicrobial impregnated catheters

Cochrane Library

Cochrane Database of Systematic Reviews

Anticoagulants and antiplatelet agents for preventing central venous haemodialysis catheter malfunction in patients with end-stage kidney disease (Review)

Wang Y, Ivany JN, Perkovic V, Gallagher MP, Woodward M, Jardine MJ



Outcomes

Cochrane Library

Cochrane Database of Systematic Reviews

Catheter malfunction	Catheter-related infection
No significant effect on catheter malfunction was observed for alternative anticoagulant locking solutions (RR 0.96, 95% CI 0.74 to 1.26), systemic agents (RR 0.59, 95% CI 0.28 to 1.23), or low or no dose heparin (RR 0.90, 95% CI 0.10 to 8.31).	A significant reduction on incidence of catheter-related bacteraemia was observed for alternative anticoagulant locking solutions (RR 0.46, 95% CI 0.32 to 0.66) but not systemic agents (RR 2.41, 95% CI 0.89 to 6.55)
recombinant tissue plasminogen (rt-PA) was the only locking solution shown to reduce catheter malfunction (RR 0.58, 95% CI 0.37 to 0.91)	all individual classes of alternative anticoagulant locking solutions, except ethanol, reduced catheter-related bacteraemia (citrate: RR 0.49, 95% CI 0.36 to 0.68; antibiotic: RR 0.27, 95% CI 0.11 to 0.70; rt-PA: RR 0.35, 95% CI 0.13 to 0.93; ethanol: RR 0.33, 95% CI 0.03 to 4.05)
No significant on catheter malfunction was observed for other individual classes of alternative anticoagulant locking solutions (citrate: RR 1.14, 95% CI 0.76 to 1.69; antibiotic: RR 1.48, 95% CI 0.79 to 2.77; ethanol: RR 0.88, 95% CI 0.21 to 3.67).	

CHEST®

Official publication of the American College of Chest Physicians

Clotting prophylaxis ?

Antithrombotic Therapy in Neonates and Children * : American College of Chest Physicians Evidence-Based Clinical Practice Guidelines (8th Edition)

Paul Monagle, Elizabeth Chalmers, Anthony Chan, Gabrielle deVeber, Fenella Kirkham, Patricia Massicotte and Alan D. Michelson

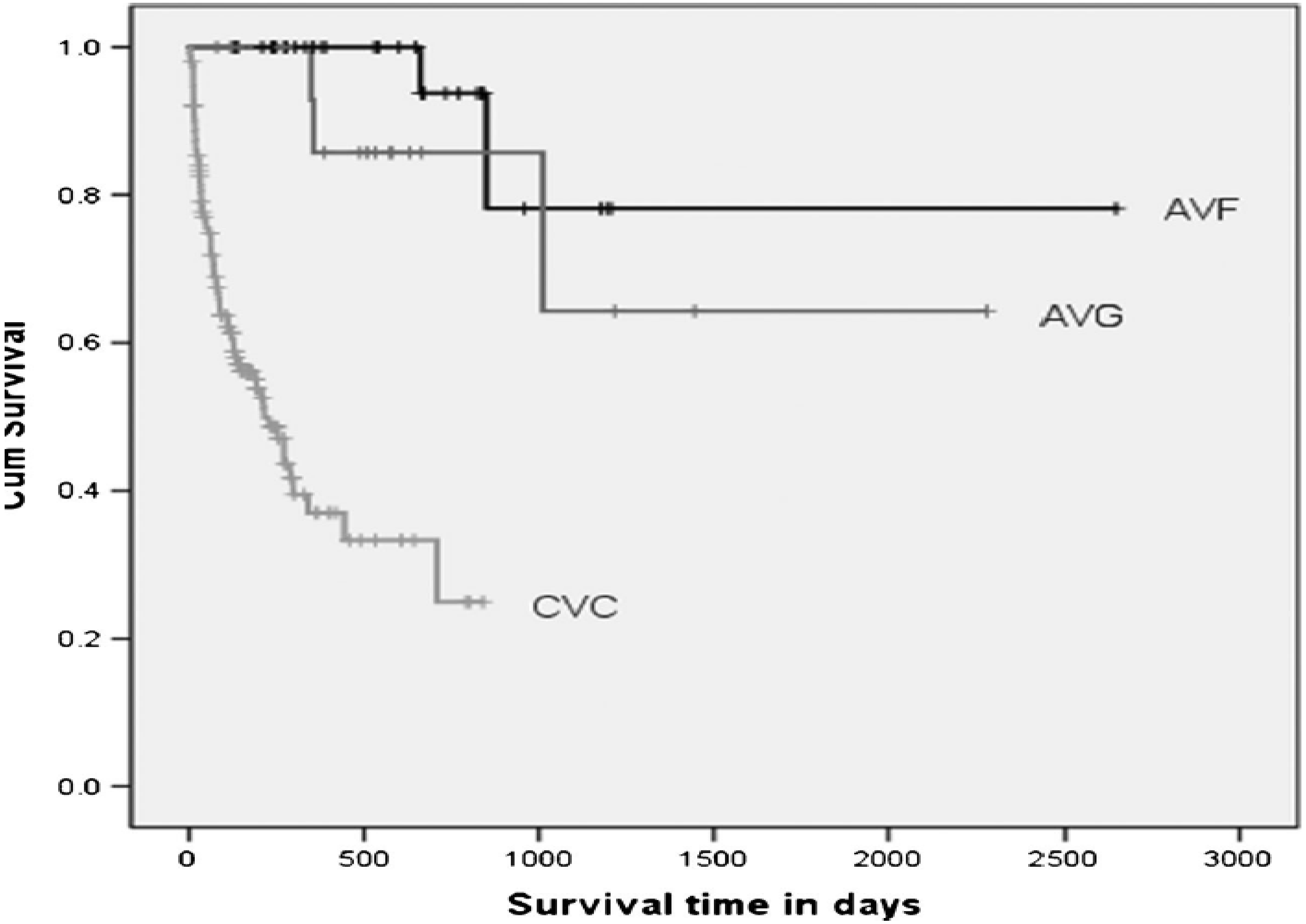
Chest 2008;133;887S-968S

Recommendation

1.25 In patients undergoing hemodialysis, we suggest against routine use of VKAs or LMWH for prevention of thrombosis related to CVLs or fistulas (Grade 2C).

AVF vs CVC

Fig. 2 Cumulative (*Cum*) Survival of arteriovenous fistula (AVF) vs. arteriovenous graft (AVG) and central venous catheter (*CVC*). $p<0.001$



Re-envisioning Fistula First in a Patient-Centered Culture

Clin J Am Soc Nephrol 8: 1791–1797, 2013.

Amanda Gomes, Rebecca Schmidt,† and Jay Wish**

Table 1. Population-focused versus patient-centered approach to vascular access

Approach	Population Focused	Patient Centered
AVF	Presumed appropriate for 66%	Deemed appropriate based on suitability: clinical, prognostic, or vascular anatomy
AVG	Acceptable if AVF not possible	May be best choice in older patients with limited life expectancy and/or need of imminent dialysis or patients with anatomy not amenable to AVF
CVC	Acceptable for no more than 10%	Acceptable only for patients with vascular access failure or poor prognosis for long-term survival

AVF, arteriovenous fistula; AVG, arteriovenous graft; CVC, tunneled cuffed central venous catheter.

Controversies and Concerns in Hemodialysis
Series Editor: Marcello Tonelli

Seminars in Dialysis—Vol 22, No 5
2009 pp. 539–544

What's Next After *Fistula First*: Is an Arteriovenous Graft or Central Venous Catheter Preferable When an Arteriovenous Fistula Is Not Possible?

Matthew T. James,*† Braden J. Manns,*†‡ Brenda R. Hemmelgarn,*†
and Pietro Ravan

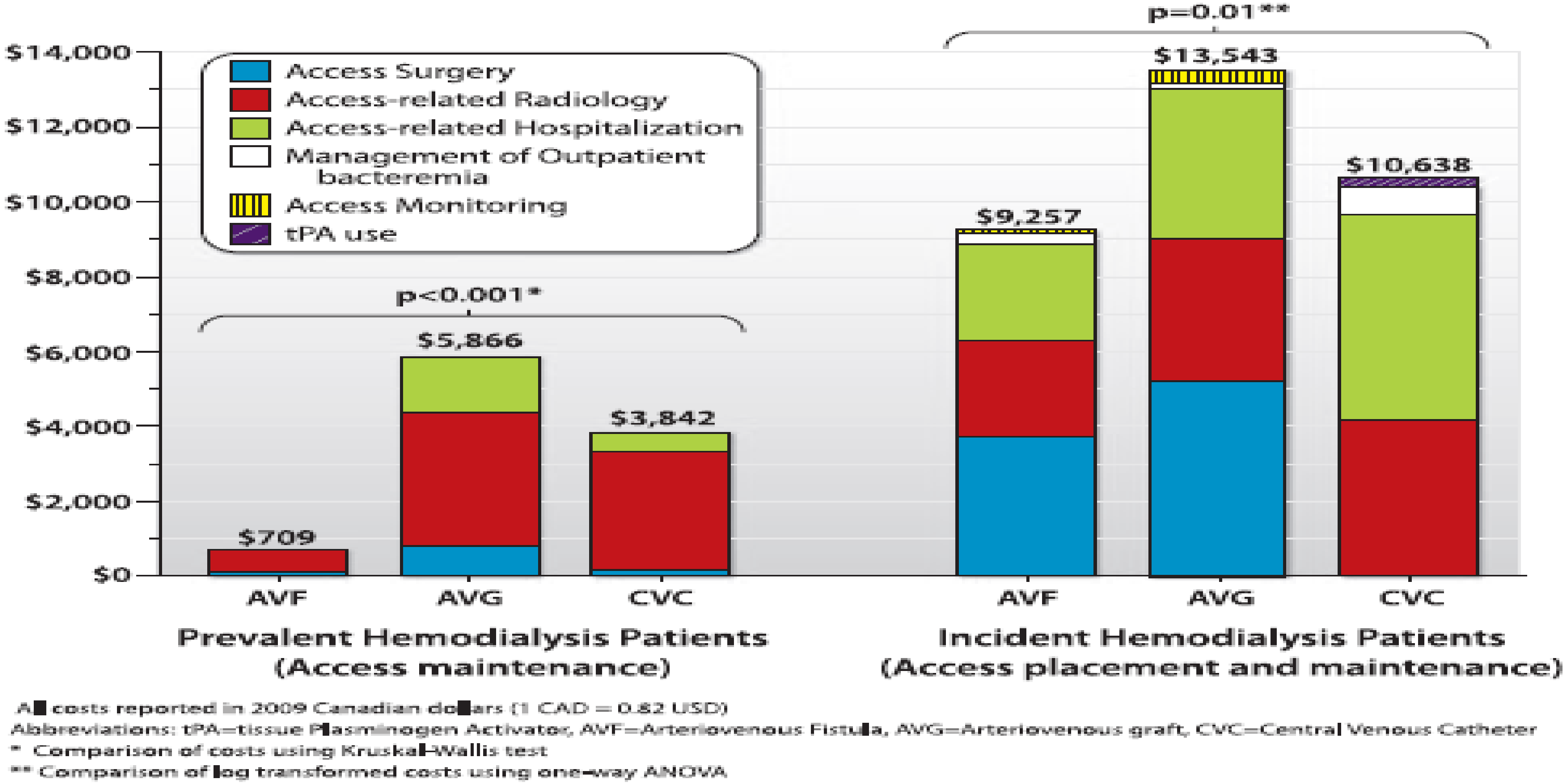


FIG. 1. Mean costs per patient year associated with types of hemodialysis vascular access.

We all know that AV fistula is better, however..

Ethical and Legal Obligation to Avoid Long-Term Tunneled Catheter Access

Clin J Am Soc Nephrol 4: 456–460, 2009.

Raheela Rehman,* Rebecca J. Schmidt,* and Alvin H. Moss*†

(1,2). In its goals for access placement set forth in 2000 and updated in 2006, the Kidney Disease Outcomes Quality Initiative (K/DOQI) recommends that primary AVFs should be constructed in at least 50% of all patients with end-stage renal disease (ESRD) who elect to receive hemodialysis, with the goal that ultimately 65% of prevalent patients should have native AVFs. K/DOQI further recommends that the use of tunneled-cuffed catheters (TCCs) be discouraged as long-term vascular access and that fewer than 10% of patients should be using them for permanent access (3). The Fistula First Initiative has promulgated similar recommendations (4).

Despite these recommendations, TCC use is rising. This growing use has been likened to a "catheter epidemic." (5). In 2006, 82% of patients in the United States initiated dialysis via a catheter (6). The overall likelihood of TCC use was 35% greater in 2005 compared with 1996 (7).

Should We Respect Patient Choice to Defer an AV Fistula?

Placement of vascular access is a matter of informed consent. On the basis of medical evidence, patients should be informed of the following about long-term dialysis with TCCs compared with AVFs: (*1*) their risk of death is increased two- to threefold; (*2*) their risk of serious infection is increased five- to 10-fold; (*3*) their risk of experiencing a painful complication from infection (osteomyelitis, septic arthritis, endocarditis, or epidural abscess) that may require major surgery and be difficult or impossible to cure is significantly increased; (*4*) their risk of needing access replacement is higher for TCCs because TCCs are not intended for permanent use; (*5*) their risk of being sicker because of inadequate dialysis through a TCC is higher; (*6*) their risk of spending more time in the hospital is higher because of TCC complications; and (*7*) their risk of death in the first year of dialysis is significantly increased with TCC use. Nephrologists need to be aware of the strength and implications of these data before discussing dialysis access with their patients, and

Pediatr Nephrol (2014) 29:2013–2020
DOI 10.1007/s00467-013-2744-9

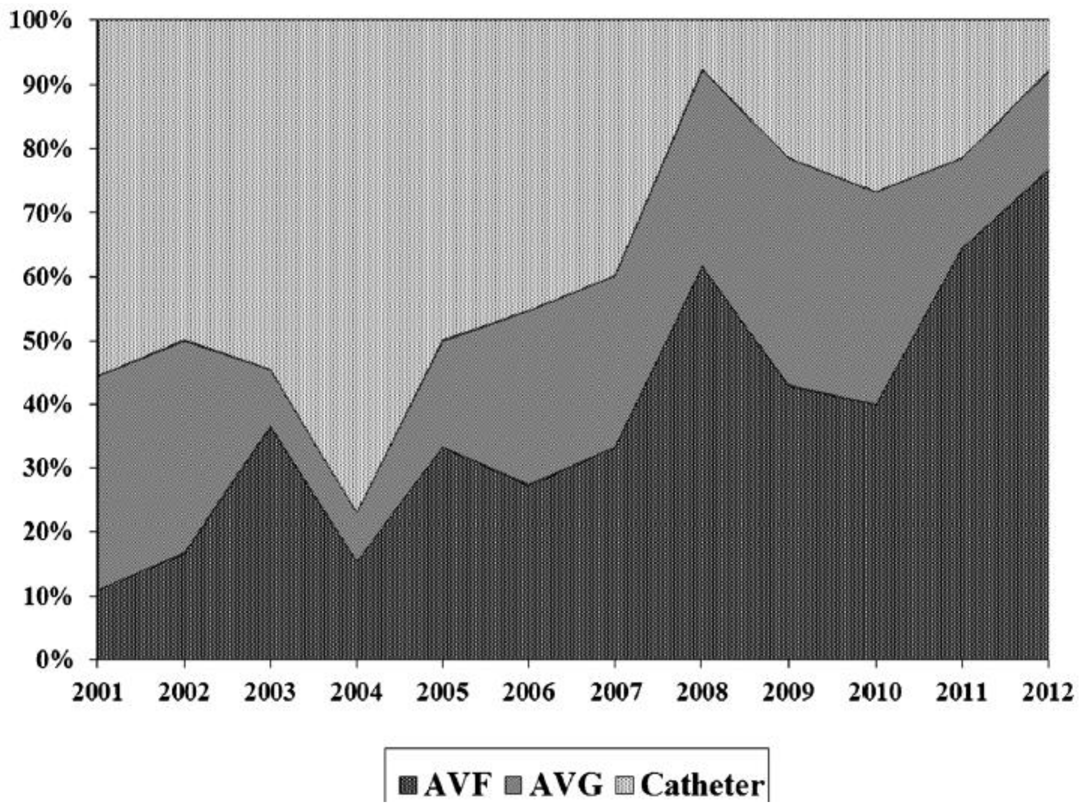
ORIGINAL ARTICLE

Reducing central venous catheters in chronic hemodialysis—a commitment to arteriovenous fistula creation in children

Rossana Baracco · Tej Mattoo · Amrish Jain · Gaurav Kapur · Rudolph P. Valentini

Parameters	Time period			Total
	2001–2005	2006–2009	2010–2012	
Hemodialysis access use rates (%)				
AVF	33.3	42.9	76.9	
AVG	16.7	35.7	15.4	
CVC	50	21.4	7.7	
AVF, *n* (%)				
Successful	10 (52.6)	19 (57.6)	12 (92.3)*	41 (63.1)
Unsuccessful	9 (47.4)	14 (42.4)	1 (7.7)	24 (36.9)

Fig. 1 Hemodialysis access rates over the three time periods. AVF arteriovenous fistula, AVG arteriovenous graft



Pediatr Nephrol (2012) 27:999–1004
DOI 10.1007/s00467-011-2079-3

ORIGINAL ARTICLE

Vascular access: choice and complications in European paediatric haemodialysis units

Wesley N. Hayes • Alan R. Watson • Nichola Callaghan • Elizabeth Wright • Constantinos J. Stefanidis • On behalf of the European Pediatric Dialysis Working Group

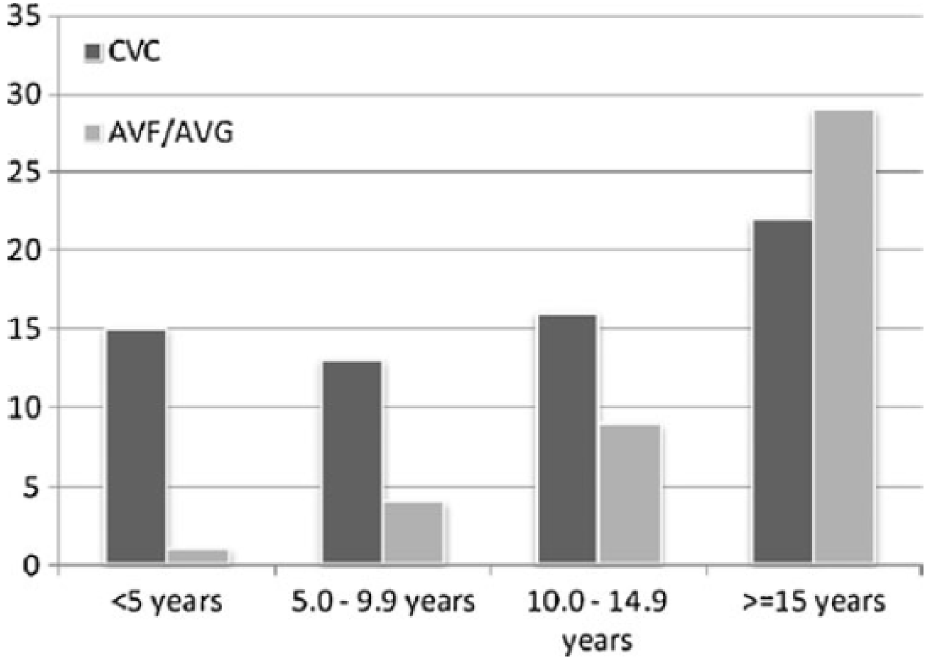


Fig. 4 Vascular access choice vs patient age; *CVC* central venous catheter, *AVF* arteriovenous fisrtula, *AVG* arteriovenous graft

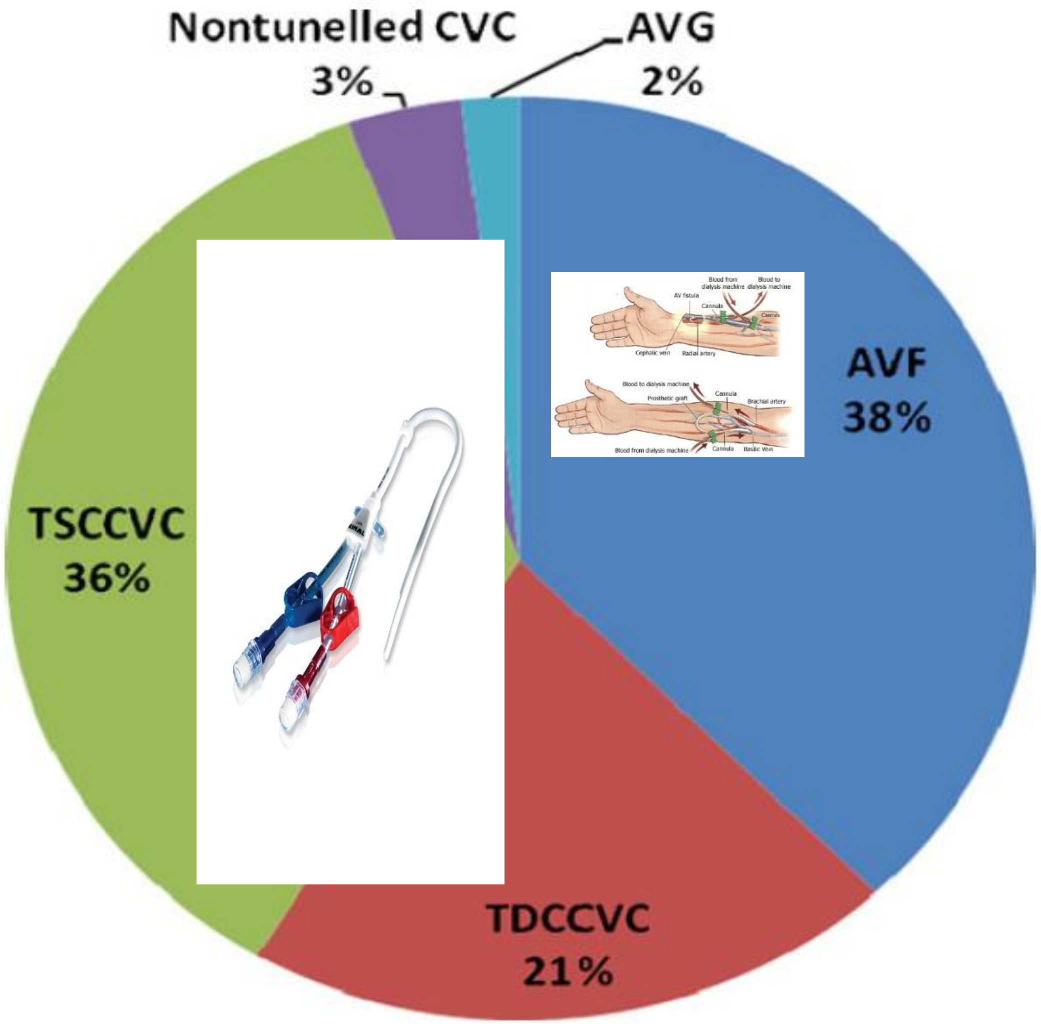


Fig. 3 Choice of vascular access. *AVF* arteriovenous fistula, *AVG* arteriovenous graft, *CVC* central venous catheter, *TSC CVC* tunneled single-cuff CVC, *TDC CVC* tunnelled double-cuff CVC

Pediatr Nephrol (2016) 31:1723–1764
DOI 10.1007/s00467-016-3466-6

ABSTRACTS

Abstracts for the 17th IPNA Congress, Iguaçu, Brazil, September 2016

CVL 78% vs [AVF 21% +AVG 1%]

Driving factor of selection = age

9.8 ± 5.1 vs 14.5 ± 2.8 y. (p<0.001)

FP-S19-2

Predominance of central venous lines (CVL) in pediatric hemodialysis (HD) despite much higher complication rates - Report from the International Pediatric Hemodialysis Network (IPHN)

D. Borzych-Duzalka[(1)], R. Shroff[(2)], Y.N. Lim[(3)], S. Testa[(4)], H. Xu[(5)], B. Warady[(6)], F. Schaefer[(7)], C.P. Schmitt[(8)]
[(1)] Medical University of Gdansk, Gdansk, Poland; [(2)] Great Ormond Street Hospital, London, United Kingdom; [(3)] Paediatric HD Unit, Kuala Lumpur Hospital, Kuala Lumpur, Malaysia; [(4)] Fondazione Ospedale Maggiore Policlinico, Milan, Italy; [(5)] Children's Hospital of Fudan University, Shanghai, China; [(6)] Children's Mercy Hospital, Kansas City, United States; [(7)] Center for Pediatrics and Adolescent Medicine, Heidelberg, Germany

Objectives: Comparison of different HD access types prospectively monitored in the IPHN
Methods: Analysis of 453 children on chronic HD/HDF from 52 units in 19 countries
Results: During 367 pt. yrs. 475 CVL, 164 fistulas (AVF) and 4 grafts (AVG) were created. 78% pts had CVL, 21% AVF, and 1% AVG as initial vascular access. The choice was driven by age (9.8±5.1 in CVL vs. 14.5±2.8 in AVF/AVG; p<0.001). Placement related complications were reported 24 times with AVF/AVG (15%) and 44 times with CVL (9%, p=ns). The predominant site for CVL was right internal jugular vein (n=287; 60%) and left forearm for AVF/AVG (n=55; 31%). 37% of pts had a transient CVL before AVF placement. The Qd/Qb was higher in CVL as compared to AVF/AVG (3.5 ± 1.97 vs. 2.5 ± 0.94, p<0.0001) with no difference in blood flow rates/per m^2 BSA and Kt/V. In 67% of AVF/AVG pts rope ladder and in 27% button hole puncture technique was applied; 37% had more than one accessible vein. Infectious complications were only reported with CVL use (n=62, 1/41 mo.); 46% required CVL removal. Catheter malfunction (n=121, 1/21 mo.), mainly defined as insufficient blood flow (36%), obstruction (24%) or leakage/breakage (14%), required access exchange in 82% of cases. AVF/AVG dysfunction occurred at 32 occasions (1/57 mo.), mainly including thrombosis (50%), puncture failure (15%) and insufficient flow (7%). In 11 cases an access revision was performed, while in 21 a new access was created. One, two and three year patency rates were significantly higher for AVF/AVG than CVL (0.92, 0.90, 0.81 and 0.84, 0.60, 0.30, respectively). The use of CVL increased the risk of access revision 4.8-fold (p<0.0001), as compared to AVF/AVG
Conclusions: This is the largest prospective pediatric report on vascular access in HD. CVL remain by far the first choice, despite much higher complication rates. Infectious complications exclusively occurred in pts with CVL, and access dysfunction risk markedly increased with CVL use

Am J Kidney Dis. 2009 January ; 53(1): 91–98. doi:10.1053/j.ajkd.2008.08.011.

Patterns of Use of Vascular Catheters for Hemodialysis in Children in the United States

Jeffrey J. Fadrowski, MD, MHS[1], **Wenke Hwang, PhD**[2], **Alicia M. Neu, MD**[1], **Barbara A. Fivush, MD**[1], and **Susan L. Furth, MD, PhD**[1,3]

Table 4

Body Size Parameters By Vascular Access Type/Reason Among 1,284 Unique Children, ESRD CPM Project Years 2001–2003

	I. Vascular Catheter, "Patient too small" Reason N= 142	II. Vascular Catheter, All Other Reasons N= 613	III. AVF/AVG N= 529
Height (cm)			
Mean*	110.8	150.1	154.2
Median	109.1	153.7	157.0
Weight (kg)			
Mean*	22.7	51.6	54.8
Median	20.5	49.5	50.8
<20 kg	73 (51.4%)	29 (4.7%)	12 (2.3%)
≥20 kg	69 (48.6%)	584 (95.3%)	517 (97.3%)
BSA (m^2)			
Mean*	0.83	1.45	1.51
Median	0.80	1.45	1.48

Abbreviation: ESRD, end-stage renal disease; CPM, Clinical Performance Measures; AVF/AVG, arteriovenous fistula/graft; BSA, body surface area

Note: BSA calculated by Mosteller equation: $\sqrt{[\text{ht (cm)} \times \text{wt (kg)}]/3600}$

*p value for means all <0.001 comparing I vs II and I vs III

Hemodialysis International 2015; **19**:100–107

Barriers, biases, and beliefs about arteriovenous fistula placement in children: A survey of the International Pediatric Fistula First Initiative (IPFFI) within the Midwest Pediatric Nephrology Consortium (MWPNC)

Deepa H. CHAND,[1] Denis GEARY,[2] Hiren PATEL,[3] Larry A. GREENBAUM,[4] Corina NAILESCU,[5] Michael E. BRIER,[6] Rudolph P. VALENTINI[7]

Dialysis staff

Experience level (post-training):
- <5 years 43%
- 5–10 years 22%
- 11–20 years 16%
- >20 years 19%

When was surgical referral made?
- CKD stage 4: 73%
- CKD stage 5: 22%

Who was referral made to?
- Vascular surgeon 33%
- Pediatric surgeon 27%
- Transplant surgeon 29%

* 65% had a dedicated access surgeon.

Imaging studies prior to surgical referral:
- Venography 34%
- Doppler ultrasound 27%
- Deferred to surgeon 27%

Monitoring
- Physical exam 74%
- Venous pressure monitoring 26%
- Ultrasound dilution 9%

Following DOQI guidelines:
- Yes 46%
- No 13%
- Unknown 38%

Barriers to AVF placement:
- Patient/parent resistance
- Impending transplant
- Patient age, poor vasculature

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Pediatr Nephrol (2014) 29:2395–2401
DOI 10.1007/s00467-014-2877-5

ORIGINAL ARTICLE

Vascular access for chronic hemodialysis in children: arteriovenous fistula or central venous catheter?

Aicha Merouani · Michel Lallier · Julie Paquet · Johanne Gagnon · Anne Laure Lapeyraque

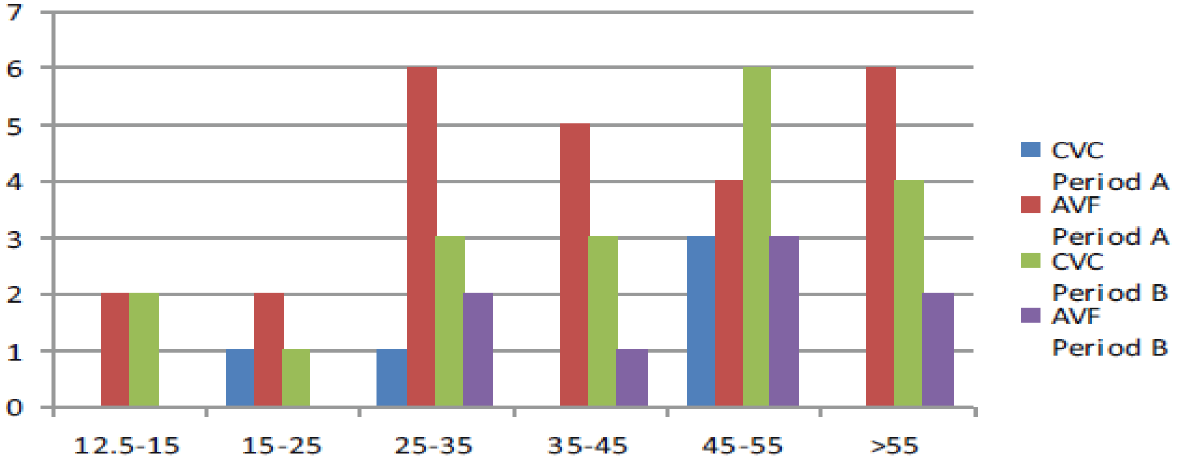


Fig. 1 Vascular access type and weight in period A and B

Table 1 Participant characteristics

	Total (n=78)	Group A, Jan 1, 1997 to Aug 1, 2004 (n=41)	Group B, Aug 2, 2004 to Dec 31, 2011 (n=37)	p value
Gender, male	49 (62 %)	24 (58 %)	25 (67 %)	0.41
Age (years)				
Median (min, max)	14.7 (0.7–20.5)	14.7 (0.7–20.2)	13.7 (1.5–20.5)	0.49
Weight (kg)				
Median (min, max)	46 (12–95)	44.5 (12–79)	46 (13–95)	0.75
Wait time on transplant list, days				
Median (min, max)	253 (2, 1,910)	413.5 (2, 1,910)	89 (18, 692)	0.003
Hemodialysis duration, days – median (min, max)				
Regardless of venous access type	539 (51–1,965)	705 (51–1,965)	349.5 (158–1,060)	0.01

Waiting time and prevalence of children living with a functioning transplant

The median of country-specific waiting times for DD KTx was 11 months (IQR 6–17), ranging from less than 4 months (Scandinavian countries) to more than 3 years (Turkey; Figure 4).

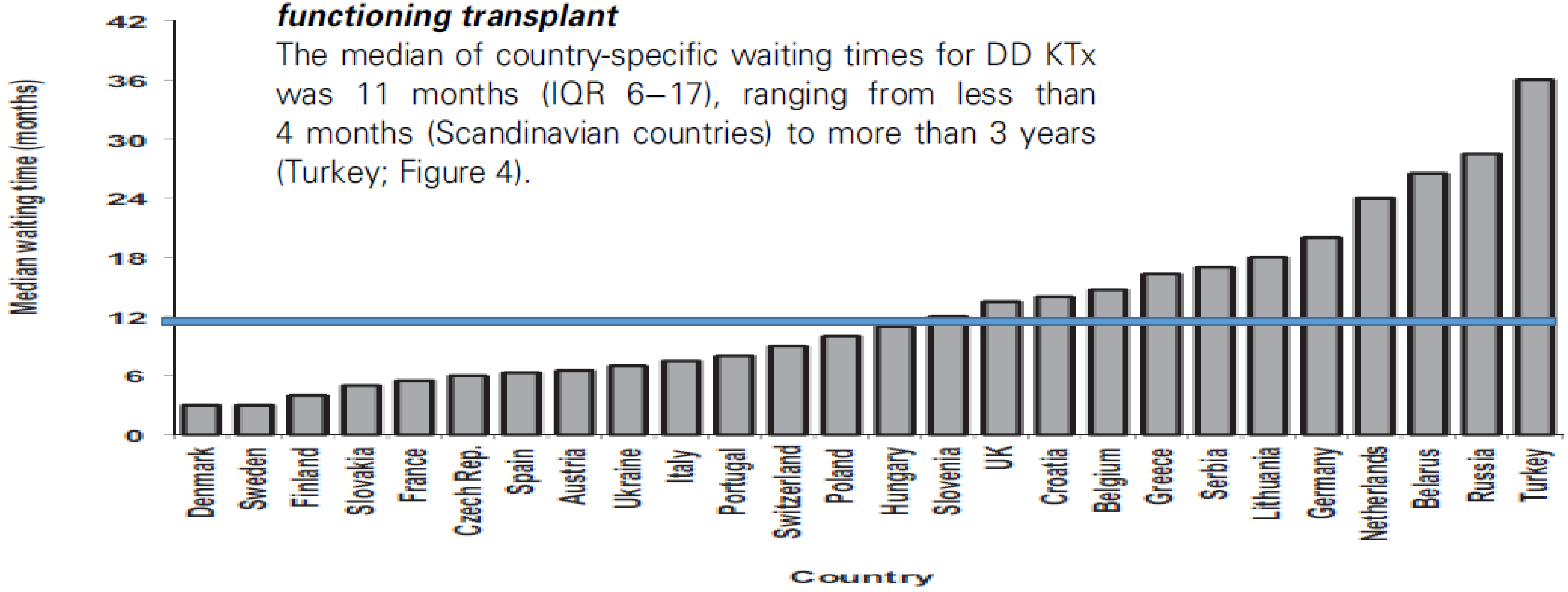
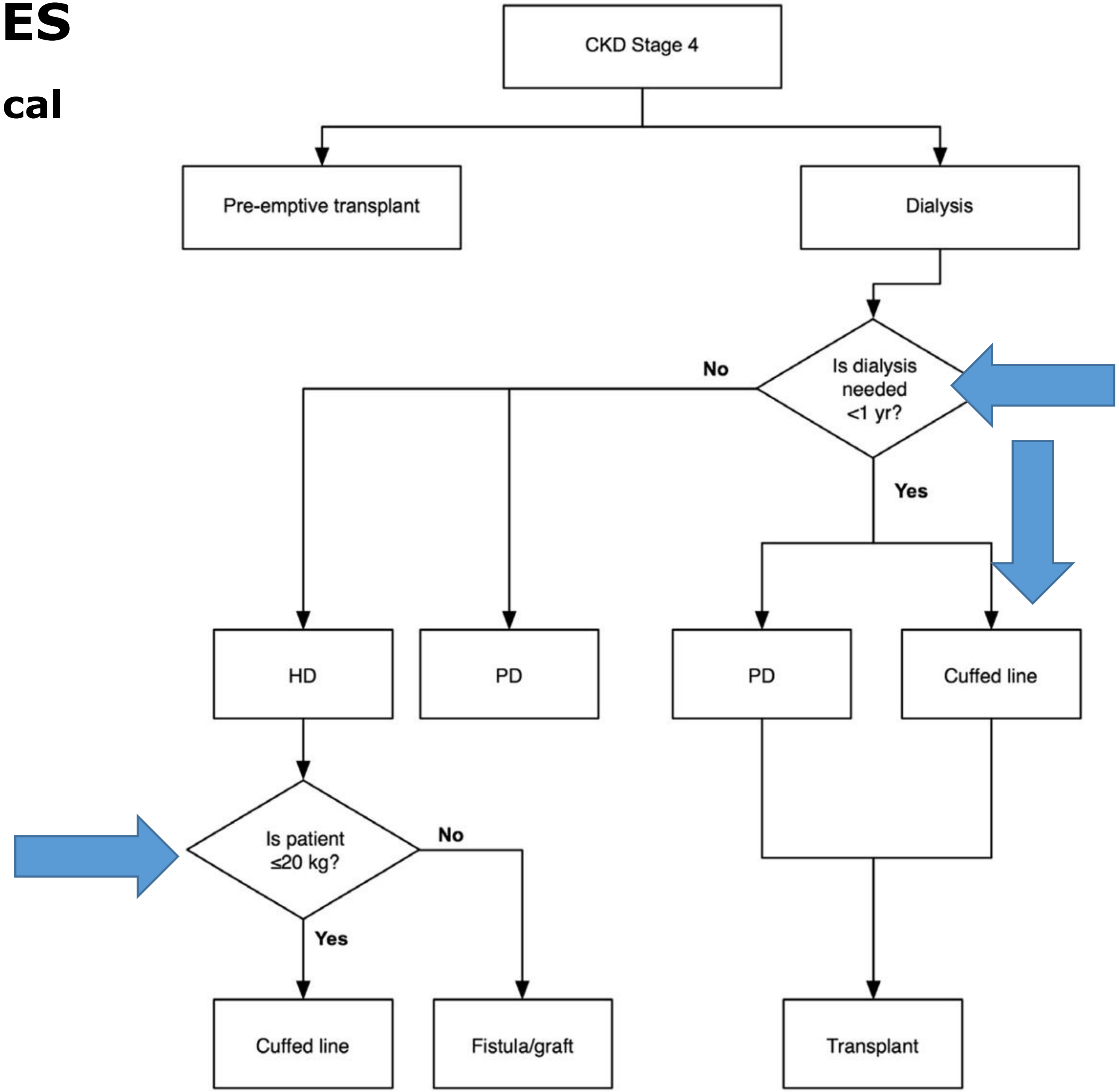


Figure 4: Median waiting time for deceased donor pediatric kidney transplantation in Europe in 2008. KTx in children <18 years of age.

American Journal of Transplantation 2013; 13: 2066–2074

NKF KDOQI GUIDELINES

Clinical Practice Guidelines and Clinical Practice Recommendations
2006 Updates
Hemodialysis Adequacy
Peritoneal Dialysis Adequacy
Vascular Access



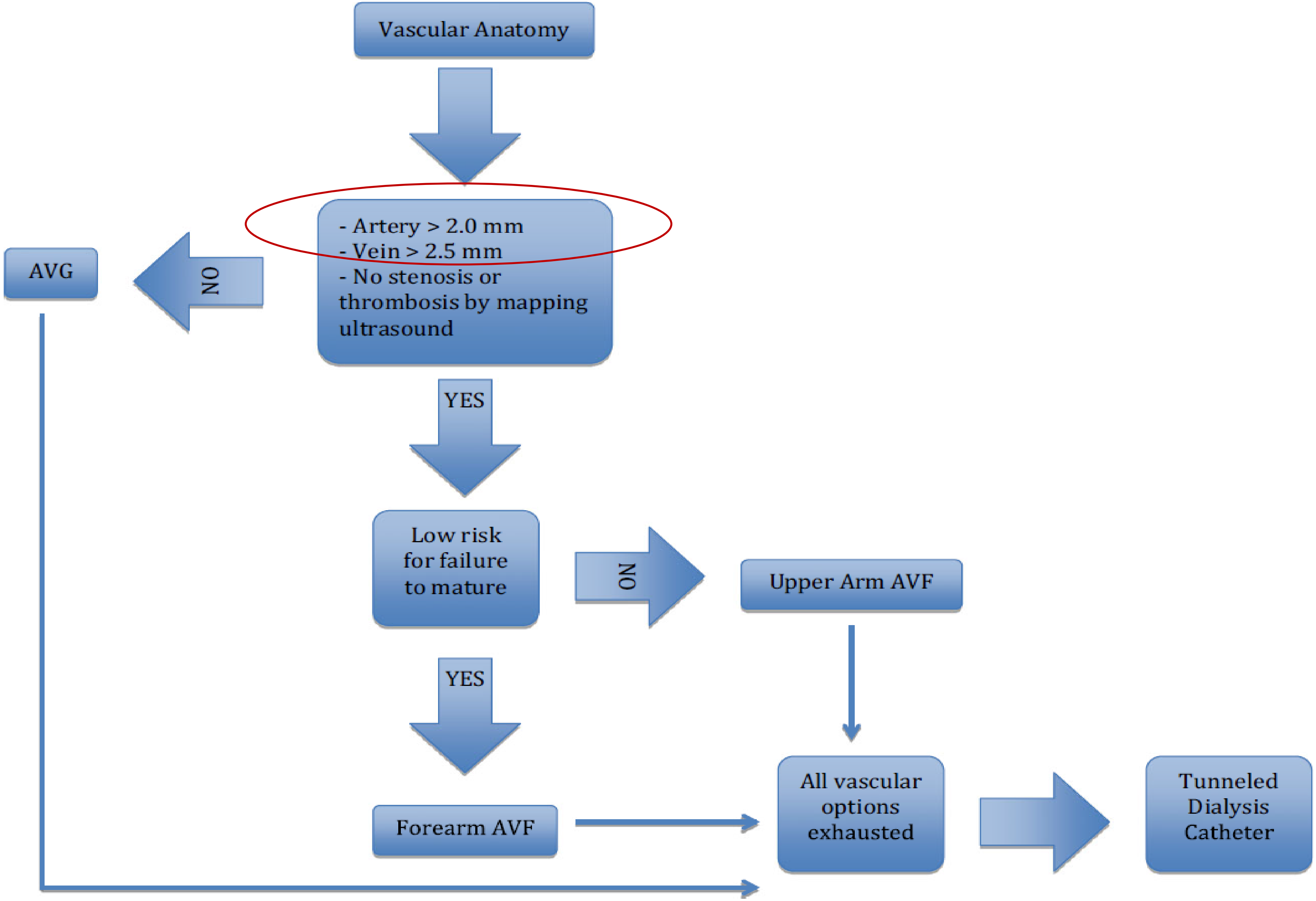


FIG. 5. Flow diagram for the selection of vascular access based on vascular anatomy. AVG, arteriovenous graft; AVF, arteriovenous fistula.

Key summary points

- Arterio-venous fistula (AVF) is recommended as primary permanent vascular acccess for hemodialysis in children („fistula first” attitude)
- Arterio- venous (artificial) graft (AVG) may be used when endogenous vasculature is insufficient to create AVF
- Time interval > 30 days is suggested between creation and first attempt to use of AVF
- Permanent iv. catheters are regarded as the last choice option, mainly to significant catheter-related infection rate
- High incidence of catheter use is seen in pediatric and adult hemodialysis populations, despite these recommendations
- Patient’s body size and dialysis duration expectancy are major determinants of vascular access selection: - smaller (younger) patients with poor vascular adequacy and shorter waiting for renal transplant = the „catheter first” policy in many centers

Vascular access to HD Patient and his problems

Case report.

8-years-old boy; eGFR 15 mL/min/1.73m2; CKD due to steroid-resistant (non-genetic) nephrotic syndrome (SRNS); pre-emptive transplantation considered; patient’s mother enthusiastic to be a donor (not fully evaluated yet)

Question 1:

What will be your first option in terms of introducing renal replacement therapy (RRT):

a. Follow mother’s wish; perform all required tests; go for pre-emptive transplantation
b. Create AV-fistula
c. Insert permanent iv. HD catheter
d. Implant Tenckhoff catheter

Living-related transplantation was discouraged, due to high risk of NS recurrence post-transplant. Family does not want peritoneal dialysis. Patient is still having proteinuria > 3 g/day.

Question 2.

What will be your choice and recommendation of vascular access:

a. AV fistula
b. AV graft
c. Permanent HD iv. catheter
d. Combination of AV fistula and temporary catheter, as you are afraid, that he will need HD before fistula is matured

AV fistula was created in left forearm.

Question 3.

Considering the risk of clotting in this patient, what is your suggestion about long-term prophylaxis:

a. Not necessary
b. Warfarine aimed to INR 2.0
c. Aspirine
d. LMWH sc.

Unexpected event: patient suddenly deteriorates renal function; is oedematic, oliguric, hypertensive; eGFR ↓ to 5 mL/min/1.73m2. All this happened 21 days after creation of AV-fistula

Question 4.

What do you suggest in this situation:

a. Try to use fistula to perform HD
b. Put temporary iv. catheter and perform HD
c. Wait and try conservative treatment to overcome the event
d. Convince the family and introduce (temporarily) peritoneal dialysis

Temporary iv. catheter was inserted and repeated HD was initiated. A week later the fistula (never used) has clotted, probably due to excessive ultrafiltration. Alteplase (thrombolytic) iv. was not effective. Fistula permanently clotted.

Question 5.

What next?

a. Continue HD using temporary catheter; create new AV fistula (upper arm maybe?)
b. Change temporary to permanent iv. catheter; forget fistula
c. Continue HD using temporary catheter; put the patient on urgent waiting list due to lack of permanent vascular access
d. Switch patient to chronic peritoneal dialysis

Patient received permanent catheter. After 2 months of HD he received renal transplant from deceased donor. There was immediate diuresis during transplant surgery

Question 5.

What to do with the permanent catheter?

a. Remove immediately; will be not required any more

b. Remove after 6 months; maybe there will be a graft failure due to rejection

c. Wait a few days, until you are sure there is no immediate recurrence of NS, which will need urgent plasmapheresis (using the same catheter)

Comments

- Nephrotic patients may accelerate CKD unexpectedly
- Nephrotic patients are at risk of clotting, also during CKD
- Do not use AV fistula < 30 days after creation
- Excessive UF promotes clotting of AV fistula
- > than half of (non-genetic) SRNS cases may recure after transplantation; many immediately post-transplant
- Vacular access in such patient may be useful after transplantation to perform plasmapheresis