2022년 대한흉부심장혈관외과학회 제15차 전공의 연수교육

Hemodialysis(HD) access

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KDOQI guideline 2006, 2019 update





National Kidney Foundation

KDOQI CLINICAL PRACTICE GUIDELINE FOR VASCULAR ACCESS: 2019 UPDATE

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KDOQI CLINICAL PRACTICE GUIDELINE FOR VASCULAR ACCESS: 2018

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- An important new concept introduced in this Vascular Access guideline update is that of the *"ESKD Life Plan"*.
- *This individualized and comprehensive map for dialysis modalities and vascular access for the lifetime of the patient* is documented in this guideline, as well as the implementation tools for this guideline that will be developed by the National Kidney Foundation.

Table 3. Classification of chronic kidney disease based on glomerular filtration rate (GFR).^{8–11}

	Stage	Description	GFR mL/min/1.73 m ²
	Stage 1	Kidney damage with normal or elevated GFR	90+
	Stage 2	Kidney damage with mildly decreased GFR	60—89
	Stage 3	Moderately decreased GFR	30-59
투석준비단계 💻	Stage 4	Severely decreased GFR	15—29
투석시작단계 🕳	Stage 5	End stage renal	<15 or on dialysis
		disease (ESRD)	

Treatment options for patients with ESRD



Central venous catheter for HD





Vascular access(혈관접근)

For hemodialysis

- ; Blood flow at least 300ml/min, preferably 500ml/min.
- Central venous catheters (CVC)
 - ; Acute HD, or as bridging VA
- Arterialization of a vein(AVF, arterio-venous fistula)
 - ; Autogenous anastomosis between artery and vein
- Interposition of a graft between an artery and a vein (AVGs, arteriovenous grafts)
 - ; VA using a prosthetic graft

Advantages and Disadvantages of CVC for HD

Advantages	Disadvantages			
 Universally applicable 	ThrombosisInfection			
 Variety sites for placement 	 Central venous stenosis or occlusion 			
 Immediately available for use 	Low patient satisfaction			
• Low cost	 Lower blood flow rate, long dialysis time → Risk of morbidity & mortality 			

투석혈관접근 과정



Choice of type of vascular access

Ideal VA

; Resistant to infection and thrombosis, minimum adverse events

• First option : *Distal autogenous AVF* in the non dominant arm.

- Lower incidence of postoperative complications and fewer endovascular and surgical revision for AVF failure

• Next options : *Prosthetic AVG* and *CVC(central venous catheter*)

- Higher morbidity and mortality in CVCs(infection...)

Time of referral for VA surgery

- Importance for the outcome of the VA.
- Early referral \rightarrow More well functional autogenous AVFs
- Late referral \rightarrow non-maturation and need for a CVC
- Poor long term risk factors of AVF
 - HD initiation with CVC, long AVF maturation time
 - Cardiovascular disease
 - Early cannulation



Kaplan-Meier curves of time to AVF failure

Months from first cannulation J Am Soc Nephrol 2004;15:204 e9. Ravani et al.

Anatomy of Upper Extremity Vessels



Primary option for vascular access (1)

- Autogenous arteriovenous fistula.
- The first choice for VA creation : *Radiocephalic AVF (RCAVF)*
- Advantages
 - Minimum of complications, revisions and hospital admissions
- Non-dominant arm
- A minimum internal vessel diameter
 - Radial artery and cephalic vein : 2.0mm using tourniquet
 - \rightarrow Successful fistula creation and maturation

Radiocephalic AVF (RCAVF)





Snuff-box fistula

: An autologous fistula constructed between a branch of the radial artery and an adjacent vein in the anatomic snuff box of the hand.

Brescia-Cimino (radiocephalic) fistula

: An autologous fistula constructed between the radial artery and the cephalic vein at the wrist.



Disadvantages of AVF

- Risk of early thrombosis and non-maturation
 - \rightarrow Access failure
 - (**17%** mean early failure rate, up to 45%)
 - → One year patency from 52% to 83%
- Old age : Maturation failure

Table 5. Early failure and one year secondary patency rate of the radiocephalic AVF.

Reference	No. RCAVF	Early	Secondary
		failure (%)	patency (%)
Silva et al. ⁵⁹	108	26	83
Golledge et al. ⁶⁰	107	18	69
Wolowczyk et al. ⁶¹	208	20	65
Gibson et al. ⁶²	130	23	56
Allon et al. ⁶³	139	46	42
Dixon et al. ⁶⁴	205	30	53
Ravani et al. ⁶⁵	197	5	71
Rooijens et al. ⁶⁶	86	41	52
Biuckians et al. ⁶⁷	80	37	63
Huijbregts et al. ⁵⁶	649	30	70

Primary option for vascular access (2)

- Brachial artery based AVFs
 - ; BCAVF(brachiocephalic AVF) and BBAVF(Brachiobasilic AVF)
- High access flow
- Good one year patency
- Low incidence of thrombosis (0.2 events per patient/year) and infection (2%)
- Reduced distal arterial perfusion and cardiac overload
 - \rightarrow Risk of Steal syndrome \uparrow
- Basilic vein transposition (BVT) (upper or forearm)

Brachiocephalic AVF(BCAVF)



Transposed Basilic Vein AVF(BBAVF)



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Forearm basilica vein transposition





Variables and outcome of AVF

- Age(>65 years old)
- DM
- Female(smaller vessels, poor maturation and low long-term patency, more revision and AVG)
- PAOD
- Obesity(BMI 35)
- CCB, aspirin, ACEi ; Better AVF, AVG patency
- Anastomosis length : Donor artery size ↓ → failure ↑

Secondary options for vascular access

• AVG VA with

- 4-6mm tapered or 6mm PTFE(polytetrafluoroethylene) graft
- Biological material (ovine graft/Omniflow)
- AVG
 - Primary patency ; 1yr (40~50%), 2yr(20~30%)
 - Neointimal proliperation
 - Multiple intervention (outcome 1)
 - Infection risk
 - Elderly patients may benefit : high rate of primary AVF failure
- Minimum outflow vein diameter : 4mm

Forearm Loop AVG

Anastomosis site

: Brachial artery to antecubital vein to cephalic vein to basilica vein to brachial vein



Other AV Grafts



Pre-operative assessment

- History and physical examination
- Duplex ultrasound(DUS)
- Digital subtraction angiography (DSA)

History and physical examination

- Hand dominance
- Previous vascular access
 - ; Central venous catheters, peripherally inserted central catheter, pacemaker, defibrillator)
- Upper and lower extremity venous thrombosis, hand ischemia
- Pulmonary hypertension or heart disease
- Skin conditions : Dryness, redness and infection.
- Upper arm swelling (Central vein stenosis)
- Hemiplegia (Create VA on the paralytic side).
- Contracture of the elbow joint

Duplex ultrasound sonography

- Venous mapping (depth of vessels and VA sites)
 - ; Measure artery and vein diameters and stenotic lesions
- Evaluation of maturation (flow and diameter check)
- The first line imaging method in suspected VA dysfunction after VA creation

(eg. Stenosis or thrombosis)

Digital subtraction angiography

- Helpful in only a small group of selected patients
- Significant peripheral vascular disease and suspected proximal arterial stenosis
- **Previous CVCs** additional preoperative imaging of the central veins should be performed.

(eg. Venography or intravascular ultrasound)

Preoperative check points - Technical aspects

• Venous preservation

- ; Save the forearm veins
- Arm exercise ; Improve artery and vein diameters
- Preoperative or perioperative hydration
 - ; Improve AVF patency

• Preoperative antiplatelet agents

- ; Incomplete evidence but reduce VA thrombosis
- Preoperative physical examination
 - ; Upper limb pulse, superficial vein check in warm room

Perioperative check points - Technical aspects

• Prophylactic antibiotics

- ; Cephalosporin, amoxycillin/clavulanic acid or a glycopeptide
- Anesthesia : Local or regional anesthesia
- Perioperative anticoagulation (heparin)
 - ; Postoperative hemorrhage and no effect on patency
 - ; Local instillation of heparinized saline or ringer's solution into vessels
- Arteriovenous fistula configuration
 - ; End to side (vein to artery) anastomosis

Meta-analysis of Heparin use

Table III. Results of randomized controlled trials of systemic heparin use in arteriovenous fistula (AVF) surgery. Stouffer's Z method results indicate combined significance levels weighted for number of participants

First author	Patients	Bleeding rate increased	Р	Patency rate increased	Р
D'Ayala (2008)44	115	Yes	.008	No	.79
Ravari H (2008)45	198	No	.175	Yes	.046
Bhomi K (2008)46	50	Yes	<.01	No	.46
Stouffer Z method (combined P)		Yes	<.001	No	.1458

Journal of Vascular Surgery 2012;55:849-55

Summary of surgical techniques (1)

- AVF ; *Most distal site possible*
- Proximal AVFs : Lower initial failure & better patency
 → Steal syndrome ↑, less comfortable
- Arterial & venous diameters : more than 2 mm
- Non-dominant arm
- Pacemaker or CVC : Contralateral side