Update in Hemodialysis

Management of Difficult Vascular Access Problems

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고 기 영

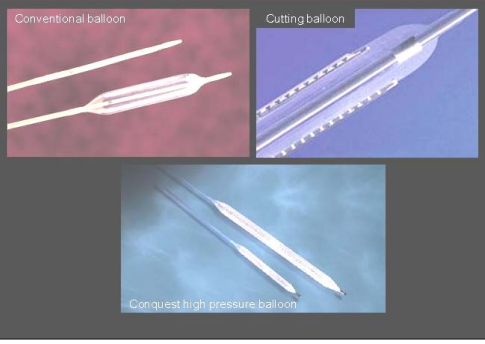
Complications of hemodialysis access

- Immature access
- Stenosis : most common
- Thrombosis
- Aneurysm
- Infection

Treatment of access failure

- Balloon angioplasty
- Stent or stent graft placement
- Thrombolysis / thrombectomy
- Advantages
  - Outpatient bases
  - Prompt dialyze after the procedure
  - Repeat Tx. on the same lesion w/o future loss of vein
  - Acceptable technical & clinical success rate

Transluminal Balloon Angioplasty



Transluminal Balloon Angioplasty

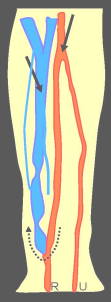
Indications

Stenosis > diameter 50% associated with

1) Previous thrombosis in the access
2) Elevated venous dialysis pressure
3) Abnormal urea recirculation
4) Abnormal physical findings
5) Unexplained decreased in dialysis dose

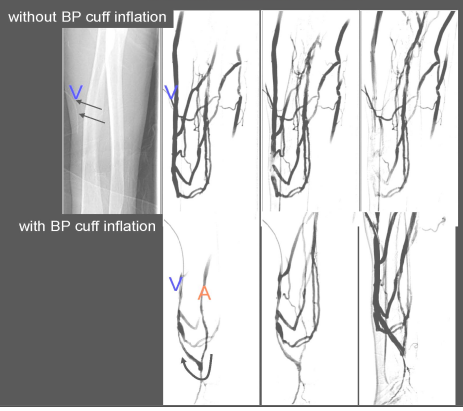
Transluminal Balloon Angioplasty
Approach into the access

- Artery (antegrade)
  - Possible to see both the A, graft, & V trees
  - Facilitates Tx of all lesions from a single access
  - Risk of distal embolization or puncture site cx.
  - Manninen H et al.(Radiology 2001)
    - Major (4%) cx: each 2 pseudoaneurysm & bleeding
    - Minor (8%), hematoma
- Venous access (retrograde)
  - Easy to access
  - Less serious cx. at access site
  - Difficult to identify AV anastomosis or stenosis



Fistulography through the brachial artery

Fistulography through a venous limb



Transluminal Balloon Angioplasty
Techniques

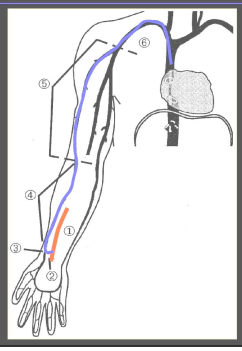
- Balloon size
  - Appx. 1-mm greater than a diameter of adjacent normal vessel
- Inflation time < 60 sec
- Frequently resist to conventional balloon
  - Balloon pr. > 20 atm due to a tight stenosis
  - Cutting balloon catheter
- Heparin : equivocal

Non-maturing AVF

- Etiology
  - Anastomotic or venous stenosis
  - Competing veins (+)
- Tx
  - PTA
  - Ligation or emb. of competing veins
- Outcome (12-mo primary & secondary patency)
  - Clark TWI (PTA): 34%, 75%
  - Turmel-Rodrigues (PTA): 39%, 79%
  - Beathard (angioplasty+collateral ligation) : 68%

M/68, Radiocephalic AVF, primary failure
PTA through the brachial a access

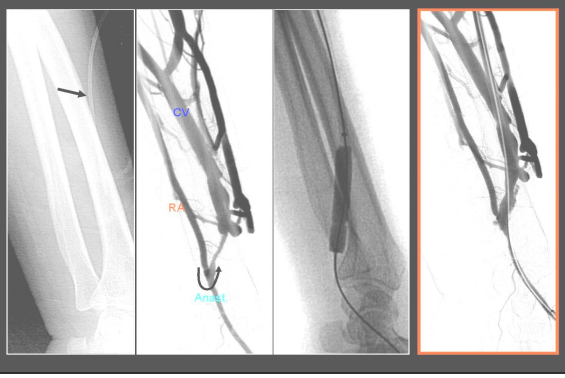
Transluminal Balloon Angioplasty
AVF, Lesion location



1. Native artery, n=10 (9.1%)
2. AV anastomosis, n=10 (9.1%)
3. Initial 2cm of fistula, n=41 (37.6%)
4. Venous outflow >2cm from anast.
   = cannulation zone, n=29 (26.6%)
5. Distal outflow, n=4 (3.7%)
6. Central vein, n=15 (13.8%)

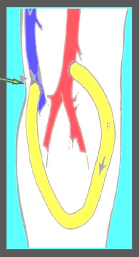
Clark TWI, et al. JVIR 2002;13:51

F/32, Radiocephalic AVF
PTA through a draining vein



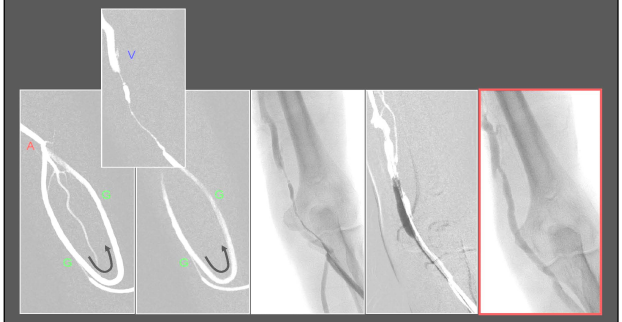
Transluminal Balloon Angioplasty
AVG, Lesion location

- 97 lesions of AVG
  - G-vein anastomosis: 93%
  - A-G anast. or inflow: 20%
  - Central vein: 15%
  - Arterial steal syndrome: 4%
- Multiple abnormality: 35%

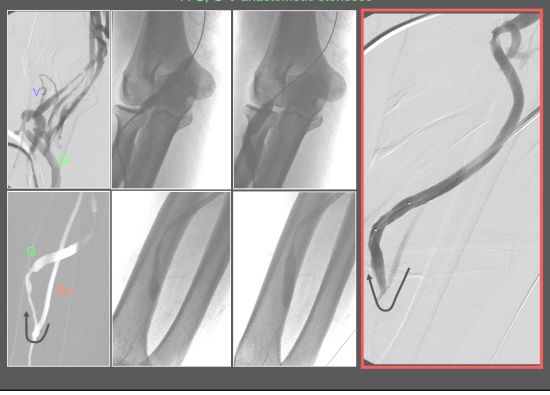


Safa AA, et al. Radiology 1996;199:653-657

M/61, U-loop brachio-antecubital AVG.
Graft-Vein anastomotic stenosis

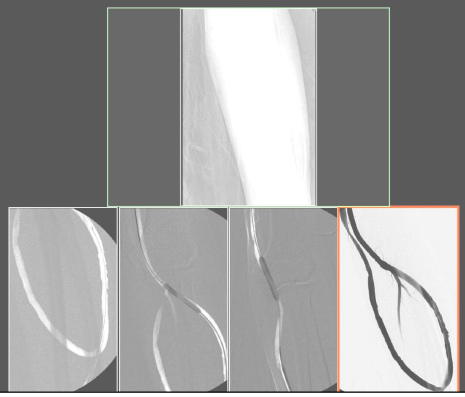


M/53, Radio-antecubital AVG
A-G, G-V anastomotic stenoses



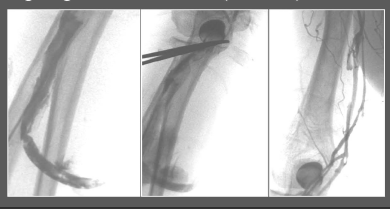
M/53, Radio-antecubital AVG
A-G, G-V anastomotic stenoses

M/60, Brachio-antecubital AVG, A-G, V-G anastomotic stenoses



Transluminal Balloon Angioplasty
Contraindications

- AVG or AVF infection
- AVG within POD 14 days
- Pseudoaneurysm adjacent to stenosis
- Long segmental stenosis (>4 cm?)



Transluminal Balloon Angioplasty
AVF, Patency

		Manninen	Lay	Rajan
No. of pts		N=53	N=31	N=94
Success rate		92%	90%	98%
1^0 patency	6mo	58%	77%	75%
	12mo	44%	64%	62%
2^0 patency	6mo	90%	85%	88%
	12mo	85%	81%	86%

Prognostic factor: lesion length (< 2cm) *JVIR 2002;13*

Manninen HI. Radiology 2001;218:711-
Lay JP. Clin Radiol 1998;58:608-
Rajan DK. Radiology 2004;232:508-

Transluminal Balloon Angioplasty
AVG, Patency

		Safa	Kanterman	Turmel-Rodrigues
No. of pts		N=80	N=47	N=31
Success rate		98%	85%	92%
1^0 patency	6mo	43%	63%	38%
	12mo	23%	41%	25%
2^0 patency	6mo	82%		81%
	12mo	51%		81%

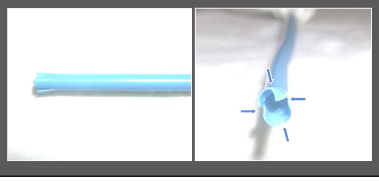
Safa AA, Radiology 1996;199:653-
Kanterman RY. Radiology 1995;195:135-
Turmel-Rodrigues. Radiology 1993;187:273-

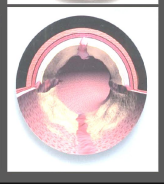
Stenosis resistant to PTA
How to treat

- Multiple tiny gauge needle puncture at lesion sites
- Wire cutting technique with balloon
- Cutting balloon
- Ultra-high pressure balloon (conquest®)
- Stent placement

Cutting balloon

- Cut and dilate
- Reduced barotrauma
- Controlled injury to the lesion
- Less restenosis than conventional balloon

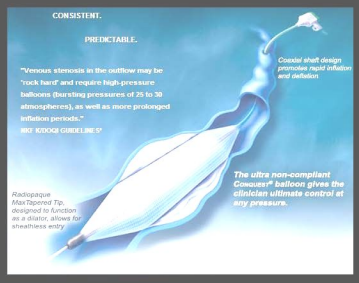




M/39, Brachio-axillary AVG

Ultra-high pressure balloon

- Up to 30 atm



Cutting balloon vs. high pressure balloon

Table 5
Success Rates and 6-month Patency Rates (AVF tx.)

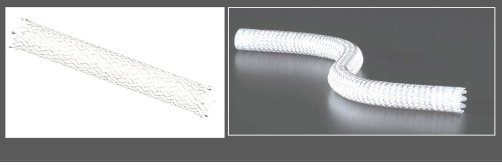
Parameter	Cutting Balloon Angioplasty (n = 35)	High-Pressure Balloon Angioplasty (n = 38)	p Value
Mean procedure time (min)	38.2 ± 14.6	25.8 ± 16.4	.001
Success rates (%)			
Procedure success	100	97.1	.99
Anatomic success	100	97.1	.99
Clinical success	100	97.1	.99
Patency rates at 6 mo (%)			
Target lesion primary patency	71.4	42.9	.009
Access primary patency	65.7	40.0	.009

Note.—Numbers in parentheses are percentages.

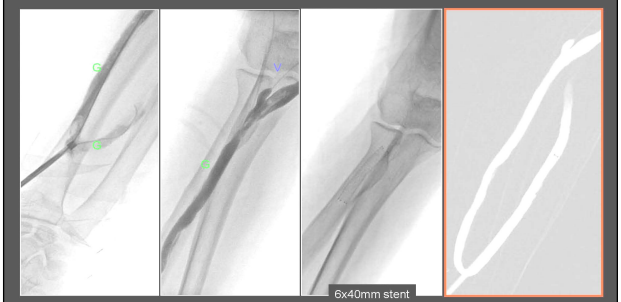
Wu CC, et al. JVIR 2008

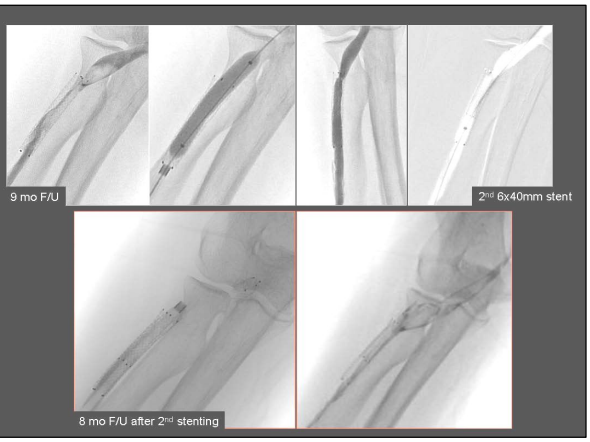
Stent placement at AVF or AVG

- Indication:
  - Failed balloon angioplasty
  - Limited remaining access sites
  - Rupture of an outflow vein
- Bare or covered stent



F/69, U-loop brachio-antecubital AVG, V-G anastomotic stenoses →stenting





PTA vs. PTA with bare stenting

		PTA	PTA + stent
No. of pts		N=47	N=40
1^0 patency	6mo	31%	27%
	12mo	10%	11%
2^0 patency	6mo	80%	64%
	12mo	71%	64%

Stents offered no advantage in the treatment of AVG stenosis

Quinn et al. JVIR1995;6:851-

PTA vs. PTA with covered stenting

- Haskal ZJ, et al. NEJM 2010
  - Graft-vein anast. stenosis
  - PTA vs. covered stenting
  - SG is superior to PTA alone with regard to patency of stenosis & the entire access circuit
  - Still remain many debates

Table 3. Treatment Success and Patency End Points in the Intention-to-Treat Population, According to Treatment Group.*

End Point	Stent Graft	Balloon Angioplasty	P Value
	no. of patients/total no. (%)		
Anatomical success	91/97 (94)	68/93 (73)	<0.001
Hemodynamic success	97/97 (100)	93/93 (100)	
Clinical success	85/97 (88)	78/93 (84)	0.49
Procedural success	91/97 (94)	68/93 (73)	<0.001
Primary patency of treatment area			
2 mo	77/96 (80)	71/92 (77)	0.72
6 mo	46/91 (51)	20/86 (23)	<0.001
Primary patency of access circuit			
2 mo	76/96 (79)	71/92 (77)	0.86
6 mo	35/92 (38)	17/86 (20)	0.008

Managements for Thrombosed Access

- Pharmacologic thrombolysis
  - Infusion thrombolysis
  - Lyse & Wait thrombolysis
- Pharmacomechanical thrombolysis
  - Pulse-Spray with urokinase
- Venotomy with squeezing
- Mechanical thrombolysis
  - Balloon assisted thromboaspiration
  - Mechanical thrombectomy devices

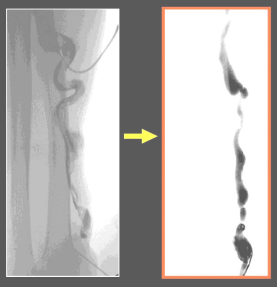
Most cases have underlying stenosis

→ need combined balloon angioplasty

Managements for Thrombosed AVF

AVFs have

1. Thin venous wall
2. Irregular anatomy
3. Underlying stenosis
4. Deceptive collateral
5. Large clots
6. Aneurysms



Neither percutaneous nor surgical technique offer good results

F/45, Radiocephalic AVF
Pharmacologic thrombolysis (Urokinase 400K U)

M/55, Radiocephalic AVF, Acute occlusion after compression
PTA alone

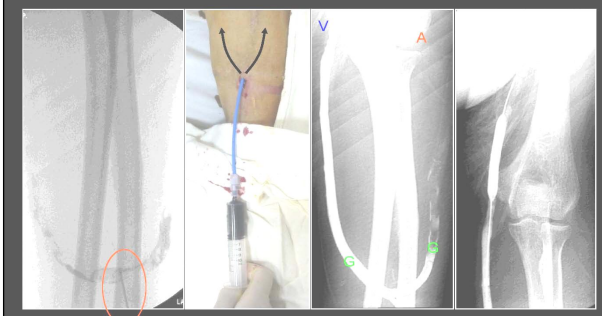
Managements for Thrombosed AVF
Venotomy & manual propulsion technique

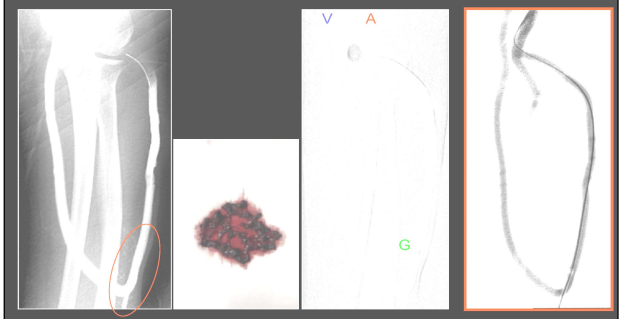
- AVF with large amount thrombi
- Won JH, et al. AJR 2012
  - TS & CS: 96% & 91%, resp. in 56 pts.
  - 6, 12 mo primary patency: 81, 58%, resp.
  - Cx rate: 7%
    - Major (2.9%), each 1 wound infection & massive bleeding

Managements for Thrombosed Access
Balloon-assisted thromboaspiration

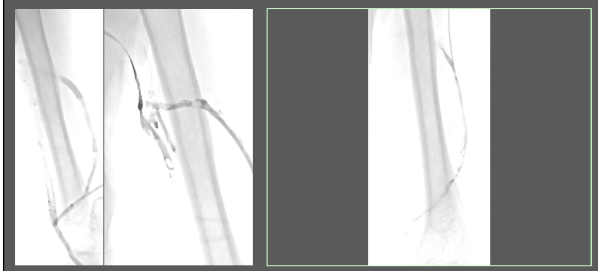
- Basis:
  - Use mechanical devices to macerate clot
  - Aspirate the resulting particulate
  - PTA for treating outflow stenosis
- Desilets-Hoffman sheath : 7F
- Advantage :
  - Low cost
  - Decreased bleeding risk
  - Reduced procedure-time

M/47, s/p U-loop brachiobasilc AVG,
Mechanical thromboaspiration using the Hoffman sheath



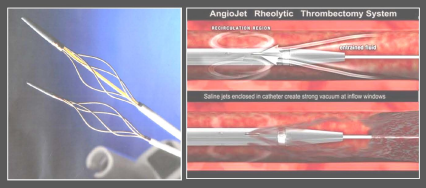


M/52, Brachioaxillary AVG, Absent thrill
s/p AVG op 2012/12/5,
Radiologic thrombectomy & PTA 2013/1/24, 2/19, 4/2 graft interposition



Managements for Thrombosed Access
Mechanical thrombectomy devices

- Acceleration of thrombus removal
- High cost



Managements for Thrombosed Access
Results

Investigator	No. of Cases	Access Type	Lysis Method
Beathard (36)	55	PTFE	Saline pulse spray, maceration, Fogarty
Trerotola (41)	34	PTFE	PTA venous outflow, Fogarty, maceration, massage
Middlebrook (42)	24	PTFE	PTA venous outflow, Fogarty, macerate, massage, flush
Beathard (40)	1,176	PTFE	PTA venous outflow, saline pulse spray, Fogarty, macerate
Sharafuddin (43)	20	PTFE	Fogarty, aspiration, maceration[a]
Vorwerk (45)	16	PTFE, AVF	Hydrodynamic thrombectomy, macerate
Uflacker (44)	19	PTFE?	Amplatz mechanical thrombectomy

Note.—AVF = arteriovenous fistula, Flush = brisk saline injection.
[a] Eight had supplemental urokinase ($n = 6$) or had failed urokinase ($n = 2$).

	Primary Patency (%)			Secondary Patency (%)	
% Salvage	30 day	3 mo	6 mo	30 day	6 mo
92.8	65	37			
82	57	47	18		
92	68	42	36		
96	74	52	39		
85 (1 wk)	53	47	33	73	40
56 (2 wk)				61	
89	47			68	

Central vein stenosis/occlusion
Etiologies

- Previous central v. catheterization
  - Incidence of CV stenosis after catheterization (Kundu S, JVIR 2010)
    - Int. Jugular v. : 0-10%
    - Subclav. v. : 42-50%
- AV access with high turbulent flow

Central vein stenosis/occlusion
Treatments

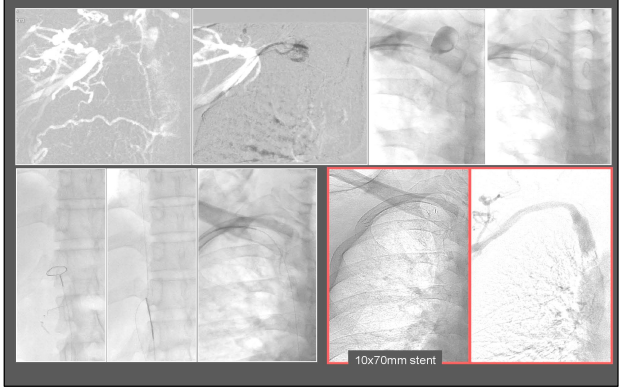
- PTA: 1st line Tx.
- Bare stent placement
  - Elastic recoiling after PTA
  - Recurrent stenosis within a 3-month
  - Rupture after PTA
  - High technical success rate
  - Risks of stent migration, shortening, fracture
  - May preclude future endovasc Tx.
- Covered stent placement

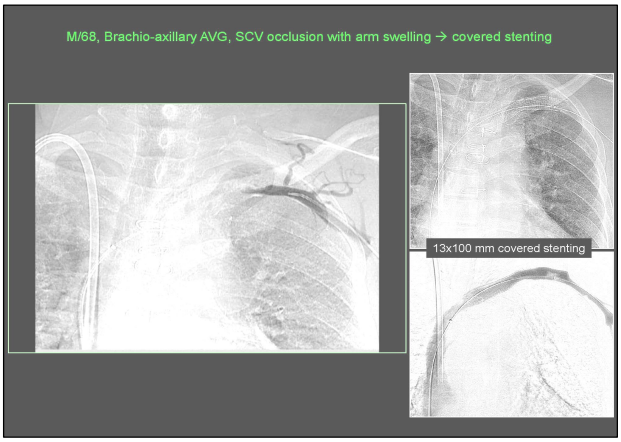
•Angioplasty is the preferred treatment for central vein stenosis.
•DOQI guideline 20

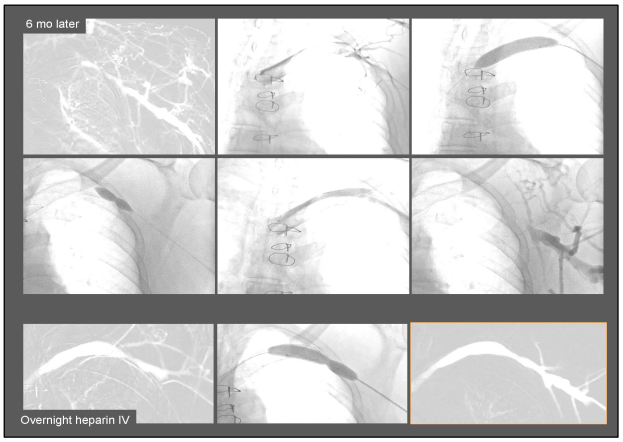
M/58, Brachioaxillary AVG, Arm swelling, PTA

M/73, Brachio-axillary AVG. Central vein occlusion
PTA with stenting

M/47, Central vein occlusion, PTA with stenting







Central vein stenosis/occlusion

Patency after treatments

	PTA (Kundu S, JVIR 2010)	Bare stent (Kundu S, JVIR 2010)	Covered stent (42 in 30 pts, Jones RG, JVIR 2011)	Covered stent (25 in 25 pts, Anaya-Ayala JE, J Vasc Surg 2011)
TS	70-90%	100%	100%	100%
3-mo primary patency		63-100%	97%	
6-mo primary patency	23-63%	42-89%	81%	
12-mo primary patency	12-50%	14-73%	67%	56%
6-mo cumulative patency	29-100%	55-100%	100%	
12-mo cumulative patency	13-100%	31-91%	100%	86%

In the future

- Drug eluting balloon
- Drug eluting stent

SUMMARY

- Interventional treatment is valuable to prolong access surivial.
- Early detection of stenosis & appropriate intervention may result in an increased duration of the access survival.
- Stent is placed only in selected cases with clearly insufficient results of PTA.