

Care of the Vascular Access in the Transplant Patient

George M. Nassar, M.D.
Clinical Associate Professor of Medicine
Weill Cornell University
The Houston Methodist

Disclosures

Speaker has no disclosures to report

Speaker has no conflicts of Interest

The Main Questions

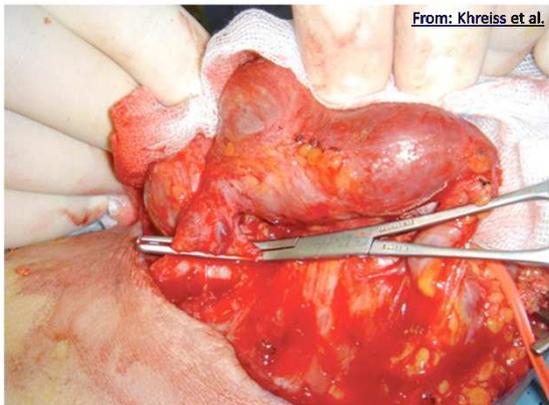
- AVF: To Ligate or not to Ligate
- AVG: To excise or not to excise

The AVF after Kidney Transplantation

- Currently, there is no consensus on the strategy for keeping or ligating the AVF after kidney transplantation.

AVF Ligation or closure Studies Case Report

- **High-output cardiac failure secondary to a large arteriovenous fistula: a persistent threat to the dialysis and kidney transplant patient**
- [Mohamad Khreiss](#), [Fady F. Haddad](#), [Khaled M. Musallam](#), [Walid Medawar](#), [Maiida Daouk](#), and [Ismail Khalil](#)
- NDT Plus. 2009 Apr; 2(2): 147–148
- Department of Surgery and Nephrology/I.M. American University of Beirut Medical Center, Beirut, Lebanon
- We herein present a case of a 35-year-old female who was diagnosed with refractory high-output cardiac failure secondary to an AVF and later managed with surgical division of the fistula and resolution of symptoms.
- CO: 15 L/min → Ligation → CO: 8.6 L/min



**AVF causing high Cardiac Output Heart Failure-
Several case reports of surgical management**

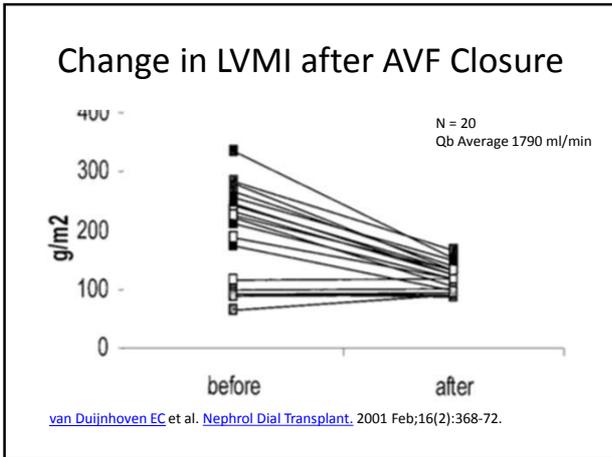
- Anderson CB et al. ; Arch. Int. Med 1976
 - Series of 6 patients that had high output Heart Failure needing AVF ligation (flow rates 0.6-2.9L/min).
 - Reviewed literature: 13/14 similar cases improved following AVF ligation.
- Engeberts I et al.; Am J Neph 1995
- Young PR et al.; Am Surg 1998
 - Two kidney Transplant patients had AVF ligated with successful resolution of high output failure.
- MacRae JM et al.; AJKD 2004
- Stern et al.; Hemodial Int. 2011
- Kurita N et al.; Ther Apher Dial. 15:195-202, 2011

AVF Closure Studies

- All are small studies
- Some are retrospective; few are prospective
- Some are matched with controls but none are truly randomized
- Different conclusions

Studies on LVH and closure of AVF

- **Studies showing decrease LVH after AVF closure**
 - Movilli E. et al., AJKD, 2010
 - Unger P. et al., Transplantation, 2002
 - van Duijnhoven EC. et al., Neph Dial Transplant, 2001
- **Studies showing minimal changes after AVF closure**
 - Soleimani MJ, et al. Iran J Kidney Dis, 2012
 - De Lima JJ, et al., Cardiology, 1999
 - Peteiro J. et al. Cardiology 1994



The Left Ventricle and AVF closure

CONCLUSION:
 Closure of the arteriovenous fistula in stable renal transplant patients results in a decrease in LVMI, due to a reduction in LVEDD.
 In patients with a well-functioning allograft and persistent LV dilatation, closure of the AV fistula might be considered.

[van Duijnhoven EC et al. Nephrol Dial Transplant. 2001 Feb;16\(2\):368-72.](#)

Summary (1)

(Authors conclude that AVF closure is associated with significant benefits on the LV function)

	N Cases AVF Flow	Control	LVMI (before) g/m ²	LVMI (after) g/m ²	P - value	LVEDD
Movilli (HD patients)	25 (AVF Malfunction)	36	135 ± 40	123 ± 35	<0.001	Decreased
Unger (Tx patients)	17 (symptomatic)	6	141 ± 37	132 ± 39	<0.05	Decreased
Van Duijnhoven (Tx patients)	20 1790 ml/min (elective)	0	135 ± 34	120 ± 23	<0.01	Decreased

Summary 2

(Authors conclude: AVF had minimal effects on the LV function)

	N	Control	AVF Flow	Comment	Study Design
De Lima	22 surg	39	900 ± 350 ml/min	LVMi comparable LVEF comparable LVEDD higher in control	Retrospective
Peteiro	30 (Total TX)	0		LVMi decreased LVEDD decreased No effect of AVF closure BP control correlated	Prospective
Soleimani	17 spont	33	560 ± 405 ml/min	LVEF better both groups AVF closure: Decrease in LV and septal wall thickness Control: Trend to less LVEDD and LVESD but N.S.	Retrospective

AVF and Kidney Transplant Survival

- **Functional status of hemodialysis arteriovenous fistula in kidney transplant recipients as a predictor of allograft function and survival.**
- [Vajdič B¹](#), [Arnol M](#), [Ponikvar R](#), [Kandus A](#), [Buturović-Ponikvar J](#).
- [Transplant Proc.](#) 2010 Dec;42(10):4006-9.

AVF and Kidney Transplant Survival

- Patients with functional AVF at 1 year (n = 239) showed higher serum creatinine and lower eGFR values than those with nonfunctional AVF (n = 72): namely 110 ± 38 μmol/L and 69 ± 21 mL/min/1.73 m² versus 99 ± 30 μmol/L and 74 ± 19 mL/min/1.73 m², respectively (P < .05). Persistence of a functional AVF at 1 year after transplantation was associated with a greater incidence of eGFR <60 mL/min/1.73 m² compared with nonfunctional AVF: 36.8% versus 23.6% (odds ratio, 1.885; 95% confidence interval [CI], 1.031-3.450; P = .038). The 5-year allograft survival rates were 60% among patients with a functional AVF versus 75% among those with a nonfunctional AVF (P = .045). The adjusted analyses revealed the persistence of a functional AVF to be associated with an increased risk for future allograft loss (hazard ratio, 1.336; 95% CI, 1.018-1.755; P = .037). In conclusion, the persistence of a functional AVF was associated with a lower eGFR at 1 year after-transplantation and an increased risk for future allograft loss.

[Nephrol Dial Transplant.](#) 2008 Jan;23(1):282-7. Epub 2007 Oct 17.

The relationship between the flow of arteriovenous fistula and cardiac output in haemodialysis patients.

[Basile C¹](#), [Lomonte C](#), [Vernaglione L](#), [Casucci F](#), [Antonelli M](#), [Losurdo N](#).

Division of Nephrology, Miulli General Hospital, Acquaviva delle Fonti and ²Division of Nephrology, Hospital of Manduria, Manduria, Italy

The relationship between the flow of arteriovenous fistula and cardiac output in haemodialysis patients

Demographic, clinical and haemodynamic characteristics of the 96 patients enrolled in the study according to the classification of the American College of Cardiology/American Heart Association task force [10]

Patients with stage A heart failure [(no.(lower arm/upper arm))] 30 (28/2)
 Patients with stage B heart failure [(no.(lower arm/upper arm))] 56 (34/22)
 Patients with stage C heart failure [(no.(lower arm/upper arm))] 10 (3/7)*
 Patients with stage D heart failure [(no.(lower arm/upper arm))] 0

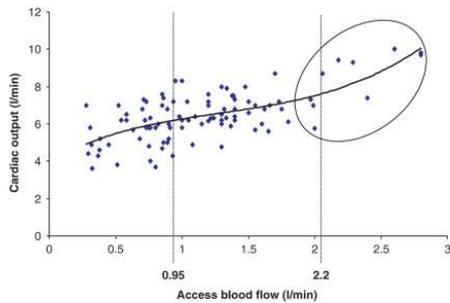
	Stage C CHF (no. 10)	Stages A and B CHF (no. 86)
Mean age (years)	70.8 ± 8.3	62.0 ± 10.0*
Mean HD duration (months)	73.0 ± 43.0	56.5 ± 41.4**
Mean cardiac output (l/min)	8.4 ± 1.5	6.2 ± 1.1#
Mean Qa of AVFs (ml/min)	2.3 ± 0.3	1.0 ± 0.4#
Mean AVF duration (months)	39.0 ± 13.7	31.5 ± 21.4**

*P=significant; **P = not significant; #P < 0.0001. Student's t-test for unpaired data was used. P < 0.04. χ2 test was used.

A third-order polynomial regression model best fitted the relationships between vascular access flow and cardiac output in the 96 patients.

$$Y = 0.564x^3 - 2.1964x^2 + 3.8853x + 4.0145$$

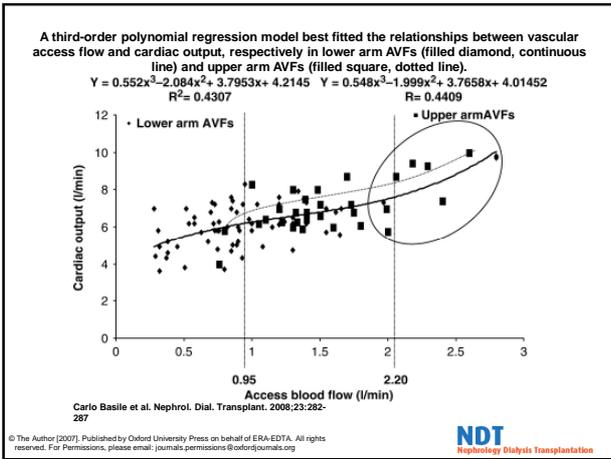
$$R^2 = 0.4607$$

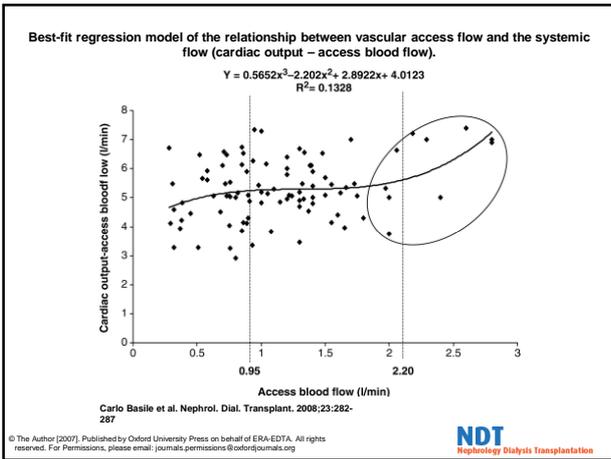


Carlo Basile et al. Nephrol. Dial. Transplant. 2008;23:282-287

© The Author (2007). Published by Oxford University Press on behalf of ERA-EDTA. All rights reserved. For Permissions, please email: journals.permissions@oxfordjournals.org







[Basile C](#), [Lomonte C](#), [Vernaglione L](#), [Casucci F](#), [Antonelli M](#), [Losurdo N](#).

Conclusions:

1. Our prospective study shows that the relationship between Qa of AVFs and CO is complex and a third-order polynomial regression model best fits this relationship.
2. Furthermore, it is the first study to clearly show the high predictive power for high-output cardiac failure occurrence of Qa cut-off values ≥ 2.0 l/min.

Conclusions & Recommendations

- **Conclusions:**
 - Most studies show that AVF ligation decreases left ventricular volume and mass in a stable kidney transplant recipient.
- **Recommendations:**
 - Surgical closure of the AVF can be indicated in kidney transplant patients with heart failure, cardiac disease, high-flow AVF, fistula complications, low risk of kidney transplant failure, and cosmetic reasons.

Kidney Transplant & Functioning AVF Recommendations are Speaker's opinion

Excellent Kidney Transplant Function	1 st 6 months post Tx	> 6 months post Tx
Qa > 2L and CHF	Ligate AVF	Ligate AVF
Qa > 2L no CHF	Leave alone	Ligate AVF or Reduce AVF
Qa < 2L and CHF	Ligate AVF	Ligate AVF
Qa 1.2-2L and no CHF	Leave alone	Controversial
Qa < 1.2L and no CHF	Leave alone	Leave alone

Poor Kidney Transplant Function	Expected HD start < 6 months
Qa > 2L and CHF	Ligate AVF
Qa > 2L no CHF	Reduce AVF
Qa < 2L and CHF	Ligate AVF
Qa 1.2-2L and no CHF	Leave alone
Qa < 1.2L and no CHF	Leave alone

Kidney Transplant & Functioning AVF Recommendations are Speaker's opinion

Excellent Kidney Transplant Function	1 st 6 months post Tx	> 6 months post Tx
Qa > 2L and CHF	Ligate AVF	Ligate AVF
Qa > 2L no CHF	Leave alone	Ligate AVF or Reduce AVF
Qa < 2L and CHF	Ligate AVF	Ligate AVF
Qa 1.2-2L and no CHF	Leave alone	Controversial
Qa < 1.2L and no CHF	Leave alone	Leave alone

Poor Kidney Transplant Function	Expected HD start < 6 months
Qa > 2L and CHF	Ligate AVF
Qa > 2L no CHF	Reduce AVF
Qa < 2L and CHF	Ligate AVF
Qa 1.2-2L and no CHF	Leave alone
Qa < 1.2L and no CHF	Leave alone

Infections of the Old Clotted Arteriovenous Grafts

Complications:

- a) Acute dissemination of bacterial infection
- b) Chronic inflammatory state
- c) Occult Bacterial Infection

Nassar GM, Ayus JC; Infectious Complications of the Hemodialysis Access, *Kidney International* 1-13 July 2001.

Infectious Complications of AVGs

2

Nassar and Ayus: Infectious related to HD access

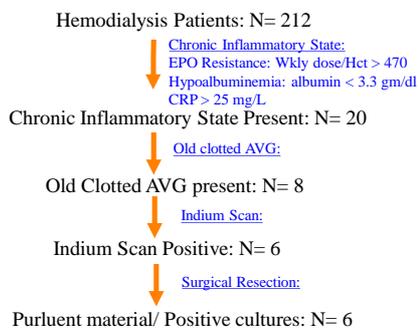
Table 1. Incidence of bacteremia in hemodialysis patients

Source [reference]	Country	Year	N	Incidence of bacteremia per 100 patient-years	Bacteremia due to vascular access	% bacteremia due to gram-positive cocci
Dublin et al. [13]	USA	1978	N/A	15	73%	70% ^a
Kessler et al. [8]	France	1989	1455	8.4	51%	69-80%
USRDS [1]	USA	1996	USRDS	7.6	48%	N/A
Marr et al. [9] ^b	USA	1998	445	14.4	89%	100%
Kaplanitz et al. [18]	USA	1988	71	8.4	27%	50%
Haem et al. [20]	France	1998	988	11.2	N/A	68%

^a N denotes number of hemodialysis patients during the study period. N/A denotes data not available.
^b Rate applies to bacteremia in vascular access-related.
^c A study on staphylococcal aureus bacteremia.
^d Percent of combined bacteremic and nonbacteremic infections related to vascular access.

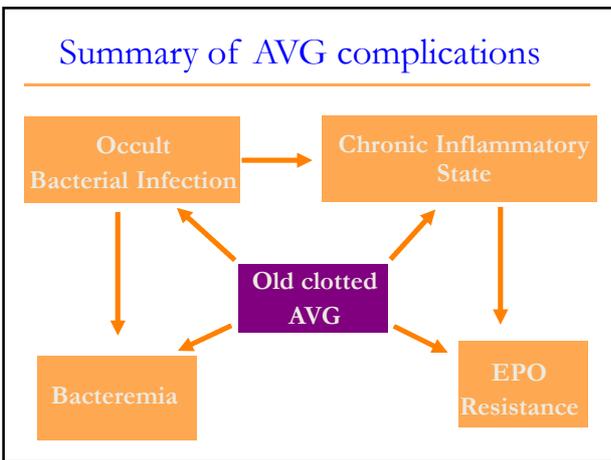
Nassar and Ayus: Infectious Complications of the Dialysis Access, *Kidney International* 2001; 60:1-14

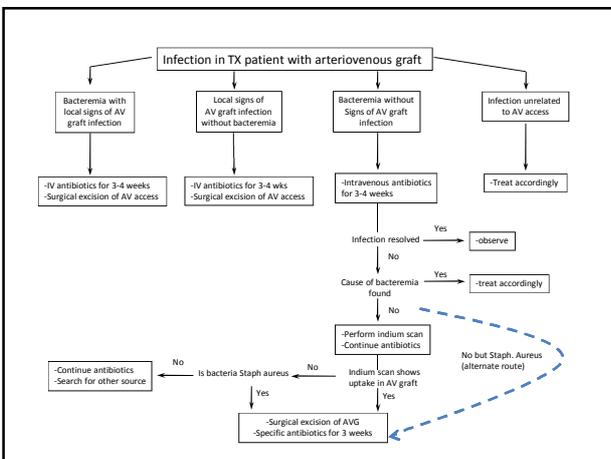
AVG: Chronic Inflammatory State Present



Nassar G, Fishbane S, Ayus JC : KI, vol 61(80) 2002, pp S49-S54

From Beathard G. et al. 2015 data





Kidney Transplant & AVG problems
 Recommendations are Speaker's opinion

AVG is not clotted but has the following problems:	Dialysis not expected in < 6 months	Dialysis is expected in < 6 months
-Aneurysmal segments worsening	Resect	Resect
-Infected/ulcerated	Resect	Resect
-Vascular Steal	Ligate	Ligate
-Arm swelling/ other swelling related to AVG	Ligate	Evaluate cause. Manage if possible with least volume of IV dye.

Kidney Transplant & AVG problems
 Recommendations are Speaker's opinion

AVG is clotted and:	Dialysis not expected in < 6 months	Dialysis is expected in < 6 months
-History of poor prior performance	Leave alone	Leave alone
-History of good prior long term performance	Leave alone	Declot if possible. Consider surgical declot. Least volume of IV dye

AVGs and Kidney Transplants
 Conclusion

- **AVG infection could be a source of:**
 - bacteremia or local infection
 - chronic inflammatory state.
 - Surgical excision is recommended treatment
- **AVG thrombosis following transplant:**
 - Abandon AVG unless (a) patient expected to go back to dialysis soon (3-6 months), and (b) the AVG had a long track record of successful function.
