

# Endovascular management of renal transplant dysfunction secondary to hemodynamic effects related to ipsilateral femoral arteriovenous graft

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## ABSTRACT

Hemodialysis access options become complex in long-term treatment for patients with renal disease, while awaiting renal transplantation (RT). Once upper extremity sites are exhausted, lower extremities are used. RT is preferably in the contralateral iliac fossa, rarely ipsilateral. In current literature, RT dysfunction secondary to the hemodynamic effects of an ipsilateral femoral arteriovenous graft (AVG) has been rarely described. To our knowledge, AVG ligation is the only published technique for hemodynamic correction of an ipsilateral AVG. We present a simple, potentially reversible endovascular approach to manage the hemodynamic effects of an AVG, without potentially permanently losing future AVG access.

**V**enous access options can become complex in patients receiving long-term hemodialysis, while awaiting renal transplantation (RT). Once upper extremity sites have been exhausted, femoral hemodialysis access is critical. Traditionally, kidney transplants are placed in the iliac fossa contralateral to the femoral arteriovenous graft (AVG). Ipsilateral RT, performed on occasion due to contralateral anatomic issues, have rarely been reported to lead to RT graft dysfunction due to local hemodynamic factors (1). We present one such case and discuss the technique and management options.

## Case

We present a 23-year-old female status post cardiac transplantation for arrhythmogenic right ventricular dysplasia complicated with an episode of severe rejection. During this time period, acute tubular necrosis progressed to end-stage renal disease. All venous access sites were exhausted secondary to multiple dialysis catheters. The only remaining hemodialysis access was a 10 mm right femoral polytetrafluoroethylene arteriovenous loop graft (AVG). A year and half after right femoral AVG creation, she received a living related donor kidney transplant placed within the right iliac fossa. Post-transplant course was complicated with graft dysfunction. Renal biopsy and nuclear medicine scan ruled out rejection. An initial duplex ultrasound (DUS) (LOGIQ, GE Healthcare) revealed a high resistance waveform of the renal artery without significant diastolic flow. However, no stenosis or vascular cause of renal dysfunction was seen. Based on the dynamic DUS, angiography, and arterial pressures measurement, the hemodynamic influence of renal perfusion was considered significant and possibly contributing to RT dysfunction in the absence of other etiologies (Figs. 1, 2, and Table). After multidisciplinary discussion a decision, to occlude the AVG was taken.

## Technique

A preliminary DUS confirmed a patent AVG. Under US guidance and using a 21G micropuncture needle (Cook Medical) a transvenous access was obtained. The transvenous access was obtained in the venous loop of the graft, close to the venous anastomosis in order to have adequate purchase length for the planned placement of balloon shaft. A 7F vascular sheath (Terumo Interventional Systems) was placed for stable access. Over a 0.035-inch guidewire (Terumo Interventional Systems), a 6F Fogarty arterial embolectomy catheter (Edwards Lifesciences Corp.) was advanced by one operator into the venous limb of the graft and tip positioned approximately 5 cm from arterial anastomosis. The other operator provided real-time

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US guidance. The balloon was then inflated under US guidance, occluding the AVG over a period of 10 minutes. Real-time US monitoring was performed during the entire 10 minutes, which showed gradual decrease in color flow leading to ultimate loss of flow and development of an echogenic thrombus on gray scale US. The balloon was then slowly deflated, while applying gentle manual compression with the ultrasound transducer. A repeat DUS in 20 minutes confirmed echogenic material within the lumen of the graft and no color flow indicative of thrombosis. The balloon was removed. Figs. 3 and 4 show images of the procedure. Fig. 5 is an illustration to describe the technique.

Postprocedural course was uneventful with renal transplant function improving with decreased serum creatinine steadily from 4.1 to 1.4 mg/dL and increased urine output over a period of 14 days without requiring hemodialysis. The patient did not receive any anticoagulation after the procedure. Follow-up DUS demonstrated normal low resistance morphologic waveforms within the allograft (Fig. 6).

## Discussion

Our 23-year-old female patient who successfully received a renal transplant in the

### Main points

- Long-term hemodialysis access options become complex in patients with renal disease awaiting renal transplantation (RT). Once upper extremity sites are exhausted, lower extremities are used.
- RT is preferably performed in the iliac fossa contralateral to the lower limb graft. Ipsilateral RT, performed on occasion due to contralateral anatomic issues, has been reported to lead to renal graft dysfunction.
- Dynamic ultrasound, angiography, and intra-arterial pressures measurement without and with graft compression can establish the diagnosis.
- Arteriovenous graft (AVG) ligation is the only published technique for hemodynamic correction of renal graft dysfunction of an ipsilateral AVG.
- A simple, endovascular approach involves intentional balloon occlusion and thrombosis of the graft under real-time ultrasound guidance; the greatest advantage being its use in high-risk surgical patients and potential short-term reversibility if renal graft viability becomes threatened and dialysis access is needed in these patients with very limited venous access sites.

Table. Pressure measurements obtained with and without manual graft occlusion		
	Without graft occlusion (mmHg)	With graft occlusion* (mmHg)
Aorta	100/50 (69)	108/60 (79)
Common iliac	97/49 (65)	107/59 (77)
Perianastomotic	94/44 (62)	105/58 (76)
External iliac	75/40 (53)	108/60 (76)
Renal transplant artery	68/37 (48)	108/50 (76)

Data are presented as systolic/diastolic mean blood pressure (mmHg).  
\*Diastolic pressures in the vessels after graft occlusion demonstrated an increase of 10 mmHg or greater.

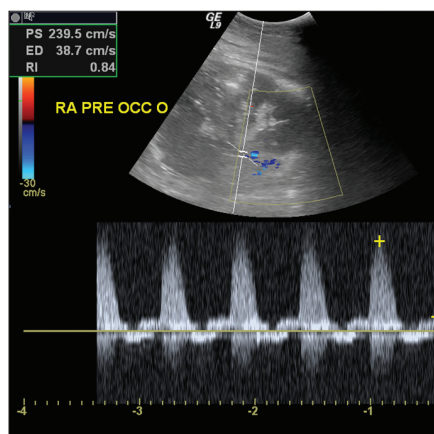


Figure 1. Renal transplant arterial duplex US demonstrates a high resistance waveform (resistive index, RI, 0.84) with reversal of diastolic flow.

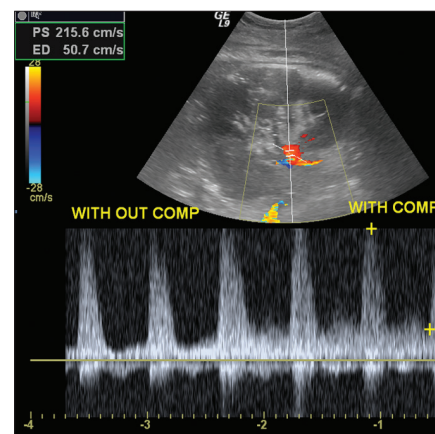


Figure 2. After manual compression of the fistula, duplex US demonstrates a low resistance waveform (RI, 0.65) with improved diastolic flow.

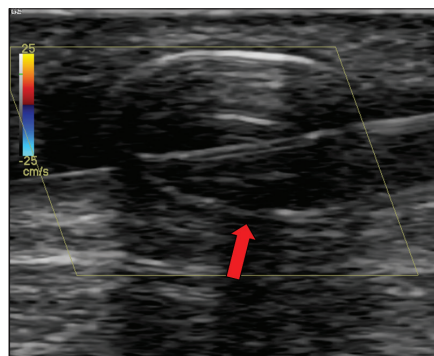


Figure 3. A 6F Fogarty arterial embolectomy catheter (red arrow) was advanced within 5 cm of the arterial anastomosis under real-time US guidance.

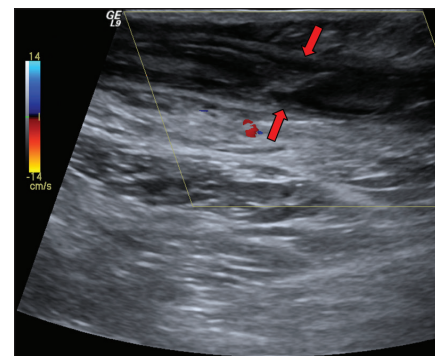
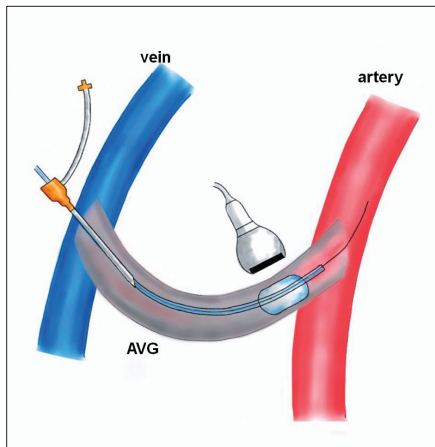


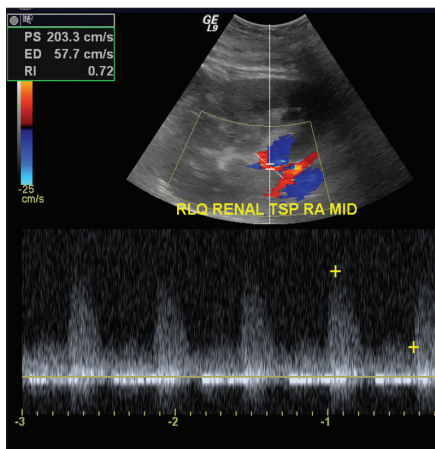
Figure 4. US image demonstrates the thrombosed arteriovenous graft (between two red arrows).

right iliac fossa highlights the hemodynamic impact of an ipsilateral thigh AVG. Long-term persistence of ipsilateral AVG in post-transplant kidneys increases the chance of developing renal dysfunction, likely attributed to a combination of an arterial inflow problem due to flow diversion (vascular steal) and a venous outflow issue due to venous hypertension (increased AVG venous return). In patients who have ipsilateral femoral AVG, flow dynamics across the iliac vessels is thought to be greatly altered by the fistulous connection. The arterial

flow is diverted preferentially through the low-resistance AVG rather than through the renal artery anastomosis, creating a shunt phenomenon (2–5). DUS shows a high resistance renal arterial waveform with diminished or even reversed diastolic flow, as in our case. Manual compression of the AVG during DUS resulted in increased velocity of flow in the intrarenal arteries, confirming the diagnosis of a steal. This can also be a predictor of response after AVG occlusion. Thus, DUS is a powerful diagnostic and prognostic tool (6).



**Figure 5.** Illustration of the technique in arteriovenous graft thrombosis using a balloon. The access was obtained closer to the venous end. The balloon was inflated under duplex US guidance near the arterial end of the arteriovenous graft. The arterial end of the anastomosis shows blood flow (indicated in red in the lumen), while the rest of the graft at the venous end is thrombosed (indicated by the grey area occupying the lumen).



**Figure 6.** Post-procedure Doppler US after one week showed decreased resistive indices in the renal artery (RI, 0.72).

Techniques for correcting steal include AVG ligation, banding, or restrictive procedures (7). However, lack of simple reversibility of ligation can result in sacrifice of the

access, if RT graft viability becomes threatened and dialysis access is needed. This is especially applicable in our patient who had exhausted all other venous access options. To balance the requirement for occluding flow in the AVG with the potential need of “reversibility” for hemodialysis access in the near future, we considered two endovascular treatment options, endovascular-assisted AVG banding and AVG thrombosis with balloon occlusion. As near total occlusion of the AVG graft was necessary to improve renal arterial flow on DUS, we elected balloon occlusion and thrombosis of the AVG, rather than banding. Recanalization, in the event that RT graft function did not improve would involve the use of various mechanical and thrombolytic approaches that are routinely used to de clot thrombosed dialysis accesses. However, it is of note that recanalization is useful only in the acute setting, as success of thrombolysis/thrombectomy falls beyond a week.

Although we had good technical and clinical success with the procedure, we recognize that a potential complication of the induced clot is migration and fatal pulmonary embolism. However, it is now established knowledge that thrombi in other circulations, like in those released during percutaneous thrombectomy techniques of native hemodialysis access, are associated with a low incidence of pulmonary embolism, in the 0%–1.0% range (8). In our case, use of inferior vena cava filter was also not an option due to lack of venous access in the neck for future retrieval. Although the OptEase filter (Cordis Endovascular) can be retrieved from a femoral vein approach, this filter has been reported to have higher incident of caval thrombosis and loss of graft in our case.

In conclusion, there are just a handful published cases in the literature on management of RT graft dysfunction due to hemodynamic influences of an ipsilateral

femoral AVG. Traditional management has been surgical ligation. However, a surgical procedure may not be an ideal option in these high-risk patients. Also surgery essentially precludes future use of the AVG. For the subset of patients with very limited venous access sites, the current report is the first case of a potentially reversible, less invasive endovascular management option.

#### Conflict of interest disclosure

The authors declared no conflicts of interest.

#### References

1. Van Tricht I, De Wachter D, Tordoir J, Verdonck P. Hemodynamics and complications encountered with arteriovenous fistulas and grafts as vascular access for hemodialysis: a review. *Ann Biomed Eng* 2005; 33:1142–1157. [CrossRef]
2. Osband AJ, Jones NI, Bonomo M, Zaki RF. Femoral arteriovenous grafts can complicate kidney transplantation. *Surgical Rounds* 2008; 31: 27.
3. Kuwertz-Bröking E, Bulla M, Langer K, et al. Steal syndrome after kidney transplantation caused by AV fistula at the thigh. *Child Nephrol Urol* 1988; 9:163–168.
4. Reek C, Tenschert W, Cremaschi L, Nicolas V, Wolf W, Fernandez S. Femoral arteriovenous fistula and transplant malfunction after allogeneic kidney transplantation. A case report. *Urologe A* 1997; 36:81–83. [CrossRef]
5. Gourlay WA, Legiehn G, Manson DC, Landsberg DN. Successful renal transplantation with ipsilateral femoral arteriovenous grafts. *Transplantation* 1999; 67:493–495. [CrossRef]
6. Malik J, Tuka V, Kasalova Z, et al. Understanding the dialysis access steal syndrome. A review of the etiologies, diagnosis, prevention and treatment strategies. *J Vasc Access* 2008; 9:155–166.
7. Padberg FT, Calligaro KD, Sidawy AN. Complications of arteriovenous hemodialysis access: recognition and management. *J Vasc Surgery* 2008; 48:S55–S80. [CrossRef]
8. Weng FL, Berns JS. Complications of percutaneous treatment of thrombosed hemodialysis access grafts. *Semin Dial* 2003; 16:257–262.