Embolization of iatrogenic Renal Arteriovenous fistula

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Specimen is bivalved to reveal aneurysm, 5 by 5 by 4.5 cm, that appeared to communicate with renal artery.
Renal Arteriovenous Fistula (AVF) is an abnormal channel between intrarenal artery and vein.

- Congenital (1/3rd)
  - Cirrhotic (more common)
  - Cavernous
- Acquired (2/3rd)
  - Percutaneous Renal Biopsy
  - Trauma
  - Idiopathic (<3%)
  - RCC
Our Patient KK:  
**History and Physical Examination**

**PMH**
- 20 years-old female with MPGN since the age of 9 yrs.
- Kidney Biopsy to rule out rejection lead to a AV fistula.
- Persistent deterioration in renal function post Nov 2007 requiring dialysis and plasmapheresis (suspected recurrence of MPGN in transplanted kidney)

**Social History**
Student at Umass Boston majoring in health sciences.

**Family History**
No history of kidney disease

**PE**
BP: 155/103
NAD

**LABS**
- Hb. 8gm%
- BUN/Cr 48/4.5
- LDH 344
- Ca/P/Mg 8.3/4.9/1.4
Current Status of our patient KK

So, in summary:

- Kidney transplant from her father on 8/2005.
- Hypertension
- Renal osteodystrophy
- Anemia
- Transplant kidney AV fistula post renal biopsy
- Persistently deteriorating renal function
Medications: Our patient KK

1. Calcitriol
2. Folic Acid
3. Ferrous Sulfate
4. Calcium Carbonate
5. Losartan
6. Prednisone
7. Clonidine
8. Acetaminophen
9. Furosemide
10. Sodium Bicarbonate
11. Nifedipine
12. Metoprolol Tartrate
13. Mycophenolate Mofetil
14. Tacrolimus
15. Isradipine
16. Hydralazine
17. Epoetin Alfa
Imaging Modalities for diagnosis of AVF

- Doppler US
- Intravenous pyelography
- CT scan
- Magnetic resonance angiography
Doppler Ultrasonography (US)

Features:
- Turbulent flow in a small cystic mass.

Advantages:
- High sensitivity
- Cystic vs. solid mass
- Non invasive

Disadvantages:
- Less accurate for lesions of collecting system
- Indirect information on renal function
Our patient KK: Doppler US pre embolization

Overlapping arterial and venous waveforms
Our patient KK: Doppler US pre embolization

Abnormal renal artery and veins
Turbulent flow
Our patient KK: Doppler US pre embolization

Overlapping arterial and venous waveforms
In the procedure intravenous pyelogram (IVP), the patient is injected with radiopaque dye and X-rays are taken as the dye travels through the urinary tract.

Normal Intravenous pyelogram showing renal pelvis, ureters and the bladder.
AVF on IVU

Features:
- Mass lesion
- Wedge shaped defect (due to hypoperfusion distal to the AVM)
- Filling defect of the collecting system

Advantages:
- Anatomical details of the collecting system
- Functional information about perfusion, function, obstruction.

Disadvantages:
- Cost
- Radiation
- Contrast exposure
- Insensitivity for small lesions

The IVP is now becoming more and more obsolete. It has largely been replaced by CT, which gives greater detail of anatomy and function.
Companion Patient 1: AVF on CT Scan

**Features:**
- Early filling of the renal vein and IVC

**Advantages:**
- Detailed functional and anatomical information

CT section in arterial phase showing early enhancement of the suprarenal IVC almost to the same degree as that of the abdominal aorta suggesting presence of an arteriovenous fistula.

www.ispub.com
Magnetic Resonance Angiography (MRA)

- **Advantages:**
  - Non Invasive
  - Faster recovery
  - Cheaper than traditional angiography
  - No contrast – useful to patients allergic to contrast

- **Disadvantages:**
  - Cannot be used in the presence of metallic implants
  - Quality does not yet match the conventional angiography especially for small vessels.

www.hmhd.org/mra.htm

www.xraydocs.com
Treatment Options

- **Nephrectomy**
  - Partial (for small polar lesions)
  - Total (Cirsoid AVM)
  - Radical (RCC)

- **Embolization**
Treatment Options (cont)

- Nephrectomy

Post renal transplant patient

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Compromised renal function

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Renal parenchyma is precious

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Nephrectomy needs to be avoided

Best treatment option is

EMBOLIZATION
EMBOLIZATION

Therapeutic introduction of various substances into the circulation to occlude vessels.

**Goals:**
- Arrest or prevent hemorrhage
- Devitalize a tumor, structure or organ
- Reduce the blood flow to AVM/AVF

**Embolization Materials:**
- Coils
- Gelfoam
- Polyvinyl alcohol
- Sodium Tetradecyl Sulfate
- Tris Acryln micro spheres
- Cyanoacrylate
- Ethanol
- Others

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EMBOLIZATION COILS

Thrombus induced occlusion of the vessel, not mechanical.

Disadvantages:

- Persistent flow in the vascular territory of the vessel due to collateralization
- Repeat intervention via the same artery is not possible

www.radiologyinfo.org
1. A small incision is made in the groin through which a tiny catheter is guided through an artery. (Seldinger Technique)

2. The catheter is carefully guided into the aneurysm/fistula.
3. Coils are deposited through the micro catheter into the aneurysm/arterial side of the AVF.
4. The coils conform to the often irregular shape of an aneurysm/AVF.
5. Coils will prevent blood flow into the aneurysm/AVF.
Gelfoam

Temporary intravascular embolic material, vessel recannalises in few weeks.

Torpedoes or Slurry

Used as Slurry or Torpedoes

www.embolution.com
Other Embolization Materials

**Ethanol:**
Toxic to the endothelium activating the coagulation system.

**Sodium tetradecyl sulfate:**
Sclerosing agent-less toxic than absolute alcohol.

**Cynoacrylate:**
Hardens immediately on contact with blood or other ionic fluids.

**Polyvinyl alcohol:**
Causes thrombosis secondary to endothelial damage

**Microspheres:**
Non reabsorbable precisely calibrated 40-1200mm particles, which cause permanent occlusion.
Embolization in Patient KK

- An arteriogram demonstrated the presence of the transplant kidney in the right pelvis with arterial anastomosis with the mid right external iliac artery.

- A big aneurysm with early opacification of the draining vein could be seen indicating an AV Malformation.
Angiography in our patient KK: Catheterization and injection of contrast in internal iliac artery
Angiography in our patient KK: Catheterization and injection of contrast in external iliac artery EARLY ARTERIAL PHASE

Catheter in External Iliac Artery

Early visualization of Renal Artery
Angiography in our patient KK: Late Arterial phase

- Aneurysmal dilation of vein
- Intrarenal arteries
- Catheter in External iliac artery
Embolization in our patient KK: Selective catheterization of the renal artery

Micro catheter at the arterial end of AVF
Embolization in our patient KK: Eight coils deployed

Coils deployed in the AVF

Patient KK
PACS, BIDMC
Our patient KK: Persistent leak post coil embolization

Leak into the vein
Embolization of our patient KK: Gelfoam torpedoes injected

Gelfoam injected
Post embolization In our patient KK: Injection of contrast, Very early arterial phase

Embolization Coils
Intrarenal arteries
Our patient KK post embolisation-Early arterial phase

Renal arterial branches

Patient KK
PACS, BIDMC
Post embolization in our patient KK: Late arterial phase

Enhanced renal parenchyma with a small area of infarct
Our patient KK: Doppler US post embolization

Patent renal artery and vein

Appropriate arterial waveform
Our patient KK: Doppler US post embolization

Appropriate venous waveform
Complications of Embolization

- Catheter related risk of bleeding, infection and arterial damage.
- Embolus can lodge in the wrong place and deprive normal tissue of its oxygen supply.
- Risk of allergy to contrast.
- Displacement of the coils into the systemic circulation causing infarcts at different sites.
Conclusion

- Embolization is one of the most effective treatment modalities to occlude an aneurysm or fistula.

- Combination of different materials e.g. gelfoam and coils can be used when either of them fail alone.
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