TRANSCATHETER RENAL ARTERY INTERVENTIONS: A REVIEW OF VARIOUS ESTABLISHED PROCEDURES AND CLINICAL OUTCOMES

Yunsup Hwang, MD, Yooodong Won, MD, Jung Myung Kim, MD, Su Lim Lee, MD, Young Mi Ku, MD
Department of Radiology, Uijeongbu St. Mary's Hospital, The Catholic University of Korea

Purpose
Transcatheter interventions play an important role in the treatment of renal pathology.

Material and method
The institutional review board approved this retrospective study and waived informed consent.

We reviewed 36 patients (23 male, 13 female; mean age, 51 years) who had transcatheter renal interventional techniques, such as angioplasty, stenting, and embolization for renovascular disease and embolization for renal neoplasms in two different hospitals from December 1988 to March 2015.

Results
Renal artery stenosis (n=16), renal artery aneurysm/pseudoaneurysm (n=4), renal arteriovenous fistula and malformation (n=4), renal tumors including angiomyolipoma (n=4) and renal cell carcinoma (n=3), and traumatic renal injury (n=6) were treated by angioplasty (n=4), embolization (n=22), stenting (n=3), and tumor embolization (n=7).

There was no technical failure and no major complication such as life-threatening hemorrhage, end-organ infarction, need for salvage surgical intervention or death.

Renal artery stenosis
- Treatment options
  - Angioplasty with or without stent placement (drug-eluting or otherwise)
  - Renal artery stents are the preferred treatment for ostial stenosis in arteries with a reference diameter ≥8 mm
  - Stents are typically deployed to the extent of 1-2 mm into the aortic lumen in order to completely eliminate ostial lesions
  - Relatively contraindicated if they traverse renal artery branch
  - No established role in the primary treatment of FMD

Renal artery aneurysm & pseudoaneurysm
- Goal of treatment
  - Exclude the aneurysm sac from the circulation while preserving sufficient blood flow to the affected kidney
- Indications for intervention
  - Size greater than 1.5 cm, renovascular hypertension, dissection, localized symptoms, distal embolization, and female patients in child bearing age
- Treatment options
  - Occlusion of inflow and outflow arteries, direct occlusion of the aneurysm sac itself (for lesions with a narrow neck), and exclusion of the aneurysm with a stent graft
  - Coils are the most commonly employed embolic agent
  - In contrast to visceral vessel embolization which requires inflow and outflow vessel occlusion during coil deployment, collateral reconstitution of (pseudo) aneurysms
- Inflow vessel occlusion is sufficient for renal arteries, which are terminal vessels

Renal arteriovenous fistula and malformation
- Historically, large, symptomatic renal AVFs were treated with total or partial nephrectomy
- Endovascular treatment is now preferred in most patients
- Embolization with coils, stent grafts, detachable balloons, liquid occlusive agents, and silk suture
  - Vascular plug devices may also be used
  - Large vessel occlusion, precision in deployment, positional stability, and ability to reconnect
  - The therapeutic approach to renal AVMs may parallel that for renal AVFs
  - Particularly in cases showing a single inflow vessel (cavernous AVM)
  - The presence of multiple arterial feeders (island AVM)
  - Increase the incidence of clinical recurrence
  - Liquid agents such as ethanol or glue, and multiple sequential treatment sessions may be required

Angiomyolipoma
- Selective renal artery embolization
  - Increasingly popular treatment option for patients with AMLs larger than 4 cm
  - Effectiveness in both preventing hemorrhage and controlling symptoms
  - Ethanol or without ethiodized oil, coils with or without gelatin sponge, tris-acryl gelatin microspheres, and/or polyvinyl alcohol particles
  - Balloon occlusion of the renal artery to avoid non-target distribution of the liquid agent
  - Simultaneous balloon occlusion of the renal vein may prevent systemic washout of the injected ethanol
  - If renal venous balloon occlusion technique is utilized, renal arterial occlusion should always be performed in conjunction
  - Injection of alcohol without inflow control can significantly increase hemorrhagic complications

Figure 1. 65-year-old man with hypertension and renal artery stenosis
(a) Abdominal aortogram shows stenosis of right proximal renal arteries (arrow)
(b) After right renal angiogram following embolization of feeding artery shows no filling of pseudoaneurysm

Figure 2. 41-year-old asymptomatic woman with incidental discovery of renal pseudoanerysm
(a) Contrast-enhanced axial CT image demonstrates 3.2 cm left middle portion renal AML.
(b) Left renal arteriogram displays faint renal mass with supplying arteries (arrow)
(c) Post embolization right renal arteriogram shows no significant residual flow to embolized renal AMLs

Figure 3. 82-year-old woman suffered flank trauma resulting in renal artery pseudoaneurysm
(a) Contrast-enhanced axial CT image reveals focal round high attenuation pseudoaneurysm (arrow)
(b) Main left renal arteriogram and (c) selective left renal arteriogram demonstrate traumatic renal artery pseudoaneurysm (arrow)
(c) Completion of angiogram following embolization of feeding artery shows no filling of pseudoaneurysm

Figure 4. 45-year-old asymptomatic woman with incidental discovery of renal pseudoanerysm
(a) Contrast-enhanced axial CT image demonstrates 3.2 cm left middle portion renal AML.
(b) Left renal arteriogram displays faint renal mass with supplying arteries (arrow)
(c) Post embolization right renal arteriogram shows no significant residual flow to embolized renal AMLs

Figure 5. 58-year-old woman with left flank pain
(a) Abdominal-pelvic CT shows about 7 cm large angiomyolipoma (arrow) with diffuse hemorhage
(b) Renal arteriogram shows tumor feeding vessel (arrow)
(c) After embolization of feeding artery with PVA particle, tumor feeding artery is completely occluded

Renal cell carcinoma
- Nephrectomy remains an essential component
- Embolization of renal neoplasms is controversial
  - The two main indications include controlling operative blood loss during nephrectomy and for palliation in the setting of unresectable tumors
  - Ethanol, coils, gelatin sponge, tris-acryl gelatin microspheres, polyvinyl alcohol particles, and various combinations of those embolic agents
  - A recent report described radioembolization with yttrium-90
  - Recent report described radioembolization with yttrium-90 glass microspheres for palliation treatment of RCC in an 81-year-old woman with a 14.7 × 11.5 cm left renal mass, in which the mass remained stable in size and the patient reported decreased pain and hematuria during the first year following treatment

Renal arteriovenous fistula and malformation
(a) Abdominal-pelvic CT shows about 3 cm large RCC in right kidney
(b) Renal arteriogram shows numerous tumor vessel supply
(c) After embolization of feeding artery with PVA particles, most of tumor feeding artery is occluded

Conclusion
Transcatheter interventions play an important role in the treatment of renal pathology, and to know about the interventional techniques will help to manage the wide variety of kidney diseases