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Renal Transcatheter Arterial Embolization for ADPKD

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INTRODUCTION

Autosomal dominant polycystic kidney disease (ADPKD) is a genetic disorder in which numerous cysts develop in the kidneys. It not only causes a partial or complete loss of kidney function but also substantially decreases quality of life because of chronic low back pain, abdominal fullness, loss of appetite, heartburn, or constipation. Herein, we revisit the effectiveness of renal transcatheter arterial embolization (TAE), which alleviates the symptoms associated with enlarged kidneys.

CASE PRESENTATION

A 60-year-old man with end-stage renal disease secondary to ADPKD presented with worsening abdominal distension. He had been on maintenance hemodialysis for 10 years, coping with abdominal fullness for years, and was now finding difficulty in ambulation and in eating a normal portion of food because of the distended abdomen. Spherical surfaces of the cysts in bilateral kidneys were palpable in the upper abdomen. Computed tomography angiography (maximum intensity projection) showed enlarged kidneys with numerous cysts (Figure 1), elevated diaphragm, and limited abdominal cavity, where the small intestine was pushed into the lower pelvic area. Enlarged kidneys were likely to be the cause of abdominal distension, and hence renal TAE was performed to reduce kidney volume. The right and left renal arteries were embolized with 28 and 20 platinum coils, respectively (Figure 2).

Three-dimensional volume rendering of the computed tomography images by an image analysis software (Synapse Vincent; Fujifilm Corporation, Minato, Tokyo, Japan) revealed a decrease in total kidney volume from 9.8 L to 7.4 L in 3 months and to 6.9 L in 5 months. The patient is delighted with decreased abdominal fullness, easier ambulation, and improved appetite. Informed, voluntary, and written consent has been obtained from the patient for publication of this article.

The procedure of renal TAE is as follows. The patient enters the angiography room after an epidural catheter is placed in the operation room for intra- and postoperative epidural analgesia with ropivacaine. Epidural analgesia may be substituted by i.v. fentanyl administration when epidural catheter placement is contraindicated. Hydroxyzine is administered for mild sedation, atropine for vasovagal response prevention, cefotiam for antibiotic prophylaxis, lansoprazole for stress ulcer prophylaxis, and carbazochrome and tranexamic acid to prevent bleeding, as long as each medicine is not contraindicated in the patient. After the groin area has its hair removed and is disinfected with iodine, the right femoral artery is punctured below the inguinal ligament following local anesthesia with mepivacaine. A guidewire is inserted and guided toward the abdominal aorta, and a 5-French sheath (Supersheath; Medikit Co. Ltd., Bunkyo, Tokyo, Japan) is placed. The anatomy and distribution of the abdominal arteries are confirmed by injecting contrast agent to the abdominal aorta with a 5-French pigtail catheter (Impress Pigtail Flush Catheter; Merit Medical, South Jordan, UT) and to the renal arteries with a 5-French hook catheter (CX Catheter; Gadelius Medical K.K., Minato, Tokyo, Japan). While leaving the hook catheter placed at either one of the renal arteries, a 2.2-French microcatheter (Sirabe; Piolax Medical Devices, Inc., Yokohama, Kanagawa, Japan) and its 1.1-French guidewire (Labyrinth Noah; Piolax Medical Devices, Inc.) are inserted to the branches of the renal arteries,

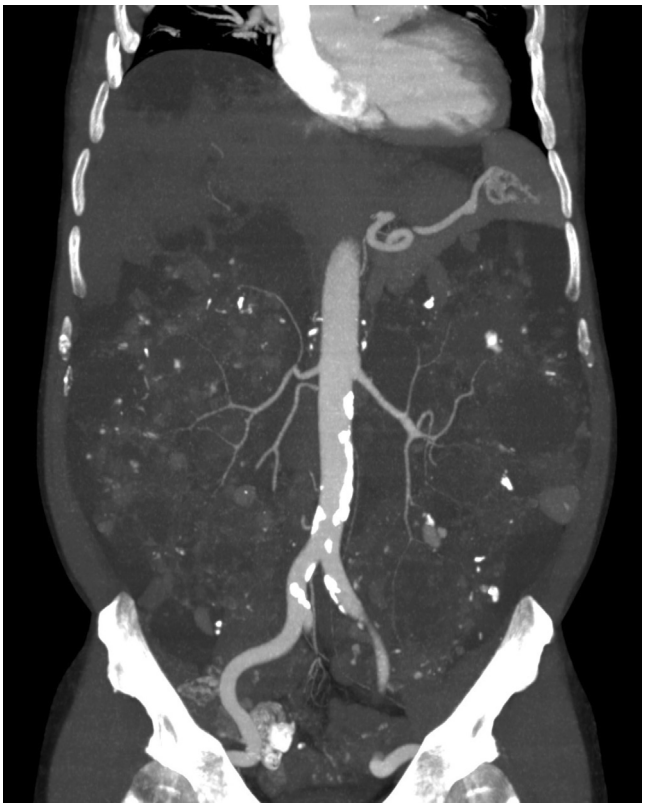

Figure 1. Computed tomography angiography (maximum intensity projection) before renal transcatheter arterial embolization shows enlarged kidneys with numerous cysts. Contrast medium reveals the anatomy of the aorta and renal arteries, which needs to be checked before arterial intervention.

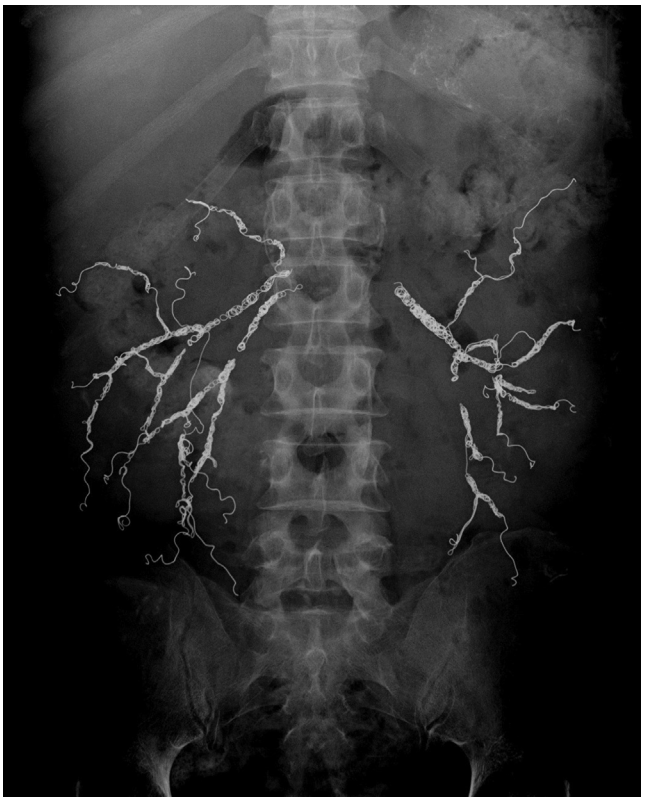

Figure 2. Abdominal X-ray image after renal transcatheter arterial embolization shows platinum coils used for embolization tracing the original distribution of renal arteries.

which are embolized with 1.2-French platinum coils (C-Stopper 0.016″ Anchor Coil; Piolax Medical Devices, Inc.) sent through the microcatheter with a saline flush and a 1.3-French pusher (Trupush; Codman & Shurtleff, Inc., Raynham, MA). (Note that 1 French is equal to one-third of a millimeter, and 1 inch is equal to 25.4 millimeters.) Epidural ropivacaine infusion is started right before starting the embolization for pain relief, and pentazocine is administered i.v. *pro re nata* during and after the TAE. Renal capsular arteries are also embolized when possible. When the renal arteries are embolized sufficiently, contrast medium infused to the renal arteries is blocked and flows out from the renal arteries to the aorta. The sheath is removed, and the puncture site of the femoral artery is compressed for at least 15 minutes, followed by an overnight compression with a rolled cotton and a band. Fever, inflammation, and abdominal pain have their peak in the first 3 days after the procedure and are gradually relieved in the next few days, after which epidural catheter is removed. Antibiotic prophylaxis is continued for 1 week. A mild fever below 38°C is frequently observed during the next month, whereas a fever above 38 °C may indicate an infection of the cysts or other organs. Most patients have no urine output after the procedure but may observe a slight amount of very dark macroscopic hematuria during the following half-year period. Magnetic resonance imaging can be performed in patients with platinum coils, as platinum is nonferromagnetic and barely causes an artifact.

DISCUSSION

Our team first proposed renal TAE as a treatment to reduce kidney volume in ADPKD patients in 1999.[1] Analyses of ADPKD patients who underwent renal TAE in our institution revealed a 46% to 54% decrease in kidney volume on average in 12 months, although its reduction rate varied among patients.[2-4] Previous research showed that renal TAE improved the patients' quality of life by demonstrating better rating scores for abdominal fullness, appetite, and heartburn after the intervention.[5] Physical, mental, and social well-being were evaluated by the 36-item Short Form Health Survey, which also showed improved scores after renal TAE.[5] Its benefits are not confined to the improvement of gastrointestinal symptoms: our team observed increased total lung capacity and 1-second forced expiratory volume/forced vital capacity ratio on average in correlation with reduction in renal volume after renal TAE.[3] Petitpierre *et al*. reported that 68 of 76 ADPKD patients contraindicated for kidney

Table 1. Studies on the outcome and complications of renal transcatheter arterial embolization (TAE)

Author, reference	No. of patients	Single kidney volume pre-TAE (mean ± SD)	Mean % reduction in kidney volume post-TAE		Common complications
			+ 6 mo	+ 12 mo	
Indication for TAE: abdominal symptoms due to enlarged kidneys					
Ubara *et al.*[2]	64	2068 ± 1972	38.3	46.6	Fever, flank pain
Yamakoshi *et al.*[3]	28	3165 ± N/A	N/A	54.4	Fever, flank pain
Sakuhara *et al.*[9]	15	3380 ± N/A	52.7	61.2	Fever, low back pain
Suwabe *et al.*[4]	449	2529 ± 1017	38.2	45.5	Fever, flank pain[a]
Indication for TAE: insufficient abdominal space for transplantation					
Cornelis *et al.*[10]	25	2,314 ± 1,898	54	N/A	Fever, flank pain
Petitpierre *et al.*[6]	76	2,141 ± 1,439	N/A[b]	N/A	Fever, flank pain[c]

N/A, not available.
[a]Rare complications are as follows: death (n = 3, due to arrhythmia/heart failure, tumor lysis syndrome, and intestinal perforation); femoral artery pseudoaneurysm (n = 3); intestinal perforation (n = 2, one patient died and is counted in the above 3 deaths); and severe renal cyst infection followed by nephrectomy (n = 1). Some patients who used nonsteroidal anti-inflammatory drugs as analgesics experienced severe gastrointestinal bleeding.
[b]Mean percent reduction in kidney volume three months after TAE was 40%.
[c]Rare complications include pulmonary embolism (n = 1), deep vein thrombosis (n = 1), femoral artery pseudoaneurysm (n = 1), and cyst infection (n = 1).

transplantation because of excessive renal volume observed successful decreases in kidney volume and had their contraindications withdrawn in 5.6 months on average after renal TAE.[6]

Another treatment option for enlarged kidneys is bilateral nephrectomy, but its safety and morbidity are controversial. Some groups highlight the benefits of bilateral nephrectomy than its complications because of a lower complication rate (receiving transfusion 4%, intraoperative complication 4%, postoperative complication 29%, Clavien grade ≥3 complication 7%, according to their study) than in the past,[7] whereas other groups put an emphasis on its complications (receiving transfusion 4%, abdominal fluid collection 6%, iatrogenic lesion of the common iliac artery 2%, relaparotomy 2%, hemorrhage requiring radiological drainage 4%, incisional hernia 9%, death 4%, according to their study) and suggest performing bilateral nephrectomy only when it is clearly indicated.[8] In contrast, all major studies on renal TAE found it to be a safe procedure with a low complication rate.[2–4,6,9,10] Although postembolization fever and flank pain are observed in nearly all patients in the first several days after renal TAE, rare complications including death, femoral artery pseudoaneurysm, intestinal perforation, pulmonary embolism, deep vein thrombosis, and cyst infection are reported in less than 2% to 6% of cases overall (Table 1).[2–4,6,9,10]

Table 2. Teaching points

Renal transcatheter arterial embolization reduces kidney volume by 46% to 54% on average in 12 months in patients with enlarged kidneys due to autosomal dominant polycystic kidney disease.
Renal transcatheter arterial embolization improves quality of life by decreasing abdominal fullness, increasing appetite, and relieving heartburn.

The teaching points of this article are summarized in Table 2. Although the prevalence of ADPKD is estimated to be as high as 3.9 to 4.8 per 10,000,[11–13] renal TAE is not universally accessible worldwide. As renal TAE marks its 20th anniversary as a treatment to reduce kidney volume in patients with ADPKD, the authors hope that this article will provide an opportunity to consider renal TAE as a treatment option for patients who may benefit from this procedure.

DISCLOSURE

All the authors declared no competing interests.

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