



# New modalities in the detection of renal transplant complications

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### ABSTRACT

Renal transplantation was considered as an efficient and ideal method for end stage renal disease treatment of the patients, by accomplishment of the first successful transplantation in 1954 (Boston USA). Renal transplantation has transmuted the treatment of choice in end stage renal disease, along with prolonging survival; it offers high quality with low morbidity. Imaging modalities play an important role in the diagnosis of complications arising in renal transplant. Color Doppler ultrasound is the first-line imaging modality for evaluation of renal graft. Computed tomography scan in parallel with magnetic resonance imaging and digital subtraction angiography are used as problem-solving tools in indetermination of cases. Interventional radiology such as transluminal angioplasty has an important role in management of complications. Use of real time ultrasound guidance for percutaneous biopsy is almost universal.

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## Introduction

By accomplishment of the first successful renal transplantation in 1954, this method was considered an efficient and ideal technique for end stage renal disease (ESRD) treatment (1-3).

About 18000 operations of renal transplantation in the U.S are done in 2011 (4). While renal transplantation rate increases by 4% every year, the numbers of patients who are in the waiting list of transplant increase by 10% yearly (5).

Although warning about renal transplant has been highly progressed, about 3% to 5% of allografts are going to be destroyed every year (6).

There is a significant shortage of organs to be used for renal transplantation. Transplant survival rate can be increased by accurate recognition, access to the new methods of imaging, selection the suitable patient for transplantation, and properly managing the treatment by accurate diagnosis of complications.

Because the clinical presentations of complica-

tions are very different in each individual, the imaging studies for observing the allografts status are highly needed and strongly recommended.

Due to delayed diagnosis of complications transplantation would be at risks and danger, so that the graft may be rejected and reimplantation will be necessary.

### Ultrasound

Typically, transplanted kidney will be located in false pelvis (in right iliac fossa), quite superficial, hence will be readily accessible with ultrasound (US). Advantages of ultrasound include lack of ionizing radiation, portability, less expensive, and lack of potentially nephrotoxic iodinated contrast agents. The operator dependence of US is, however, a relative limitation (7).

US is used as a routine technique to evaluate the transplanted organ within the first 24 hours after transplantation in order to detect or rule out

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vascular complications (8). In the perioperative period, US can detect renal artery thrombosis or renal vein thrombosis. Doppler indices are suggested for evaluation of renal graft. Many studies previously suggested that resistive index (RI) measured by duplex Doppler US is not sensitive or specific in identifying the cause of functional transplant dysfunction (9-10). Doppler US is also a very reliable and noninvasive tool to monitor the effectiveness of revascularization in patients with renal artery stenosis (RAS) (11-12). Table 1 shows common complications in patients under-

**Table 1.** Common post-transplantations complications

Complication	US finding
<b>Renal vein thrombosis</b>	Reversed EDV* flow, absent of flow in main renal vein surgical
<b>Arteriovenous fistula</b>	Focal high velocities, venous pulsatile flow
<b>Pseudoaneurysm</b>	Vascular pool with turbulent flow
<b>Acute rejection</b>	Increased RI**
<b>Acute tubular necrosis</b>	Increased RI
<b>Perinephric collection</b>	Perinephric fluid, simple (urinoma, lymphocele), complex (hematoma)
<b>Renal artery stenosis</b>	peak systolic velocity >250 cm/seconds
<b>Chronic rejection</b>	Echogenic graft, cortical thinning
<b>Tumor</b>	Solid lesion, complex cyst
<b>Ureteric stricture</b>	Hydronephrosis
<b>Calculi</b>	Echogenic lesion with posterior acoustic shadow
<b>Cyst</b>	Well defined, avascular, anechoic lesion

\*EDV: End-Diastolic Velocity; \*\*RI:Resistive Index

went renal transplantation.

Some benefits of US in evaluation of renal transplant complications:

- Reproducible
- Feasibility
- Low expenses
- Lack of nephrotoxic iodinated contrast agent

### **Computed tomography (CT)**

CT scan is typically not used to evaluate renal transplant dysfunction due to concerns of harmful effects of iodinated contrast agents. This modality will be only used before the percutaneous catheter angiography is performed (13).

Computed Tomography Angiography (CTA) allows for anatomic depiction in great detail and has a high diagnostic accuracy for detecting vascular complications (14).

Advantage and limitations of CT in renal transplant complications:

-CT scan can detect gas, provide best imaging of vascular bed, particularly detect kinking or stenosis in the site of anastomosis.

-CT scan has harmful contrast agents which are potential risks for allograft.

### **Magnetic resonance imaging (MRI)**

MRI is being increasingly used for renal arterial visualization in renal transplants to assess renal artery stenosis (15). Magnetic resonance angiography (MRA) has been used for post-transplantation patients (16).

MRI, however, has a few pitfalls that may lead to false diagnosis or overestimation of a stenosis. These include artifacts caused by metallic surgical clips near the transplant artery that result in signal drop overlying the vessel, giving the false impression of stenosis, and bright signal at the margin of the signal drop in the soft tissue next to the renal allograft due to metallic clips. And venous overlaps due to inaccurate timing of the arterial bolus. Careful evaluation of the source images and multiplanar reformats may solve these problems (17).

Newer techniques like nonenhanced MRA with steady-state free precession imaging can help to avoid contrast and the risk of NSF in these patients (17).

Blood oxygen level dependent (BOLD) imaging depends on contrast generated by changing levels of paramagnetic deoxyhemoglobin with a decrease in intrarenal T2 during hypoxia taken as a reflection of increasing concentrations of deoxyhemoglobin. BOLD imaging can noninvasively detect change in intrarenal oxygenation and renal hypoxia induced by RAS (18).

## Nuclear medicine

Radionuclide tests are valuable in renal transplantation since they provide a noninvasive mean to evaluate transplant function qualitatively and help to screen for surgical complications. Only scintigraphic studies are able to separate function of the graft from residual function of the native kidneys.

There is a wide variety of techniques advocated in renal transplant. The most commonly used procedures are scintigraphy with combined imaging. Renal scintigraphy can assess complications such as acute rejection, vasomotor nephropathy, vascular problems and leaks. It is recommended that a baseline scan should be obtained within day one or two of transplant so as to detect subtle abnormalities in the follow-up period (19-20).

## Angiography

With the availability of MRI, percutaneous angiography is rarely performed for the diagnosis of renal artery stenosis. However, percutaneous transluminal angioplasty (PTA) and stenting (PTAS) are the treatment of choice in renal artery stenosis, with a reported success rate of 65% to 100% (21-23).

## Conclusion

Renal transplant dysfunction is a devastating event and appropriate management of complications which is necessary to avoid graft failure. US with Doppler is the primary imaging modality for evaluating renal transplant. Radionuclide tests using Tc-99m MAG3 or Tc-99m diethylene-triamine-penta-acetic acid (DTPA) can evaluate renal transplant and help in screening for surgical complications. MRI and CT can also be used for evaluating renal transplants; however, concerns about iodinated contrast media and gadolinium toxicity need to be considered in a population at risk of renal dysfunction.

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## Conflict of Interest

The authors declare no conflict of interest.

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