

The Role of CEUS in the Assessment of Renal Graft – Immediate and Long-Term Transplant Follow-Up

Thomas Fischer

Ultrasound Research Laboratory, Department of Radiology

Charité – University Medicine Berlin, Central Campus
Berlin, Germany

Kidney transplant is the method of choice for treating terminal renal failure. The timely transplant of a suitable donor kidney is the only way to ensure optimal medical management and social participation of affected patients. A kidney graft is susceptible to numerous postoperative complications and deleterious effects and therefore requires close postoperative follow-up. Ultrasound (US) is the most widely employed non-invasive modality for the postoperative assessment of kidney grafts. Contrast-enhanced ultrasound (CEUS) is a promising and straightforward method that is superior to established sonographic techniques such as conventional B-mode scanning (volume measurement, demonstration of hematoma) and color Doppler (rejection, perfusion defects, vascularization) in the diagnostic evaluation of kidney grafts. Moreover, CEUS potentially allows tumor

characterization in transplant and shrunken kidneys. A single contrast-enhanced ultrasound examination can answer a variety of questions in the early postoperative phase (rejection) and long-term follow-up (chronic damage). Initial studies indicate that efficient and early diagnosis of rejection or acute tubular necrosis (ATN) is possible as these conditions show characteristic bolus kinetics curves. Surgical complications like perfusion defects secondary to thrombosis of a polar artery or postoperative hematoma are also identified. Moreover, perfusion effects of a hematoma can be assessed. Further technical developments of ultrasound equipment will trigger new applications of CEUS. The rapid technical advances seen in recent years led to the introduction of many new software tools for the analysis of raw data sets or improved visualization of microbubbles at very low

energy, for instance by means of techniques that accumulate and depict the microbubble signals over time such as MicroFlow Imaging by Toshiba. This new technique in turn laid the foundation for the so-called Parametric Imaging (Fig. 5) which relies on bolus or replenishment kinetics and is able to analyze individual curve parameters such as time-to-peak on a pixel by pixel basis. The information is displayed in a color-coded image that presents all US data in a standardized manner. This simple and fast technique offers high diagnostic yield that may improve the acceptance of CEUS as a routine diagnostic tool that provides all diagnostic information on contrast medium dynamics in a single image of the transplant kidney.

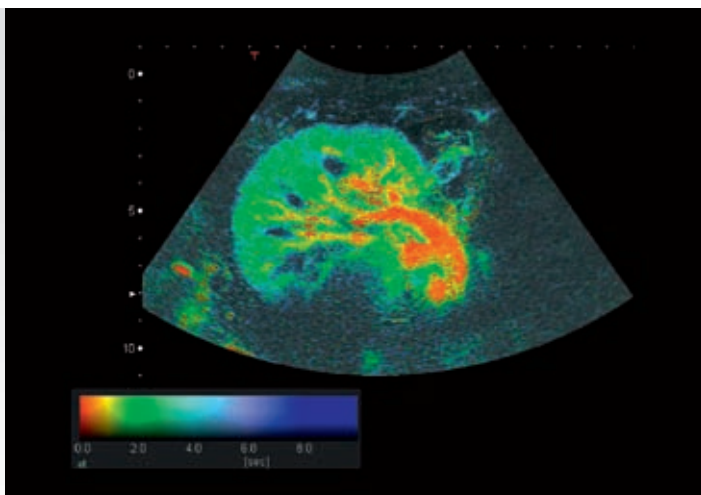


Fig. 1: Temporal course of contrast inflow after bolus administration of 1.6 ml of SonoVue™ via the left cubital vein. Patient with good graft function. Analysis shows that signal intensity in the cortex increases as early as 1 s (green color) after the increase in the main renal artery (red color).

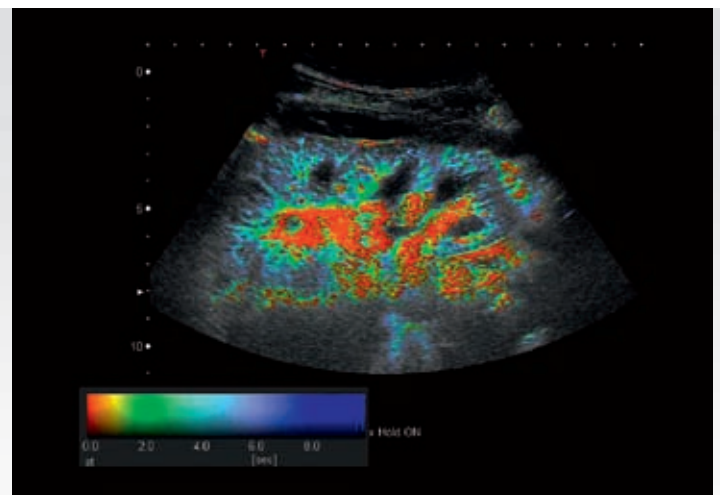


Fig. 2: Delayed inflow in the renal cortex in a patient with histologically proven rejection. Arterial inflow of the contrast medium is shown. Analysis shows that the signal intensity in the cortex increases as late as 4 s after the increase in the main renal artery.

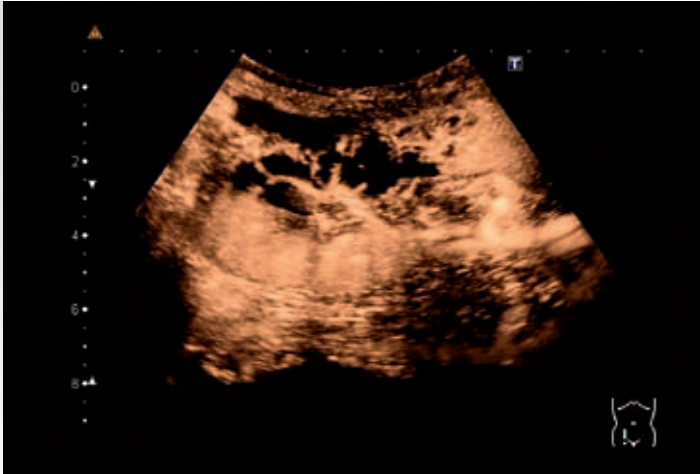


Fig. 3: Following contrast administration, a perfusion defect is well depicted in the polar area covering about 30%.

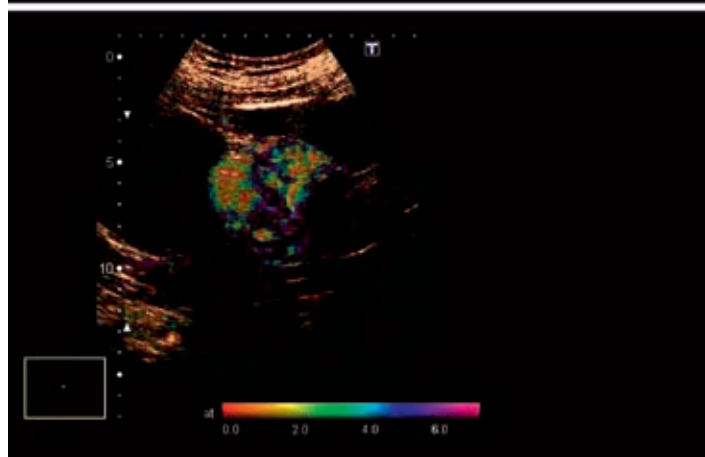
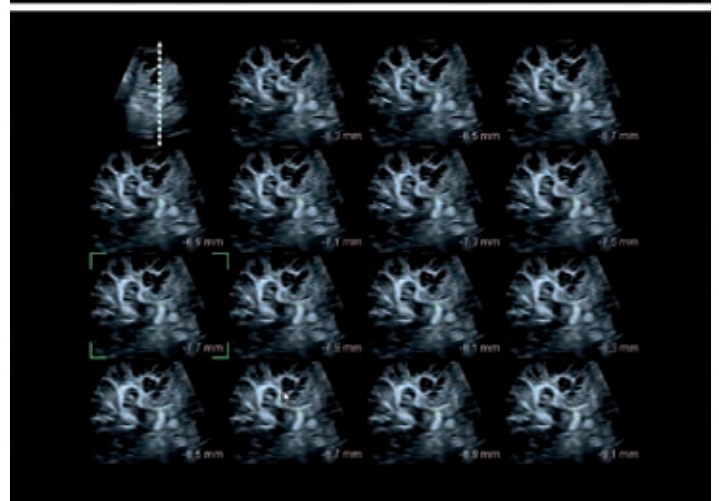
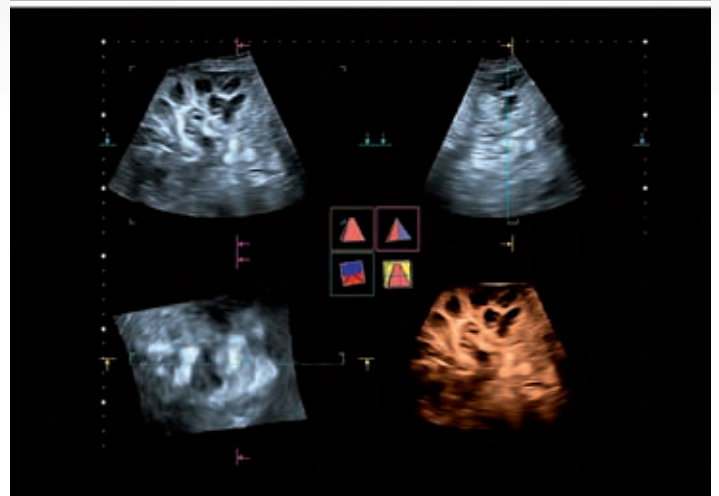
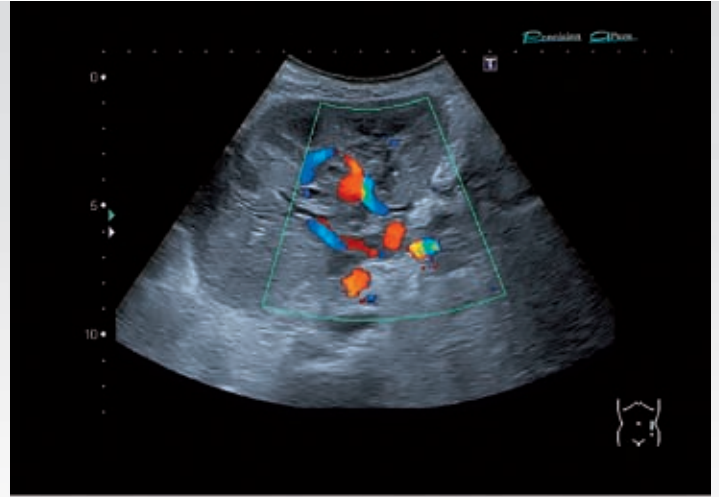


Fig. 5: Lesion with complex echo pattern indicating solid and cystic portions in a patient with renal failure and shrunken kidneys. Only contrast-enhanced US demonstrated tumor vascularization with enhancement of the central tumor portions.

Fig. 4: Kinking of the renal artery is well visible in the 4D evaluation. The anastomosis with turbulent flow can be well observed in the 2D image.

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