Value of Contrast-enhanced Ultrasound in renal and renal-pancreatic transplants

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Learning objectives

To emphasize the interest of Contrasted-enhanced Ultrasound in patients with kidney and pancreas-kidney transplantation

Background

Transplantation is the most effective surgical method for end-stage organ failure (1).

Renal transplant is considered the choice treatment in advanced renal failure and when this failure is due to a type 1 diabetes, renal and pancreatic transplantation is usually simultaneously preformed (1-4)

Doppler Ultrasound is a non-expensive, available and safe technique that has been considered the first diagnostic tool evaluating allograft complications. Changes in the organ morphology, fluid collections, or vascular abnormalities can be easily detected, so that a suitable treatment may be indicated to assess the transplant surveillance (1-7)

Doppler Ultrasound has been well accepted as diagnostic modality in renal transplants (4-8), but pancreas transplants are often difficult to detect. This organ is located intraperitoneally so that bowel gas may create artefacts that obscures the image. Otherwise peripancreatic fat (or tissues surrounding it) sometimes makes it difficult to determine the graft shape and contour (2,3) And if there are fluid collections with similar ecogenicity, they may be missed or underestimated.

In patients with pancreatic failure in which Ultrasound is not able to detect the complications, enhanced CT would be the choice technique for diagnosis (2,3), but intravenous iodinated contrast media may be contraindicated in cases of simultaneous kidney transplant because of its nephrotoxicity.

Findings and procedure details

Since January 2009, 281 Kidney and 52 pancreas transplants have been preformed in our Hospital
We select 17 patients (8 renal and 9 renal-pancreas transplants) that in the course of an organ dysfunction episode, were studied with Contrast-enhanced Ultrasound.

All of them had been evaluated with conventional Doppler Ultrasound before the contrast administration.

The Ultrasound exams were performed with a Philips IU-22 unit, and a convex 5-2 MHz transducer suitable for abdominal exams.

The contrast enhanced agent (SonoVue) was injected intravenously as a bolus (average 2.5 ml/sec) 4.8 ml dose followed by 10 ml of normal saline flush using a 18 G peripheral intravenous cannula. A low mechanical index was used and focus was always placed deeper than the area being examined.

After bolus injection a video clip was recorded for approximately 1 minute, and subsequently sequential static images were also recorded for at least 3 minutes.

The clinical symptoms of the patients included renal failure with elevation of serum creatinine levels and decreased urine output in renal transplants.

Hyperglycemia and fever of uncertain origin were found in pancreas transplanted patients.

Some of the pathological findings were detected incidentally in routine control exams.

The diagnoses were confirmed by 4 surgical transplant extractions and subsequent pathological exams.

One surgical and one percutaneous abscess drainages.

In six cases of nodes of uncertain ethiology, the follow-up studies (ultrasound and CT) demonstrated the benign nature of the lesions.

The complications were described as follows:

VASCULAR THROMBOSIS

Were detected in two renal and two pancreatic transplant.

In all of them there was a suspicion of an important vascular complication in the conventional Doppler scan.
In three cases (two pancreatic and one renal) the contrast exam demonstrated a total lack of signal inside the organ (Fig 1, Fig 2 and Fig 3).

In one case, a transplanted kidney with small Doppler flow just in the mid part of the graft, complete nonvascular zones were detected in the upper and lower poles after the contrast administration (Fig 4).

Two days later the patient needed nephrectomy since the thrombosis became total.

INTRATRANSPALNT NODES OF UNCERTAIN ORIGIN

Were studied in seven cases.

One of them had a clear enhancement in the contrast exam (Fig 5). That suggested a solid renal mass, probably a renal carcinoma.

The result of the Pathological exam was of intracystic papillary renal carcinoma (G2 Furham).

Six complex masses (five renal and one pancreatic) with equivocal behaviour in basal scans corresponded to clear cysts after the contrast administration (Fig 6).

In the follow-up studies the renal lesions disappeared or diminished (Fig 7) so that we concluded they corresponded to hemorrhagic cysts. One located in the tail of the pancreas (Fig 8) disappeared as well.

PERIPANCREATIC FLUID COLLECTIONS

Were present in three pancreatic transplants:

Two of them had fever and septic symptoms, and in the standard ultrasound examination no clear collections were detected. After contrast injection fluid collections corresponding to abscesses were perfectly demarcated (Fig 9).

The third patient had an abnormal amount of liquid drainage after some days of the implant, so a pancreatic leak was suspected. In the sonographic exam only a small linear collection was detected. In the contrast US exam a clear, big avascular image was seen surrounding the posterior edge of the graft that was proved in a posterior CT exam (Fig 10).
NON CLEARLY VISUALIZED PANCREATIC TRANSPLANTS

In three patients that came to the ultrasound room with elevated glucemia, the pancreas was impossible to detect in the basal Doppler ultrasound exam, so a contrasted study was performed in each case.

All of them showed a normal graft enhancement after the contrast injection, and vascular thrombosis could be excluded. (Fig11)

Furthermore, in a new exam after contrast administration, Color Doppler signal was much more evident, allowing the correct evaluation of the graft vasculatization (fig 12)

Images for this section:

![Images](image_url)

**Fig. 1:** A. High resistance with reversal diastolic flow in extrapancreatic artery suggesting venous thrombosis B. Doppler US image shows very poor and pathologic vascularity
inside the allograft C. Contrast US images show a complete lack of transplant enhancement during the entire exam

Fig. 2: A. In conventional US the pancreas showed a very low ecogenicity B. No flow was detected after the contrast injection C. Color Doppler exam after the contrast did not show any vascularity in the organ
Fig. 3: A. Gray scale US image shows an enlarged kidney with very hypoechoic cortex
B. Doppler Duplex US image: total absence of flow at renal hilum and parenchyma
C. Complete lack of enhancement after contrast injection
D. Gammagraphy showed, as well absence of signal in the kidney transplant
Fig. 4: A. Conventional and Doppler images shows very poor vascularization only in the middle part of the kidney B. Contrast US images demonstrate lack of enhancement in the upper and lower poles
Fig. 5: A. Gray scale US image shows well defined hypoechoic node in the lower part of the kidney allograft B. With Color Doppler the lesion has some peripheral vascularity. C. The node shows peak enhancement at 32 seconds, and less than the renal cortex tissue D. A relative wash out was seen at 1 minute and 52 seconds after contrast administration
Fig. 6: A. Conventional US image: Hyperechoic mass in lower part of kidney transplant
B. The lesion did not s not enhance during contras exam C. In a follow-up exam, 20 months later, the node had disappeared
**Fig. 7:** A. Complex cyst with an echoic pole in the lower part of kidney transplant in conventional US image B. The contrast US study demonstrated a cystic lesion without solid components.
**Fig. 8:** A. Gray scale US image shows a complex cystic lesion in the tail of the pancreas with anfractuous and apparently solid contours B. With color Doppler no flow was detected C. The lesion did not enhance after contrast administration, demonstrating to be a cyst D. In a follow up exam, 7 months later, the cyst had disappeared.
Fig. 9: A. Gray scale image of a pancreas transplant with apparently homogeneous aspect. B. After contrast injection a collection was detected in the tail of pancreas. C. CT images confirmed the findings.
**Fig. 10:** A. Gray scale image showed a fluid collection posterior to the pancreas transplant. B. After contrast administration the collection was better delimited and clearly showed a bigger size. C. CT exam demonstrating the collection.
Fig. 11: A. Poor vascularization inside the graft B. In a new Doppler US after the contrast exam, color signal was much more evident allowing the correct evaluation of the graft vascularity.
Fig. 12: A. Pre-contrast study with poor vascularization B, C, D y images: After contrast administration intrapancreatic vascularization was easily detected allowing to measure both arterial an venous intrapancreatic flow
Conclusion

Although gray-scale ultrasound and Doppler have been accepted as the first choice diagnostic method in transplanted patients, sometimes, and specially in pancreatic transplants, these exams may be insufficient.

Contrast enhanced CT would be the next modality evaluating these patients. But administration of intravenous iodinated contrast media in double renal-pancreas or renal transplants may be contraindicated because of its nephrotoxicity.

When conventional Doppler Ultrasound is inconclusive, Contrast-enhanced Ultrasound is a good and safe technique for diagnosis in determined complications of kidney and pancreas transplantation.

Personal information

References