Exceptional Case

‘Bench’ MRI before transplant on harvested kidneys: a possible tool for diagnosis of acute pyelonephritis

Elisabetta Mezza1, Luigi Biancone2, Fabio Tattoli2, Maria Messina1, Laura Rizzo3, Elisabetta Tola4 and Giuseppe Paolo Segoloni2

1Renal Transplant Unit, ASO San Giovanni della Città di Torino, 2Internal Medicine Department, University of Turin, Turin, 3Radiology Unit, ASO San Luigi Gonzaga, Orbassano and 4Radiology Unit, ASO San Giovanni della Città di Torino, Turin, Italy

Abstract
We present the first case in which magnetic resonance imaging (MRI) has been utilized to rule out lesions compatible with acute pyelonephritis in kidneys from a cadaveric organ donor before transplanting them. A 40-year-old female underwent diagnosis of brain death following a septic shock. The ecotomography of the kidneys showed areas compatible with micro-abscesses raising the hypothesis of acute pyelonephritis. Our radiologist proposed to perform a bench-MRI (maintaining kidneys within the sterile preservation bags constantly on ice); this did not show lesions except little cysts not relevant by the clinical point of view. We transplanted kidneys without infective complications and results were very good.

Keywords: acute pyelonephritis; kidney harvesting; magnetic resonance; cortical microcysts

Introduction
In facing the worldwide growing demand for renal transplantation, particular attention should be paid to the assessment of kidneys harvested from cadaver donors affected by infections, to transplant them safely into patients on the waiting list. Among the potentially useful diagnostic tools, magnetic resonance imaging (MRI) has progressively extended its use on the side of computerized tomography (CT) as a ‘gold standard’ in the imaging of acute pyelonephritis [1–3]. Herein, we present a case in which this tool has been utilized ex vivo to rule out lesions compatible with acute pyelonephritis in kidneys from a cadaveric organ donor before transplanting them. Apart from the use of ex vivo MRI of the pretransplant human donor liver [4] and the report of the use of magnetic resonance spectroscopy for pretransplant assessment of renal viability [5], to our knowledge this is the first report on the use of MRI to perform the morphological evaluation of harvested kidneys before transplantation.

Case report
RN, a Caucasian, 40-year-old female, was admitted to the emergency ward (EW) of a small country hospital after 2 days of fever with nocturnal sweating and cough. The clinical features, laboratory examination and chest X-rays suggested the diagnosis of respiratory distress in pneumonia, and a broad antimicrobial therapy was administrated (piperacillin/tazobactam + levofloxacin + teicoplanin + fluconazole). Amine support (noradrenaline 0.4 γ/kg/min and dobutamine 10 γ/kg/min) was instituted for the sudden onset of hypotension. In the meantime, blood and tracheo-bronchial aspirate culture resulted positive for Streptococcus Pyogenes; antimicrobial therapy was changed, discontinuing piperacillin/tazobactam and adding ceftriaxone i.v. After 3 days, clinical situation worsened and the CT scan allowed the diagnosis of brain death. The evaluation procedure for multiorgan donation was activated.

The abdomen ecotomography showed kidneys of normal size with rare millimetric hypoechogenic areas compatible with the presence of micro-abscesses, raising the hypothesis of acute pyelonephritis. Abdomen CT scan was not performed for local logistical reasons.

Cerebrospinal fluid resulted negative for Haemophilus influenzae, Streptococcus pneumoniae, Neisseria meningitidis (A, B and C), Escherichia coli and Streptococcus beta-hemoliticus.

Glomerular filtration rate according to the Cokroft–Gault formula was 143 ml/min.

An infectivologist’s second opinion was required by our organ procurement organization (http://www.trapianti.ministerosalute.it/imgs/C 17 normativa 449 allegato.pdf) about RN’s suitability as organ donor, considering the cause of death (septic shock in pneumonitis due to Streptococcus pyogenes), the positive blood and tracheo-bronchial aspirate...
cultures and the current antimicrobial therapy. The second opinion considered RN suitable for organ donation according to the National Transplant Network’s protocol for the utilization of donors affected by bacterial meningitis, bacteremia or other systemic infections considering that the antimicrobial therapy was not able to save the patient, but was probably effective against the isolated bacterium, and the risk of transmission of this infection is very low, due to the proper antimicrobial therapy.

However, since it appeared that the possibility of focal infections is limited to single organs, the decision for the transplantation use of a given organ was referred to each specialist.

At this point, we decided to perform one-needle biopsies for each kidney to evaluate the kidney histology in order to detect signs of acute pyelonephritis (by retrieving infiltration of neutrophils around supposed abscesses).

On the other hand, during kidney harvesting, macroscopic features of the kidney revealed the possible presence of cortical microcysts instead of abscesses, suggesting the hypothesis of a polycystic kidney disease, considering the patient’s age and the epidemiological data of a possible late diagnosis of adult polycystic kidney disease [6,7]. According to the suggestion of the radiologist of our center, both of the kidneys were studied by MRI, maintaining them within their sterile preservation bags constantly on ice for the whole duration of the exam.

MR examination was carried out with a 1 T G.E. Signa Horizon using a volumetric head coil; S.E. T1- (TR/TE 540/16) (Figure 1), FSE T2- (TR/TE 3000/113, ETL 15) (Figure 2). Even with the limitation due to the impossibility of using contrast media, we could not identify focal parenchymal lesions, except little cysts on the left, not relevant by the clinical point of view, and the signs of previous biopsies. The urinary tract appeared hyperintense related to washing substances (Figures 1 and 2).

In the meantime, the renal biopsy study was completed showing no signs of neutrophil infiltration in either specimen.

Taking into account the results of the MRI and the biopsies, we performed the transplantation with a cold ischaemia time of 16 h and 50 min for the first transplanted kidney and 27 h and 50 min for the second, after a previous informed consent signed by the patients, who accepted the risk of the transmission of a bacterial infection. The proper antibiotic prophylaxis was administered and the transplantation outcome was very good for both recipients, with negative blood cultures and preservation solution.

**Discussion**

The crucial point in deciding to consider RN suitable for organ donation was to distinguish between the risk of wasting kidneys potentially optimal by the functional point of view (normal kidney size, normal GFR, a young donor with negative past medical history) and the risk of infection transmission (positive blood culture, echographic features...
compatible with the diagnosis of acute pyelonephritis); these issues are highlighted since the kidney transplant is not lifesaving and, on the other hand, the problem of organ shortage is ever increasing [8,9]. The renal biopsies that we performed did not show signs of infection. However, needle biopsy may easily miss the detection of acute pyelonephritis on the basis of its focal nature.

We discussed with the radiologist which imaging technique could be more useful in this situation. CT scan was excluded since in the absence of contrast medium perfusion there is a low-contrast resolution for renal parenchyma and among the renal tissue and inflammatory lesions. 'Bench' ultrasound would have hardly provided different results from those obtained when performed on the donor body. In addition, ultrasound has constitutively a poor sensitivity for pyelonephritic foci.

MRI produces images with a good contrast resolution in cortical–medullar differentiation. In this situation, indeed, the use of medium contrast not being possible, the use of T2-weighted sequences allows us to distinguish among cystic lesions and abscessual lesions; simple cysts, in fact, give homogeneous signal, hyperintense in T2, and are not associated with structural alteration of the surrounding parenchyma. The abscesses, instead, have a non-homogeneous signal and present an altered signal of the surrounding parenchyma due to oedema [10]. We chose a volumetric head coil because of the great signal/noise ratio.

In the images we obtained, kidney normal parenchymal architecture was easily demonstrable, particularly on T2-weighted sequences: medullar parenchyma appeared striping because of tubular assessment, while the cortex showed lower signal intensity.

In conclusion, considering the short time restriction (∼30 min) to assess both of the kidneys without compromising their sterile and temperature preservation and the low cost of this technique (∼500 euros), our experience led us to propose that ex vivo MRI may represent a ‘rescue’ technique of help in evaluating renal suitability for transplantation in particular situations, at least where this technique is available, when there is a suspect of focal lesions (e.g. cystic or inflammatory) in the harvested kidneys in order to avoid the risk to transplant unhealthy kidneys or to refuse safe kidneys.

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Conflict of interest statement. None declared.

References


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