Evaluation of Deceased Kidney Donors for Renal Stone Disease: Is Computed Tomography Needed?

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Abstract

Objective: To investigate the clinical consequences of neglected risk of urolithiasis in deceased kidney donors in routine clinical practice, this study focused on different management options for transplanted allograft stones, and tried to find new solutions for more accurate detection of urolithiasis in deceased kidney donors prior to renal transplantation. Methods and Results: The overall prevalence of stone disease in endemic countries is between 7 and 29%. Because of the increased risk for stone disease in epidemic countries, screening renal grafts from deceased donors necessitates more sensitive imaging tests. Despite well established procedures on preoperative living related renal donor evaluation, there is no consensus on a preoperative imaging tool in cadaveric renal donor evaluation. The most commonly used imaging modality in deceased renal donors is ultrasonography. The overall sensitivity and specificity of ultrasonography for kidney stones are 45 and 88%, respectively. Use of a computed tomography scan for renal diseases, especially for urinary stones is now almost a routine test in clinical practice. Its sensitivity for renal stones < 3 mm is 85%, whereas for renal stones > 3 mm it is 100%. Conclusion: The use of radiological modalities i.e. computed tomography with higher sensitivity in deceased donors prior to renal transplantation seems reasonable in urinary stone epidemic countries.

Introduction

The increased demand of renal transplantation (RT) for patients with end stage renal disease (ESRD) and the increased gap between the number of donors and recipients exert significant pressure on health care providers and policy makers.

Many actions have been proposed and undertaken worldwide to increase the number of deceased donors, such as legislations of presumed consent instead of informed consent, continuing educational programs for intensive care unit professionals, and maintaining publicity for RT programs [1–3]. In addition to brain-dead organ donors, use of non-heart-beating donors and elderly donors (> 60 years) are strongly recommended to decrease the deceased donor shortage [4]. Furthermore, marginal donors such as deceased donors older than 70 years of age, who are more likely to harbor malignancy and urinary calculi, can now be accepted as a kidney donor under some serious conditions. In contrast, evaluation of deceased kidney donors for some comorbidities prior to RT has not changed in proportion to the widely extended donation limits.

Urolithiasis in allograft kidneys is a rare entity. However, it can cause severe complications and result in deterioration of graft function. Transplanted stones from donors constitute up to 47% of all stones seen in renal transplant patients [5].

In addition to routine evaluation of renal grafts by ultrasonography, further radiological imaging of deceased donors by computed tomography (CT), for kidney tu-
mors and especially for urolithiasis seems very reasonable when increased morbidity and complications of extended criteria donors are taken into account. This review investigated the clinical consequences of the neglected risk of urolithiasis in deceased kidney donors in routine clinical practice, focused on different management options for transplanted allograft stones, and tried to find new solutions for more accurate detection of urolithiasis in deceased kidney donors prior to RT.

Risk of Urinary Stones in Potential Deceased Donors

The first successful RT with acceptable outcome was reported in the 1950s [6]. Thanks to gaining more experience in RT worldwide, evaluation of surgical techniques and improvements in treatments against transplant rejections, graft survivals dramatically increased through the years [7, 8]. However, in spite of the increased number of RTs and survival outcomes, the number of patients on waiting lists showed an increasing trend, and thus ESRD is still a serious health burden [9, 10].

Increasing the number of potential renal donors has become a new interest. A subset of the deceased patients who were already rejected as donors because of strict donor criteria might indeed benefit some patients on waiting lists [11]. A past medical history of hypertension and cerebrovascular accident, older age, and increased pre-procurement creatinine levels are considered acceptable to some degree after risk calculations for graft loss, and therefore “expanded criteria donor” was introduced.

The highest stone incidence is seen in patients between ages of 20 and 60 years [12], while this age group is also accepted for standard kidney donation. Furthermore, deceased patients over age 60 can be extended criteria donors. However, the incidence of first-episode urinary tract stones in patients over age 50 increased almost 4–5 times between 1965 and 2005 in Japan [13]. A similar increasing trend in stone prevalence was also reported in other developed countries [14, 15]. Although the incidence of bladder stones has decreased due to improvement of nutritional health, the incidence of upper urinary tract stones and calcium oxalate stones has increased [16]. Stone disease is still a major health problem in countries such as Egypt, Turkey, and India. The overall prevalence of stone disease in endemic countries is between 7 and 29% and higher prevalence rates were reported in sub-groups with a low socioeconomic and educational level status [17, 18]. Because of the increased risk for stone disease in epidemic countries, screening renal grafts from deceased donors necessitates more sensitive imaging tests.

Diagnosis of Urinary Stones in Renal Grafts from Deceased Donors

Despite well established procedures on preoperative living related renal donor evaluation, there is no consensus on preoperative imaging tools in cadaveric renal donor evaluation. The most commonly used imaging modality in deceased renal donors is ultrasonography.

The overall sensitivity and specificity of ultrasonography for kidney stones are 45 and 88%, respectively [19]. In comparison to CT, it overestimates stone size in 87% of the cases and it has 60% size discordance for stones ≤ 5 mm. Its sensitivity for 3–7 mm kidney stones is 26% whereas it is 71% for stones more than 7 mm [20]. Furthermore, it is operator dependent and misses stones ≤ 5 mm in pelvicalyceal junctions [21].

The European Association of Urology Guidelines recommends abdominal ultrasonography for annual screening of a transplant recipient [22]. For living donors, a solitary stone larger than 10 mm in size is a relative contraindication [22]. However, use of ultrasonography for both initial screening and follow-up may put renal recipients at more risk. For instance, renal stones 4–6 mm in size could be missed at an initial ultrasonography evaluation prior to RT and follow-up with ultrasonography might not diagnose them until a late stage that presents with decreased graft function or could only be treatable via invasive treatments. Conventional renal ultrasonography is also insufficient to differentiate benign complex cysts from malignant renal carcinomas [23], and thus use of a more reliable screening test for potential deceased donors, with increased risk for renal disease seems reasonable.

Pyelography is not presently a routine test for urinary stone diagnosis. Magnetic resonance imaging is not superior to CT in terms of sensitivity and is utilized only in certain conditions [24, 25]. Furthermore it is more expensive and laborious.

Use of a CT scan for renal diseases, especially for urinary stones is now almost a routine test in clinical practice. Its sensitivity for renal stones reaches 100% [21]. Birkeland et al. [26] reported that the risk of undetected malignancy in kidney donors and malignancy transmission to kidney recipient from kidney donors are 1.3 and 0.2%, respectively. A CT scan is also more accurate than ultrasonography in diagnosis of pyelonephritis [27]. De-
spite the very low risk of malignancy transmission and pyelonephritis, use of a CT scan prior to RT can diagnose renal masses and infections that could be missed by renal ultrasonography.

**Management of Urinary Stones in Renal Grafts from Deceased Donors**

Stone prevention treatments yield low stone recurrence and procedure rates in patients with known stone disease [28]. Conservative and pharmacological treatments seem a cost effective way to overcome the costs of surgery and the emergency room [29].

Management of nephrolithiasis from a deceased donor can be performed prior to transplantation by means *ex-vivo* pyelolithotomy or *ex-vivo* ureteroscopy [30].

In the post-transplantation term, renal transplanted stones can be managed with observation, shock wave lithotripsy, endoscopic, and percutaneous or open surgical approaches [31]. But all of these choices have pros and cons and also limitations so the type of the management must be determined on a case-by-case basis.

In addition to immunological compatibility, the number of nephrons available to meet the physiological needs of ESRD patients has been another concern in RT [32]. Although RT between similar age groups is a more common practice, dual transplantation from cadaveric donors can be performed in certain circumstances. Renal parenchymal damage and deterioration in renal function due to transplanted stones or their management in any kidney recipient should be considered unacceptable in the era of imaging advancements.

**The Use of CT in Brain Death and Implication of Future Direction in Potential Deceased Kidney Donors**

Diagnosis of brain death can be based on clinical examination, electroencephalography, transcranial Doppler ultrasonography, cerebral scintigraphy, CT with cerebral angiography, evoked potentials, or 4-vessel cerebral angiography [33]. The choice of the diagnostic test depends on the facilities of the unit and the condition of the patient, and the legal issues vary from clinic to clinic and country to country.

CT angiography has been widely used in living related donor evaluation for many years and is associated with an increased rate of detection of common urological disorders such as renal cysts, tumors, and stone diseases [34, 35].

Organ procurement and evaluation of deceased kidneys for RT should be performed in a reasonably short time frame for better graft functions. A CT scan without contrast could be obtained about 1–5 minutes prior to brain death diagnosis by CT angiography, which takes about 15–30 minutes. Following organ procurement, by effective organ transplantation networks, the cold ischemia time can be minimized and better graft functions can be obtained [36]. Given the severe condition of the potential deceased donors, radiation exposure due to CT scan can be ignored.

Since the chemical composition of urine, urinary system anatomy, and comorbidity differ in each person, it is difficult to predict the course of undetected stones transplanted to renal recipients. At the very least, recipients of renal graft with acceptably small stones can benefit from early life style modifications and pharmacological treatments owing to preoperative detection by a CT scan. Further stone growth and new stone formations in these patients can be prevented or slowed down. Moreover, a kidney recipient with a past medical history of urolithiasis and unfavorable risk factors can be placed on a more restricted diet for salt and meat consumption. These precautions can show benefits in the long term since half lives of grafts for both deceased and living donors were reported to be more than 10 years [37].

**Conclusion**

The use of radiological modalities i.e. CT with higher sensitivity in deceased donors prior to RT seems reasonable in urinary stone epidemic countries. It can also be more valuable in potential deceased donors whose past medical history is equivocal or impossible to obtain in emergency settings. In older individuals, atypical pain or absence of pain is very common [38], and thus a potential deceased donor with a negative past medical history for urinary stone disease should be strictly evaluated.
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