Published in final edited form as:

Clin Transplant. 2012 ; 26(4): 558–563. doi:10.1111/j.1399-0012.2011.01567.x.

Incidental kidney stones: a single center experience with kidney donor selection

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Abstract

The presence of kidney stones has been a relative contraindication for living donation. With the widespread use of more sensitive imaging techniques as part of the routine living donor workup, kidney stones are more frequently detected, and their clinical significance in this setting is largely unknown. Records from 325 potential kidney donors who underwent MRA or CT-angiography were reviewed; 294 proceeded to donation. The prevalence of kidney stones found incidentally during donor evaluation was 7.4% (24 of 325). Sixteen donors with stones proceeded with kidney donation. All incidental calculi were nonobstructing and small (median 2 mm; range 1–9 mm). Eleven recipients were transplanted with allografts containing stones. One recipient developed symptomatic nephrolithiasis after transplantation. This recipient was found to have newly formed stones secondary to hyperoxaluria, suggesting a recipient-driven propensity for stone formation. The remaining ten recipients have stable graft function, postoperative ultrasound negative for nephrolithiasis, and no sequelae from stones. No donor developed symptomatic nephrolithiasis following donation. Judicious use of allografts with small stones in donors with normal metabolic studies may be acceptable, and careful follow-up in recipients of such allografts is warranted.

Keywords

kidney stones; living donor; nephrolithiasis

Kidney donor evaluation is a complex process in which assessment of potential harm to the donor relative to the potential benefit to the recipient is carefully analyzed. Because of the severe imbalance between patients in need of transplantation and donor supply, medically complex donors are increasingly considered for potential donation. One of the most widely varying practices from transplant center to center is the evaluation of donors with asymptomatic nephrolithiasis. Traditionally, donor nephrolithiasis has been a relative contraindication to kidney donation; however, owing to the questionable clinical

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Conflict of interest: None.

significance of asymptomatic nephrolithiasis, some centers have re-evaluated their donor policies. In one study surveying the different approaches to donors with kidney stones in the United States, 77% of responding centers allowed patients with stones to donate. Forty percent of the centers had changed their attitude toward donors with nephrolithiasis over the last 5–10 yr (1, 2).

The American Society of Transplantation proposed guidelines for managing potential donors with a history of nephrolithiasis (3). These guidelines suggest that these candidates may proceed with donor evaluation if they have only passed one stone, or if they have had multiple stones, but have been asymptomatic for more than 10 yr. These candidates can proceed to donation if there is no current radiographic evidence for stones and have no metabolic abnormalities suggesting a high risk for stone formation. Such metabolic abnormalities include low urinary volume, hypercalciuria, hypocitraturia, hyperuricosuria, and hyperoxaluria. However, these guidelines do not address a growing problem of incidental stone detection in otherwise healthy, asymptomatic donors.

At our center, prospective kidney donors undergo an initial evaluation process to determine donor suitability and many are excluded because of medical reasons (4). Those potential donors who pass the first stage screening process then undergo additional tests such as abdominal cavity imaging to evaluate anatomy and screen for incidental parenchymal abnormalities, including nephrolithiasis. The purpose of this study was to review our recent living donor evaluation process and decisions regarding donors with incidental findings of nephrolithiasis. We also reviewed donor and recipient outcomes of pairs allowed to proceed with transplantation. Such analyses will aid in the development of evidence-based protocols for the evaluation of living kidney donors, taking into account the delicate balance between living donor safety and the well-being of transplant recipients.

Methods

Between November 2000 and December 2010, 325 potential kidney donors who have undergone medical evaluation at our center proceeded to the final stage of donor evaluation, which includes either MRA or CT-angiography. The details of our approach to living donor evaluation have been previously reported (3). All potential donors first underwent ultrasound of the kidneys and proceeded to further radiologic imaging only if the ultrasound showed no abnormalities. Specific abnormalities that would have prevented proceeding to further radiologic imaging include hydronephrosis, hydroureter, and multiple renal cysts. Although nephrolithiasis was not reported on ultrasound of any subjects in this series, those with nephrolithiasis who did not proceed to CT or MRA were not captured in this analysis. All images were analyzed further for 3-D reconstruction. Routine radiologic studies were changed from MRA to CT-angiography in 2004, after the introduction of more sensitive CT-imaging techniques that better delineated vascular anatomy. CTs were performed by initially acquiring noncontrast 3 mm axial images followed by acquiring 1 mm images during the systemic arterial phase after injection of intravenous administration of Isovue. Images were reviewed by our hospital radiologist, and in instances with noted abnormalities, the findings were reviewed in detail by the radiologist, transplant donor surgeon, and research investigators.

Donor data were reviewed to evaluate for the presence of stones and the decision-making process of donor selection once kidney stones were found. Recipient data were reviewed to assess for outcomes of those who received an allograft from a donor with known nephrolithiasis. Serum creatinine (SCr) levels at three months and one yr following transplantation were recorded. Hospital records were reviewed to determine graft survival and post-transplantation course. Donor outcomes were recorded at least one yr and up to three yr following donation.

As our evaluation process evolved, blood and urine from donors who were found to have nephrolithiasis were analyzed to assess stone formation risk and better screen risk conferred upon the recipient. Laboratory data such as PTH, urine pH, urine oxalate and citrate concentration, and uric acid are analyzed along with serum studies to calculate donor risk factors for developing renal stones. These data are presented as a relative risk in stone-forming propensity and have helped guide donor selection (Litholink®; Chicago, IL, USA). More specifically, potential donors with analysis of their urine that are associated with higher risk of stone formation were advised not to proceed with donation. Values considered abnormal in the 24-h urine collection included high urine calcium (>250 mg for men, >200 mg for women), high urine oxalate (>40 mg), low citrate (<450 mg).

Results

Of the 325 patients screened with radiographic imaging, 294 patients (90.5%) proceeded to kidney donation. Twenty-six patients (8.0%), who passed initial medical and laboratory screening tests, were denied donor candidacy after further radiologic imaging. Reasons for denial included unfavorable donor anatomy (n = 6) and incidental medical findings, such as steatohepatitis (n = 2) or incidental mass (n = 2), other medical conditions (n = 4), and alternative donors (n = 5), precluding organ donation. Seven of these 26 patients were excluded because of the discovery of kidney stones that were multiple bilaterally (n = 3), thought to be too large (n = 1), or were found to have alternate donors without stones (n = 3). The range of these stones was 2–7 mm in disqualified donors.

Sixteen donors with incidental finding of kidney stones, either unilateral or bilateral, proceeded to organ donation (Fig. 1). Of the 16 donors, 11 underwent uninephrectomy of the kidney with the stone. The remaining five donors donated the kidney without the stone, leaving the remaining native kidney with the incidentally discovered stone. Of the 325 donors, 91 were screened with MRI, and 234 patients were screened with CT-angiography. The size of the kidney stones ranged from 1 to 9 mm, and no kidneys were used with stones that were visualized in the collecting system. The quality and location of these calculi were also noted from imaging. In those donors who proceeded to donation, the location of the stones ranged from parenchymal regions of the upper or lower poles to interpolar regions. The size of the stones ranged from 1 to 5 mm except one donor with a 9 mm stone (further described below). Stone extraction was not attempted after procurement in any of the cases. The five subjects who donated the kidney without the stone all had a single intraparenchymal calcification <2 mm in the right kidney. All five donors were successfully contacted and reported no symptoms or evidence of stone disease. The median follow-up time was 5.3 yr (SD 1.75 yr).

Analysis of recipients with known nephrolithiasis in the allograft was performed using SCr at three months and one yr following transplantation. To date, all recipients have stable functioning allografts. The median SCr at three months and one-yr post-transplant was 1.1 and 1.2 mg/dL, respectively. One patient required hemodialysis after transplantation for delayed graft function caused by acute cellular rejection, diagnosed by biopsy. Outcomes of the 11 recipients of allografts with stones are summarized in Table 1. One developed complications from obstructive nephrolithiasis. This occurred after transplantation of an allograft with a 9 mm calcification in the upper pole of the kidney that was nonobstructing. Although urinalysis of the donor revealed hyperuricosuria and hypocitraturia prior to donation, the decision was made to proceed with transplantation because both the donor and the recipient were motivated and well informed of the risks. The recipient's early postoperative course was uncomplicated and two surveillance ultrasound studies demonstrated a stable upper pole calculus without evidence of ureteral obstruction. Three months following transplantation, the recipient presented with graft tenderness and an elevated SCr. Ultrasound revealed two new stones that were radiolucent, causing obstruction at the mid-ureter. Urinalysis of the recipient revealed hypocitraturia and a normal urine uric acid concentration. The recipient underwent percutaneous nephrostomy tube placement with eventual resolution of the obstruction. The donor was treated with potassium citrate and reported no symptoms of stone disease three yr after donation. The recipient SCr has remained stable at 1.4.

Among the donors with known nephrolithiasis who donated a kidney, none had reported symptomatic nephrolithiasis at one yr according to follow-up records. The median SCr level was 1.2 mg/dL at one yr after donation.

Discussion

The decision to accept a donor with nephrolithiasis is a difficult task because of the challenge to find suitable donors while ensuring the safety of both donor and recipient. The use of living donor allografts with nephrolithiasis raises legitimate concerns about transmitting the potentially harmful sequelae of stones in the recipient, as well as the possible increase in recurrent stone formation in the donor. The judicious use of donor kidneys with renal stones has been successfully demonstrated without adverse side effects to either donor or recipient. Much of this is based on allograft outcomes prior to the routine use of more sensitive imaging techniques such as MRA or CT angiograms in the living donor workup (5). As these newer techniques are routinely used, the dilemma lies in which donor to choose and how to choose them.

In our series, all potential kidney donors are first evaluated by ultrasonography, which notoriously lacks sensitivity for accurately detecting renal calculi (6, 7). Patients who pass initial screening are then evaluated preoperatively by either CT-angiography or MRA to delineate the anatomy and screen for parenchymal lesions, including kidney stones. Interestingly, all 22 patients found to have renal calculi were identified by CT. CT scans are the recommended diagnostic study because they are thought to be more sensitive than both MRI and intravenous pyelograms for stone detection (8, 9). This raises the possibility that small stones went undiagnosed in a fraction of our donors evaluated by MRI. In the era of

using more sensitive radiographic imaging, we may be creating our own problem of incidental stone detection and unnecessary donor elimination. According to national urologic studies, the prevalence of nephrolithiasis in the United States ranges between 2.6% and 5.2% (1). The prevalence of kidney stones found in our study was higher (7.4%) and, likely, reflects the method of detection.

Based on national studies of individuals with symptomatic stones, the transplant community has justifiably been reluctant to use donors with nephrolithiasis. The most crucial aspect of living donor selection is the “do no harm” tenant, where it is the transplant center’s responsibility to screen out donors who would suffer increased morbidity after donation because of pre-existing medical conditions. Stones may cause kidney damage by obstruction or infection. Data suggest that kidney stone formation alone incurs a greater risk for chronic kidney disease (CKD) development and raises the possibility that kidney donors with stones may have greater risk of developing CKD (10). A retrospective analysis by Rule et al. found that symptomatic kidney stone formers, when matched against control patients, were at increased risk of developing CKD. However, increased risk of ESRD or death was not significant. In addition, Lee et al. demonstrated that in patients who underwent unilateral nephrectomy for nephrolithiasis, up to 30% developed recurrent stones in the contralateral kidney. They also noted progressive renal failure and proteinuria in some of these patients (11).

While these results suggest that living donors with kidney stones may also be at higher risk for long-term complications, patients with symptomatic stone disease are inherently different from living donors with incidentally discovered asymptomatic small stones. To our knowledge, no donors who were found to have stones were harmed or suffered long-term sequelae after donation in our series. The clinical significance of smaller, asymptomatic kidney stones, such as the ones found in our kidney donors, is unknown.

In regard to recipient risk, there have been many case reports of post-transplant complications related to donor stones causing obstruction and even acute renal failure. Management for stone removal has included extracorporeal shock-wave lithotripsy, percutaneous nephrolithotomy, back-table management after explanation using techniques such as ureterotomy and pyelotomy (12–15). With the exception of one recipient in our series, all kidney transplant recipients who were transplanted with a graft with known stones fared well and enjoy good allograft function to date. The one recipient who developed obstructive uropathy developed obstruction secondary to new kidney stone formation and not from the original donor stone. Still, it should be noted that the size of the stone in this case was larger (9 mm) than all other donors who proceeded to donation, and caution is advised with the use of such donors. Urine and serum analysis revealed that this recipient had his own risk factors for stone-forming propensity. In retrospect, complications of stone disease in the transplant recipient may have been avoided if these stone-forming risk factors had been originally known. Such tests are neither feasible nor informative prior to transplantation. For example, serum parathyroid, calcium, and uric acid levels are often elevated in patients with CKD, and in oligo/anuric patients with advanced CKD, urine analysis for stone-forming propensity is neither feasible nor informative. Thus, in recipients who inherited a stone from the donor, extra attention to adequate hydration (e.g., early

treatment of diarrhea), early treatment of hyperuricemia, and analysis of 24-h urine collection for hypocitraturia, hyperoxaluria, and hyperuricosuria during the early post-transplant period may be advisable.

Throughout our experience with living donors, we have had some modified our attitudes toward accepting donors found to have incidental small kidney stones. Earlier in our experience, we denied donors on the finding of renal stones and have become more open to considering potential donors with nephrolithiasis, especially after careful metabolic and chemical workup. We have adopted a generalized protocol for evaluating a donor incidentally found to have nephrolithiasis (Fig. 2). These guidelines have aided in expanding donor selection with good outcomes for donor and recipient at our center. Larger studies are required to develop firmer guidelines when evaluating donors found to have kidney stones.

Acknowledgments

We thank Sooyee Kong for her help in obtaining clinical information used in this study. Jane C. Tan receives support from K23DK087937 from the National Institute of Diabetes and Digestive and Kidney Diseases. Jessica Lapasia received support from the John M. and Abby Sobrato Foundation.

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Fig. 1.
Patient disposition.

Fig. 2.
Proposed algorithm for kidney donor selection with donors found to have stones.

Table 1

Recipient outcomes

Donor	Imaging modality	Stone description	Donor operation	Clinical lithiasis?	Outcome
1. 55 M	CT	2 mm calcification interpolar left kidney 2 mm calcification interpolar region right kidney	Left laparoscopic nephrectomy	No	Excellent graft function
2. 45 F	CT	2, 2 mm punctate calcifications right kidney	Open right nephrectomy	No	Excellent graft function
3. 37 F	CT	1 mm calcification in lower pole of left kidney	Left laparoscopic nephrectomy	No	Excellent graft function
4. 45 M	CT	2-3 mm interpolar right renal stone	Right open nephrectomy	No	Development of mild hydronephrosis-not stone-related. Successfully treated with dilatation. Otherwise, excellent graft function
5. 56 F	CT	Several small left renal calculi	Left laparoscopic nephrectomy	No	Stable graft function. Baseline Cr went from 0.9 to 1.4
6. 53 F	CT	6 mm lower pole, nonobstructing calculus in right kidney	Right laparoscopic nephrectomy	No	DGF on HD. Stable allograft function w/Cr 2.4
7. 46 F	CT	2 mm left superior pole	Left laparoscopic nephrectomy	No	Excellent graft function
8. 64 F	CT	2 mm interpolar region of left kidney 2 mm superior pole of right	Left laparoscopic nephrectomy	No	Excellent graft function
9. 55 M	CT	4 mm nonobstructing, mid-inferior left renal calculus	Left laparoscopic nephrectomy	No	Excellent graft function
10. 54 M	CT	5 mm calculus upper pole of left kidney (nonobstructing)	Left laparoscopic nephrectomy	No	Excellent graft function
11. 41 M	CT	Conglomerate or radioopaque renal calculi in upper pole of left kidney-9 mm	Left laparoscopic nephrectomy	Yes	Obstructive stones-nephrostomy tube placement