

Research Article

The value of routine ultrasound at discharge to identify patients at risk of developing symptomatic lymphoceles after kidney transplantation: A case-cohort study

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Abstract

Background: Ultrasound examination is frequently used to evaluate the graft after renal transplantation and to detect possible lymphoceles. The first ultrasound scan in our hospital is normally performed on the day of discharge. We questioned whether perirenal fluid collections detected by ultrasound examination at discharge are predictive for future symptomatic lymphoceles.

Methods: All ultrasound reports of all renal transplant recipients treated in our hospital between January 2010 and December 2017 were collected and screened for abnormalities such as fluid collections. Patients that developed a symptomatic lymphocele were compared with a control group from the same cohort. Sensitivity and specificity of ultrasound examination to detect symptomatic lymphoceles were calculated for the primary and consecutive ultrasounds tests.

Results: There were no significant differences at baseline characteristics between the Symptomatic lymphocele group and control group, with the exception of mean age at kidney transplantation (47 ± 17 years in the control group vs. 56 ± 13 years in the symptomatic lymphocele group, $p=0.02$).

The ultrasound examination at discharge had a sensitivity of 31% and specificity of 87% to detect future symptomatic lymphoceles. The positive predictive value was only 10%. The second ultrasound test had the best test variables to detect symptomatic lymphoceles with a sensitivity of 93% and a specificity of 87% and a predictive value of 28%.

Conclusion: Routinely use of ultrasound testing on the day of discharge does detect perirenal fluid collections, but is not predictive for development of symptomatic lymphoceles in the future.

Introduction

Kidney transplantation is the therapy of choice for patients with end-stage renal disease. After transplantation, the renal graft is closely monitored for postoperative complications. The most widely adopted and non-invasive imaging modality for early diagnostics and follow-up of the renal graft is ultrasound. Ultrasound combined with Doppler techniques allows for detailed evaluation of the renal graft, such as its size, echogenicity, possible dilatation of the pyelum or ureter, renal perfusion, flow in the renal vein and artery, and

perirenal fluid collections [1]. Ultrasound testing is also the modality of choice as an auxiliary for invasive therapies such as renal biopsies and fluid drainages.

A clinically important complication of kidney transplantation is the development of a symptomatic lymphocele (SL) [2,3]. A symptomatic lymphocele in kidney transplant recipients is a symptomatic pseudo cystic entity filled with lymph fluid, covered with a hard fibrous capsule, localized around the graft.

The incidence of lymphoceles after kidney transplantation

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varies widely and is reported between 0.03% and 33.9% with a mean of 5.2% [2]. Most lymphoceles are asymptomatic and resolve spontaneously or even go unnoticed. Symptomatic lymphoceles, however, cause pain and discomfort and may have severe complications such as ureteral obstruction, infection or renal vein thrombosis causing secondary graft deterioration or even graft loss [4-9]. To detect the presence of perirenal fluid collections or other possible complications, an ultrasound of the graft and fossa is therefore often routinely made in the postoperative period. However, the detection of an asymptomatic peri-renal fluid collection, a perfusion defect or hydronephrosis without loss of renal function frequently has no clinical consequences [1]. We therefore questioned the use of routine ultrasound at discharge, particularly in regard to the detection of symptomatic lymphoceles. We hypothesised that in patients without any clinical symptoms the finding of a fluid collection on ultrasound examination on the day of discharge will have a low predictive value for the development of SL. To test this hypothesis, we evaluated the diagnostic and predictive value of ultrasound for the detection of symptomatic lymphoceles on the day of discharge after kidney transplantation.

Materials and Methods

Study population and data collection

All ultrasound reports of all renal transplant recipients transplanted between January 2010 and December 2017 in our centre were retrospectively screened for abnormalities. These reports included all discharge ultrasounds as well as consecutive ultrasound scans performed during follow-up or readmission. Fluid collections (small or large, as described by radiology report, large defined as a fluid collection of >3cm), perfusion defects and hydronephrosis were scored as abnormalities. Patients characteristics such as date of birth, age at day of transplantation, gender, weight, total kidney transplants, type of donor (living/deceased), kidney replacement therapy before transplantation or pre-emptive transplantation were retrieved from the electronic patient record system. The patient group that developed a symptomatic lymphocele (SL) was then compared to the patients from the same cohort that did not develop a SL.

Symptomatic lymphocele was defined as a symptomatic fluid collection near the graft that required an intervention

for the graft or patient. Postoperative or post intervention haematomas, urinomas and abscesses were excluded.

Follow-up

Since SLs rarely develop after six months [10,11], the minimum follow-up period for inclusion was at least 6 months. Follow-up ultrasound scans were not routinely planned, but performed on indication, e.g. rise in creatinine, abdominal pain or oliguria. A radiologist or a trained nephrologist (defined as having done more than 50 ultrasound scans per year) performed the ultrasound scan.

Data analysis

Results were analysed by using a one sample or unpaired student's T-test as appropriate. Test variables were calculated for ultrasound scans at discharge and first and second follow-up ultrasound scans.

Results

Between January 2010 and December 2017, 1003 patients were transplanted, from which 2503 ultrasound reports were reviewed (Table 1). Of these patients, 58% was male (58% in the control group vs. 60% in the SL group, $p=0.54$), the mean age at kidney transplantation was 47 years (47 ± 17 years in the control group vs. 56 ± 13 years in the SL group, $p=0.02$), the mean body weight was 75kg (75 ± 19 kg in the control group vs. 78 ± 18 kg in the SL group, $p=0.28$).

The minority of the patients, 19% in the complete cohort, previously had one or more kidney transplants (19% in the control group vs. 27% in the SL group, $p=0.34$). The majority of the renal grafts came from living donors, 62% in the total cohort (64% in the control group vs. 62% in the SL group, $p=0.12$). In the total cohort, 76% received kidney replacing therapy before the kidney transplantation (76% in the control group vs. 76% in the SL group, $p=0.92$), of these patients 25% received peritoneal dialysis (24% vs. 29%, $p=0.57$) and 75% haemodialysis (76% vs. 71%, $p=0.66$).

Ultrasound findings at discharge (on average 7 days after kidney transplantation) were abnormal in 160 patients (16%), i.e. 135 patients with fluid collections (14%), 23 patients with perfusion defects (2,3%) and 4 patients with hydronephrosis (0,4%) respectively. A SL developed in 45 (4,5%) patients.

Table 1: Abnormalities found on first, second and third ultrasound.

	Total cohort	Control group	SL group	P value
Abnormality found on first ultrasound	16%; 160/1003	15%; 145/958	33%; 15/45	0.001
Perfusion defect	2,3%; 23/1003	2,2%; 21/958	4,4%; 2/45	0.32
Hydronephrosis	0,4%; 4/1003	0,4%; 4/958	0%; 0/45	0.67
Fluid collection	14%; 135/1003	13%; 121/958	31%; 14/45	0.00
Small fluid collection	5,5%; 55/1003	5,4%; 52/958	6,7%; 3/45	0.72
Large fluid collection	8,0%; 80/1003	7,2%; 69/958	24%; 11/45	0.000
Fluid collection (large) second ultrasound	17%; 150/862	13%; 108/817	93%; 42/45	0.000
Fluid collection (large) third ultrasound	10%; 65/638	5,9%; 35/593	67%; 30/45	0.000
Intervention done	8,0%; 80/1003	3,4%; 35/958	100%; 45/45	0.000



Significantly more abnormal ultrasound scans were found in the SL group (n=15, 33%) as compared to the control group (n=145, 15%) (P=0.001).

Fluid collections were detected with the discharge ultrasound examination in 135 patients (14%) with a significant difference between the control (n=121, 13%) and SL group (n=14, 31%; P=0.000). No differences were seen between the control group (n=52, 5,4%) and SL group (n=3, 6,7%) for small fluid collections (P=0,72). Large fluid collections were detected more often in the SL group (n=11, 24%) than in the control group (n=69, 7,2%; P=0,000).

Perfusion defects were seen in 23 patients (2,3%) without a significant difference between the control group (n=21, 2,2%) and SL group (n=2, 4,4%). Hydronephrosis was detected 4 times (0,4%), all in the control group (0,4%).

Follow-up ultrasound

A second ultrasound scan was performed as the first follow-up either at the outpatient clinic or at re-admission in the hospital in 862 patients. Average interval between the first and the second (follow-up) ultrasound was 10 weeks (72 days). Large fluid collections were seen in 150 patients (17%) from the total cohort. As expected, significantly more large fluid collections were seen in the SL group (n=42, 93%) than in the control group (n=108, 13%; P=0.000).

A third ultrasound (second follow-up) was done in 638 patients. Average interval between the first and the third (follow-up) ultrasound was 12 weeks (82 days). Large fluid collections were seen in 65 patients (10%) from the total cohort. Again, significantly more large fluid collections were seen in the SL group (n=30, 67%) than in the control group (n=35, 5,9%; P=0.000).

A therapeutic intervention was done in 50% of the patients with an initial abnormal ultrasound (80/160 of 1003 patients), or in 8% of the total cohort. In the control group, 24% of the patients with an initial abnormal ultrasound (35/145 of 958 patients) underwent an intervention (insertion of drain due to haematoma/urinoma (n=10, 29%), insertion of NSK (n=12, 34%) because of hydronephrosis, surgery for postoperative bleeding (n=13, 37%)) In the SL group, all patients received an intervention.

Diagnostic value

Sensitivity and positive predictive value for the development of SL of the ultrasound examination at discharge was low, 31% and 10%, respectively (Table 2). In contrast, specificity and negative predictive value for the development of SL

of the ultrasound at discharge was high with 87% and 96%, respectively. With the second ultrasound, the numbers improved for sensitivity (93%), positive predictive value (28%) and negative predictive value (99%), whereas specificity remained unchanged (87%). With the third ultrasound, sensitivity fell to 67%, specificity improved to 94%, positive predictive value increased to 46%, and negative predictive value remained stable at 97%.

Discussion

In our hospital, ultrasounds are routinely made after kidney transplantation on the day of discharge to detect complications. Routinely use of ultrasound after renal transplantation on the day of discharge to detect fluid collections has a very low predictive value for the development of SL over time.

Test variables of ultrasound

This study has found interesting differences in test variables of the ultrasound examination for the detection of SL on the day of discharge and the consecutive ultrasound scans. When comparing the first ultrasound scan with the follow up ultrasound examinations, a noticeable higher sensitivity and specificity for the detection of SL is found in the first follow up examination. Since the second and third ultrasound scans are only made on indication which is when clinical symptoms develop or the renal function decreases, this increase in test variables was expected.

Interestingly the ultrasound scan made on the day of discharge did not show a fluid collection in almost 70% of the patients that developed a SL later on.

In contrast to a small fluid collection, a large fluid collection on the initial ultrasound examination may be of predictive value for the development of SL later on. The question remains, however, whether it is necessary to establish this fluid collection on the day of discharge when no clinical symptoms are present. One could argue that without clinical symptoms, this fluid collection remains untreated. When clinical symptoms do occur and treatment may be necessary, ultrasound examination is a quick and non invasive way to establish the presence of a fluid collection. We therefore advocate to only use ultrasound examination on indication.

An initial abnormal ultrasound was only found in 16% of the patients. Of these abnormalities, 90% was based on a fluid collection and 2, 3% were based on a perfusion defect. Only 0, 4% of the abnormal ultrasound examinations was due to hydronephrosis, a finding that generally needs treatment without the need of clinical symptoms. Hydronephrosis, however, most often leads to a decrease in renal function. One could argue that if no clinical symptoms are present, and there is no decrease in renal function, the chance that ultrasound examinations shows signs of a complication that needs treatment is fairly small.

Table 2: Test variables of first, second and third ultrasound.

	First ultrasound	Second ultrasound	Third ultrasound
Sensitivity	31%	93%	67%
Specificity	87%	87%	94%
Positive predictive value	10%	28%	46%
Negative predictive value	96%	99%	97%



In literature, ultrasounds accuracy of 85.2% have been described for the detection of hydronephrosis, with a sensitivity of 89.9% and a specificity of 84.4% [12]. For the detection of fluid collections, test values of ultrasonography have not been reported in literature.

Since ultrasound examination on the day of discharge has a low sensitivity and specificity for the detection of SL, routine use of ultrasound examination for the evaluation of fluid collections on the day of discharge in patients without clinical symptoms of SL can be discouraged.

However, other complications, such as hydronephrosis and perfusion defects, can be detected with ultrasound examination as well. Therefore, it can still be recommended to use ultrasonography for the detection of early complications after kidney transplantation, as long as it is used on indication and physicians are aware that the test values for the detection of perirenal fluid collections are poor.

When ultrasound examination is performed on a routine basis, i.e. without the presence of clinical symptoms of complications, one can speculate about the timing. Perhaps routine ultrasonography after 4 or 6 weeks will lead to increased test values in regard to SL, since symptoms generally develop within 2 months after kidney transplantation [10-11,13]. Routine use of ultrasound in the OPD to detect perirenal fluid collections after this time frame can be discouraged, since almost no SL develop after 2 months.

Other tests

Other modalities may be used to detect perirenal fluid collections that may result in SL as well, computed tomography (CT) being one of them. CT-scanning is being reported to have a 83.3% sensitivity and 93.7% specificity to detect large fluid collections (volume of $>33\text{cm}^3$). However, when comparing CT-scans to ultrasonography, CT-scanning does have its downsides. CT-scans are not only costlier to make, they expose patients to radiation, whereas ultrasounds do not [14].

Magnetic resonance imaging (MRI) does not have radiation exposure either. MRI shows promising results for the detection and characterization of renal lesions. It has the advantage of superior soft-tissue contrast in comparison with CT. For the detection of perirenal fluid collections and symptomatic lymphoceles, however, no test values have been reported in literature [15].

Neither of these test modalities is routinely used for the evaluation of fluid collections.

Cost efficiency

Despite the fact that, in comparison with CT and MRI, ultrasound is a relatively inexpensive and non-invasive modality for the evaluation of complications such as SL, it is a costly matter to make an ultrasound on the day of discharge in all kidney recipients. In the Netherlands, ultrasound examination costs on average 75 euros per ultrasound test.

To reduce these costs and lower the burden on the radiology department, it could be recommended that all Nephrologists specialised in kidney transplantations use a hand-held ultrasound for a bed side ultrasonography. On indication, they can perform ultrasound examination and refer to the radiology department when there is uncertainty.

In our hospital, only using ultrasound examination on indication, instead as a routine testing modality on the day of discharge, this would lead to a decrease in costs of €8.776 per year (€ 175.210 (€21.901 per year) on routine basis vs. € 105.000 (€13.125 per year) on indication i.e. only second and third ultrasound).

O'Neill et al., state that ultrasonography performed by a nephrologist is not only economically feasible, it improves patient care and physician efficiency as well.

The most important advantage is an improvement of quality and reliability of the ultrasound results. This occurs primarily because the studies are performed and interpreted by the nephrologists, who is best equipped to integrate the findings of ultrasonography with the clinical data of the patients, resulting in appropriate diagnosis and treatment. Furthermore, ultrasonography performed by nephrologists leads to an improvement in patientcare, since it can be performed within minutes.

Literature suggests it is save for nephrologists to perform the ultrasonography examination instead of radiologists, since the kidneys are not difficult to examine, they have little anatomic variation and exhibit a limited spectrum of pathological changes [16-18]. It is suggested, however, that a number of at least 200 cases of training are needed for physicians to develop acceptable levels of competence in sonography [19].

We suggest ultrasound examination performed by a nephrologist, only on indication.

Limitations

This study has the limitation that the data is retrospectively obtained, necessarily relying on searches of sonography reports, medical records and surgical logs. However, we were able to obtain complete and detailed information from our database covering over 1000 patients and multiple years.

Conclusion

In conclusion, routinely use of ultrasound after renal transplantation on the day of discharge to detect fluid collections has a very low predictive value for the development of SL. We therefore advise not to perform a routine discharge ultrasound in the absence of symptoms after renal transplantation for detection of fluid collections. However, ultrasound may still be used on indication for the detection of other complications.



Disclosure

The results presented in this paper have not been published previously in whole or part, except in abstract format.

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Authorship and funding

All authors participated in research design, participated in writing of the paper, participated in the performance of the research and participated in data analysis. The authors declare no conflict of interest. No funding was received.

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