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Ultrasound evaluation of morphologic changes of transplanted kidneys in Sudanese patients

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ABSTRACT

Background: Assessment of morphology of transplanted kidneys provides informative data on underlying pathological processes that involve the transplanted kidneys. Identification of these morphologic changes is useful to predict the rejection as early as possible.
Objective: To evaluate the morphologic changes such as corticomedullary differentiation (CMD), corticomedullary ratio (CMR), cortical thickness and size of transplanted kidneys correlation with duration of the graft in Sudanese patients.
Methodology: This retrospective study was conducted in Khartoum State from July 2015 to April 2017. A total of 115 cases of transplanted kidneys were analyzed. A designed data collection sheet was used to collect the sonographic findings, clinical and demographic data. The renal cortex, CMD and CMR and graft size were evaluated.
Results: The incidence of renal transplantation was higher in males than in females (89 vs. 26) and most common in the age of 20–49 years old. Sonographic evaluation of transplanted kidneys revealed that the CMD was disturbed in 20.9% (24 cases) lost in 6.96% (eight cases) and preserved in 72.2% (83 cases). The CMR was increased by eight (6.98%) and decreased by 15.65% (21 cases). The cortical thickness was thin in 9.6% (11 cases), thick in 2.6% (three cases), and normal in 87.8% (101 cases). The size of the graft was significantly decreased with duration of the transplantation (p-value = 0.008).
Conclusion: In Sudanese patients, considerable morphologic changes involving the renal graft. The incidence of morphologic changes increased as the age of transplantation increased. The graft size is the most significant morphologic change occurred as the age of transplantation advanced. The ultrasound evaluation of renal grafts should be performed periodically to predict graft dysfunction.

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Sonographic, assessment, morphological, transplanted kidneys, Sudanese

Introduction

Since the 1960s', renal transplantation is considered a treatment of choice for end-stage kidney disease (ESKD). It provides better life quality when compared to hemodialysis and peritoneal dialysis [1]. The disadvantage is cost-effective. The first Renal Transplant in Sudan was performed in 1974 [2]. In Sudan, kidney transplant estimated to be 24% of the total renal transplants cases and elsewhere provided renal replacement therapies [3].

Transplanted kidneys were at risk of various morphologic and physiological changes. The ultrasound (US) plays an effective role to assess these abnormal changes. The parenchymal changes that involve the allografts include poor or obscured corticomedullary differentiation (CMD), a defect of the corticomedullary ratio (CMR), decreased or increased echogenicity [4]. (These findings were associated with graft dysfunction and reflect several diseases such as acute tubular necrosis, hyperacute, acute and chronic rejection, infection and drug nephrotoxicity.) However, Differential diagnosis

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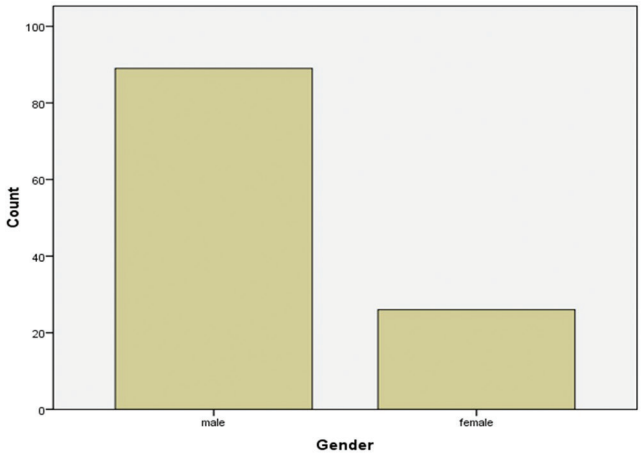

Figure 1. Gender distribution of the study participants.

is difficult by US alone, and the US is not sensitive to confirm the final diagnosis of renal rejection [5]. Although final diagnosis still relies on biopsy [6], US provides accurate assessment of morphology and vascularity of the grafts. Therefore, the sonographic assessment of morphologic changes provides structural information and early prediction of signs of rejection. It is an indicator of early pathological changes which may develop to acute rejection. On the other hand, color Doppler ultrasonography provides functional data on assessment of hemodynamic of renal arteries of the grafts. It is one of the necessary examinations performed in the clinical management of kidney transplant patients [7,8]. In this study, we emphasized on morphologic changes in the graft using gray scale US. In previous studies, the morphology and vascularity of the renal grafts were assessed to predict the signs of rejection [9,10].

The aim of this study was to evaluate the morphologic changes (CMD, CMR, cortical thickness, graft size of transplanted kidneys) in Sudanese recipients using gray scale ultrasonography. And to find whether there was a correlation of morphologic changes with graft age. The importance of assessing these abnormalities is to predict early renal dysfunction that may cause rejection of the graft.

Table 1. Characteristics of the study population according to occupation.

Characteristic	Frequency	Percentage
Worker	34	29.6
Employee	32	27.8
Housewives	23	20.0
No occupation	15	13.0
Student	11	9.57
Total	115	100%

Table 2. Age groups distribution of patients with transplanted kidneys.

Age groups	Frequency	Percentage
20–35 years	40	34.8
36–49 years	40	34.8
50–60 years	27	23.5
61–75 years	8	7.0
Total	115	100

Methodology

This retrospective study conducted in Khartoum State from July 2015 to April 2017. A total of 115 patients with known transplanted kidneys were retrospectively reviewed. The age was categorized into four groups: group 1 (20–35 years), group 2 (36–49 years), group 3 (50–60 years), and group 4 (61–75 years). The categorization is important to measure the incidence. The inclusion criteria included patients with transplanted kidneys and uncomplicated with tumors. Exclusion criteria included signs of cardiac diseases and other systematic diseases. A standardized data collection sheet was used to record the clinical history and demographic information. The Institute approved the study.

The sonographic findings were collected from the US reports in the patient's records. The renal parameters such as CMD, CMR, renal length, and echogenicity were recorded. The CMD was classified as normal, preserved, disturbed, and lost. The CMR was classified as normal, increased, and decreased. The echogenicity was assessed as hyper, hypo and normal. The kidney size follows the same classification. Measurement of kidney length above 12 cm was regarded abnormal (enlarged).

Table 3. Descriptive statistics of the study variables.

Variables	Minimum	Maximum	Mean	Std. Deviation
Age (years)	20	73	42.43	13.13
Blood urea	20	277	76.04	46.36
Serum creatinine	0.64	15.00	3.44	3.45
Size of the graft (cm)	5.70	14.00	10.56	1.54
Cortical thickness (mm)	2.30	15.00	10.098	2.32
Duration of the graft (month)	2	30	11.06	5.64

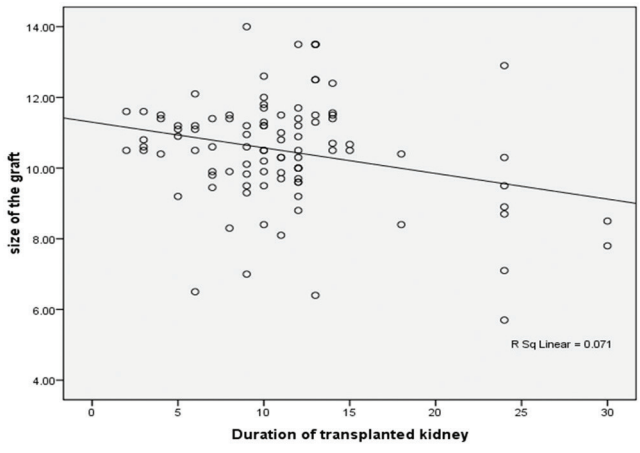

Figure 2. Correlation of age of transplantation and the graft size.

Statistical analysis

The data were analyzed using statistical software program (SPSS, version 20, USA). Descriptive statistics was used by which data presented as frequency and percent. Spearman man correlation was used to find correlation between duration of transplantation and the morphological changes. Pearson correlation was used to find correlation between length of the grafts and duration of transplantation. Values lesser than 0.05 were regarded as significant.

Results

A total of 115 cases of transplanted kidneys were retrospectively evaluated. The study population composed of 89 males and 26 females (Fig. 1). Table 1 summarizes the occupation of the patients. It was observed the majority were workers (34, 29.6%), employees (32, 27.8%), and housewives (23, 20%), respectively. The mean age was 42 ± 13-year-old, and it was categorized into four groups. The incidence of transplantation was most common in the age groups of 20–35 and 36–49 equally (Table 2). The mean duration of kidney transplantation was 11.06 ± 5.6 months, mean of cortical thickness was 10.098 ± 2.3mm, and mean of graft length was 10.56 ± 1.54 cm (Table 3). The mean values of serum creatinine and blood urea were 3.4 mg/dl and 76.04 mg/dl, respectively.

Table 5. Correlation of CMD, CMR, cortical thickness and graft size with duration of the graft.

Variables	Correlation coefficient	*p*-values
Corticomedullary differentiation	–0.08	0.38
Corticomedullary ratio	–0.16	0.11
Thickness of renal cortex	–0.01	0.95
Size of the allograft	–0.27	0.008
Echogenicity of the graft	0.002	0.98

Table 4. Sonographic assessment of morphologic changes of the transplanted kidneys.

Changes	Frequency	Percentage
Cortical thickness		
Thin	11	9.6
Thick	3	2.60
Normal	101	87.8
Cortico-medullary differentiation		
Preserved	83	72.2
Lost	08	6.96
Disturbed	24	20.9
Cortico-medullary ratio		
Increased CMR	08	6.95
Decreased CMR	21	15.65
Normal CMR	86	74.8
Increased CMR	08	6.95
Echogenicity		
Hyper	13	11.30
Hypo	8	6.96
Normal	94	71.73

The sonographic findings of transplanted kidneys were summarized in Table 4. It was observed that the thickness of kidney cortex was normal in 101 cases (87.8%), thin in 11 cases (9.6%) and thick in three cases (2.60 %). The CMD was normal in 72.2% of the cases, disturbed in 20.9% and lost in 4.3% less by 2.6. However, the CMR was normal in 74.8% of the cases, decreased by 13% and increased by 7.8% less by 4.4 There was negative correlation of age of transplantation with CMD (r = 0.08, p-value = 0.38), CMR (r = –0.16, p-value = 0.11), cortical thickness (r = 0.006, p-value = 0.95), and echogenicity (r = 0.002, p-value = 0.98) as shown in Table 5.

A negative significant correlation was found between size of the graft and age of the transplantation. It was observed that the size of the grafts was significantly decreased with the age of

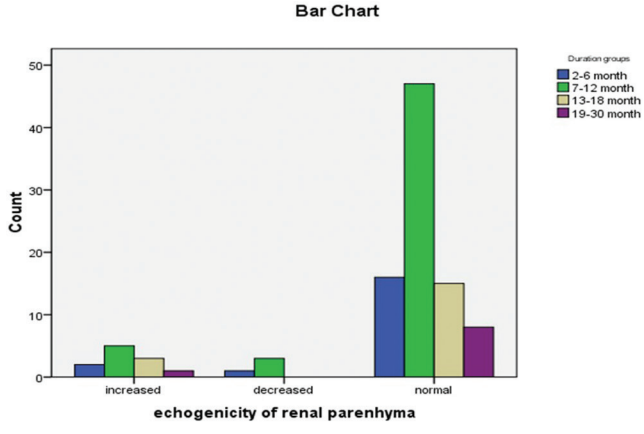

Figure 3. Comparison of echogenecity of the graft and age of transplantaion.

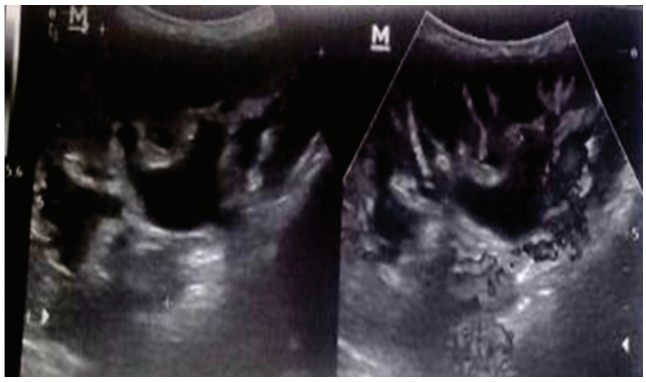

Figure 4. A hydronephrosis of transplanted kidney in a 54-year male patient.

the transplantation (p-value = 0.008) as shown in Figure 2 and Table 5. The echogenicity of the grafts was normal in 94 patients (81.74%), hyperechoic in 13 (11.30%), and hypoechoic in 8 (6.96%) as shown in Figure 3 and Table 5. Figures 4, 5, and 6 were sonograms demonstrating the morphologic changes within the grafts. Although the changes were statistically insignificant, clinically they were considered. The overall results indicate that the morphologic changes of the graft were decline due to ongoing time of transplantation.

Discussion

Ultrasonographic morphologic parameters are widely used to assess not only the present graft function but also the predictive factors of pathological processes and rejection. These parameters have been utilized to correlate with rejection and pathological changes that involved the allograft. The morphologic changes of the grafts in this study occurred in duration of transplantation ranged at 2–30 months.

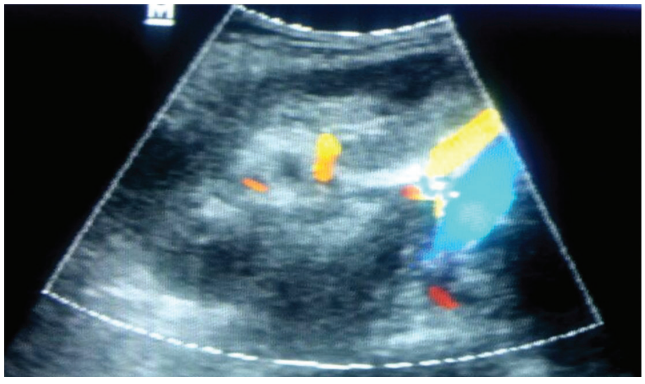

Figure 6. A sonogram reveals a transverse section through a renal graft revealed an increased echogenicity of the renal cortex which confirmed as infection.

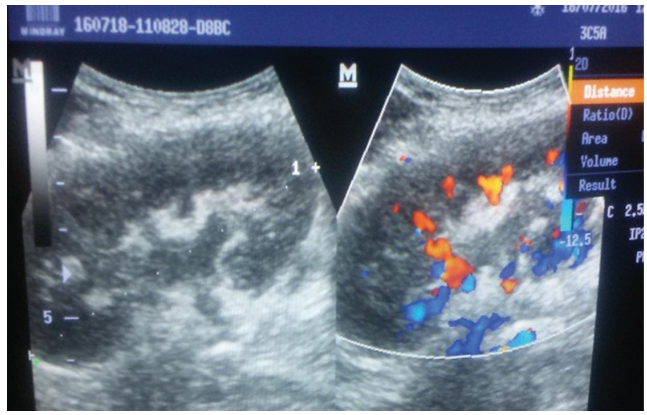

Figure 5. A sonogram of transplanted kidney measuring 8.87cm length with reduced CMD and dilated pelvicalyceal system.

The demographic results of this study revealed that the renal transplantation is common in male more than female (77.4% vs. 22.6%). This is attributed to high incidence of chronic kidney disease who undergoing hemodialysis. However, this finding is consistent with a previous study reported that 68.5% of the hemodialyzed patients who need Renal Transplantation (RT) were males [11].

The patients were categorized as follows: workers, employee, and housewives, respectively, and were prevalent in the age group of 20–35 and 36–49 years old. This result agreed with the study reported the incidence of ESKD with RT in Sudanese were common in these age groups [12].

In the current study, sonographic assessment of renal cortex of the transplanted kidneys revealed that the majority of renal grafts exhibited normal cortex and only 9.6% showed thin cortices. The normality of renal cortex may reflect the improvement and development of surgical techniques and immunosuppression drugs in renal transplantation. The study revealed that the CMD was disturbed in 20.9% and lost 4.3% in the transplanted kidneys. In literature, changes in the renal CMD were associated with renal parenchymal damage and renal insufficiency secondary to many causes [13]. In renal transplants, variations in the CMD may be associated with acute rejection [14]. And gradually developing renal cortical fibrosis in chronic allograft nephropathy. It is the most prevalent cause of chronic allograft dysfunction [15]. Therefore, changes in CMD predict allograft nephropathy.

On the other hand, assessment of CMR is necessary since it reflects pathological changes in the graft. In the present study, the CMR is increased by 7.8% and decreased by 13%. The importance of

CMR is to detect renal scarring and fibrosis which may result in a progressive loss of kidney function, ultimately leading to end-stage renal failure [15]. Already it was reported that as CMR is "a quantitative marker for monitoring the progression of cortical fibrosis in renal transplants" [16].

It was found that CMD, CMR, and cortical thickness had negative correlation with duration of the transplantation. The correlation is not strong. This is attributed to the short-term duration of the transplantation. However, these changes decline with long-term of graft transplantation (graft age). In general, these morphologic changes might be attributed to a slow decline in graft function [17].

The morphologic changes occurred when the age of the graft advance and this is attributed to many factors. In previous studies, morphologic changes may be caused by several factors such as inflammation, ischemia-reperfusion injury, rejection episodes, and other systematic diseases which may lead to graft dysfunction [18,19]. There were also factors that affect survival of the graft. Previously, it was reported that many factors influence the long-term outcome of the kidney transplant [20]. They include the quality of the operation, age, disease recurrence, ethnic background, and cardiovascular comorbidities.

In general, the incidence of morphologic changes in this study is not high and this might be attributed to short-term of transplantation which was ranged from 2 to 30 months. This is not enough to cause graft damage. Several reports discussed the factors and disorders that influence the stability of the graft [21,22]. All these disorders reflected on renal tissue of the graft and may lead to acute or chronic rejection. Although the incidence of the morphological changes in this study is not high, it should be observed and managed so as not to develop to worse complications.

Conclusion

In the duration of graft transplantation ranged 2 to 30 months, morphologic changes in cortical thickness, CMD, CMR,. and graft size have occurred. However, these changes were attributed to pathological changes that involved the graft. The sonographic evaluation of morphologic changes is useful and important to predict the rejection in an early stage.

Conflicts of Interest

There are no conflicts of interest regarding this study.

Funding

Nil.

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