



EVALUATION OF CHANGES IN LABORATORY PARAMETERS IN PATIENTS AFTER KIDNEY TRANSPLANTATION FOLLOWING TREATMENT PROCEDURES

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Abstract:

The article presents a comparative study of laboratory parameters over time in patients who underwent kidney transplantation. It also demonstrates that fibroblast-23 has a strong correlation with phosphorus, calcium, vitamin D, and parathyroid hormone, and plays a central role in phosphate homeostasis in the body. These findings were confirmed by strong correlations observed in patients who underwent kidney transplantation.

Keywords: chronic kidney disease, fibroblast-23, parathyroid hormone, vitamin D

INTRODUCTION. Over the past decade, the number of patients receiving kidney transplants has been steadily increasing, which, in turn, is leading to the emergence of new and complex problems for them. This method is considered an alternative treatment for end-stage renal failure and is being increasingly implemented in all countries, including Uzbekistan [1]. Unlike hemodialysis, patients living with a transplanted kidney experience not only an improvement in quality of life and increased life expectancy, but also significant positive changes in their survival rates.

In 2018, 36,541 successful kidney transplants were performed in the United States of America, 27,917 in Europe, 18,505 in the Western Pacific, 8,604 in Southeast Asia, 3,207 in Eastern Mediterranean countries, and 705 in Africa [15].

The importance of kidney transplant patients adhering to doctors' recommendations has been reflected in several articles published abroad in recent years. As these are considered chronic patients, following the recommended procedures and treatment measures prevents the risk of transplant rejection, reduces the likelihood of exacerbation of concomitant diseases, and minimizes the onset of new complications. The prescribed measures are complex, including non-drug treatments such as smoking cessation, avoiding alcohol abuse, regular physical activity, as well as taking immunosuppressive drugs [19].

In one study, between 28% and 67% of patients (depending on the detection method) did not adhere to the immunosuppressant regimen. As a result, the

probability of transplant rejection in patients increased sevenfold, accompanied by pronounced acute rejection, increased morbidity, and led to high additional costs for the healthcare system [23]. Observations on non-drug treatment methods were less frequent, with non-compliance with physical activity recorded in 21.8-84% of cases [25]. This, in turn, increases the risk of death from cardiovascular diseases. Smoking was detected in 2.8-4.0 cases per 100 kidney transplant patients within a year [26]. It should also be noted that smoking significantly increases mortality from cardiovascular diseases [27]. Alcohol abuse leads to the risk of transplant rejection and death [28].

In Uzbekistan, kidney transplant operations are being successfully carried out in several medical centers, with the Samarkand Regional Medical Center being one of the first among the regions to do so.

It is known that kidney transplant patients face stress factors associated with certain limitations in their lives. These include frequent doctor visits, strict adherence to immunosuppressant drug regimens and concerns about their side effects, uncertainty about future life, the possibility of infection, and the risk of transplant rejection in case of a crisis. Therefore, studying the quality of life of kidney transplant recipients is of particular importance. Having information about the quality of life of this group of patients enables the planning of further therapeutic procedures and provides an opportunity for targeted counseling before transplantation [29].



In 2023, more than 300 patients underwent kidney transplant surgery in Uzbekistan. It has been fully proven and generally recognized that after kidney transplantation, patients' quality of life improves and their life expectancy increases compared to those on hemodialysis and peritoneal dialysis.

PURPOSE OF THE STUDY: Assessment of changes in individual laboratory parameters before and after surgery in patients who underwent kidney transplantation.

RESEARCH MATERIALS AND METHODS: The study included 90 patients who underwent kidney transplantation in the Samarkand region of the Republic of Uzbekistan. Their average age was 52.6 ± 4.60 years, comprising 58 males and 32 females. All patients were placed under comprehensive observation, and their treatment regimens were studied. They underwent general blood and urine analyses, biochemical tests (urea, creatinine, albumin, and others), as well as examinations for vitamin D, parathyroid hormone, and fibroblast growth factor 23.

Patients who have undergone kidney transplantation are prescribed medications such as Basiliximab, methylprednisolone IV, tacrolimus, mycophenolate mofetil, and mycophenolate sodium for a specified period or lifelong according to established protocols. The dosage and administration schedule of these drugs are determined based on the time of surgery, patient's age, body weight, risk of infection and transplant rejection, levels of hemoglobin, leukocytes, platelets, vitamin D, parathyroid hormone, phosphorus, fibroblast growth factor 23, and the functional state of the kidneys.

ANALYSIS OF THE RESEARCH RESULTS. In our observations, laboratory parameters in patients before and after kidney transplantation were studied dynamically and compared. Table 1 below presents the results obtained in patients.

Table 1.

Comparative analysis of laboratory parameters obtained before and after treatment in observed patients with kidney transplantation.

Indicators	6 months after kidney transplantation (Group I)		1-3 years after kidney transplantation (Group II)		More than 3 years after kidney transplantation (Group III)	
	Before treatment	After treatment	Before treatment	After treatment	Before treatment	After treatment
Leukocytes, $10^9/l$	$6,6 \pm 2,0$	$4,8 \pm 2,4$	$6,8 \pm 2,2$	$4,2 \pm 2,3$	$7,2 \pm 2,1$	$5,6 \pm 2,3$
Hemoglobin, $10^{12} g/l$	$116 \pm 8,5$	$118 \pm 8,2$	$125,4 \pm 8,4$	$122,2 \pm 7,8$	$115,2 \pm 10,1$	$118,5 \pm 9,3$
Platelets, $10^9/l$	$206,2 \pm 10,8$	$218,5 \pm 12,9$	$192,4 \pm 12,3$	$207,4 \pm 15,4$	$167,2 \pm 12,9$	$185,7 \pm 7,7$
Urea, ($\mu mol/l$)	7.3 ± 0.3	6.8 ± 0.2	7.5 ± 0.2	7.2 ± 0.1	8.0 ± 0.2	7.6 ± 0.3
Creatinine, ($\mu mol/l$)	126.2 ± 4.7	$102.8 \pm 4.2^{**}$ *	128.3 ± 2.9	$104 \pm 3.8^{**}$ *	134.6 ± 5.2	108.4 ± 5.4 ***
Calculated glomerular filtration rate (per 1.73 m ² of body surface)	66.4 ± 1.3	$85.2 \pm 1.6^{***}$	64.6 ± 1.5	$82.4 \pm 2.2^{**}$ **	60.6 ± 1.8	$78.5 \pm 1.6^*$ **



Phosphorus (mmol/l)	1.3±0.1	1.2±0.15	1.3±0.1	1.24±0.1	1.5±0.1	1.4±0.2
Calcium Ca (mmol/l)	2.0±0.1	2.1±0.2	1.8±0.1	2.0±0.2	1.76±0.1	1.82±0.15
Vitamin D (ng/ml)	20.4±0.5	22.4±0.3***	18.6±0.6	20.8±0.4* *	16.2±0.9	20.3±0.6* **

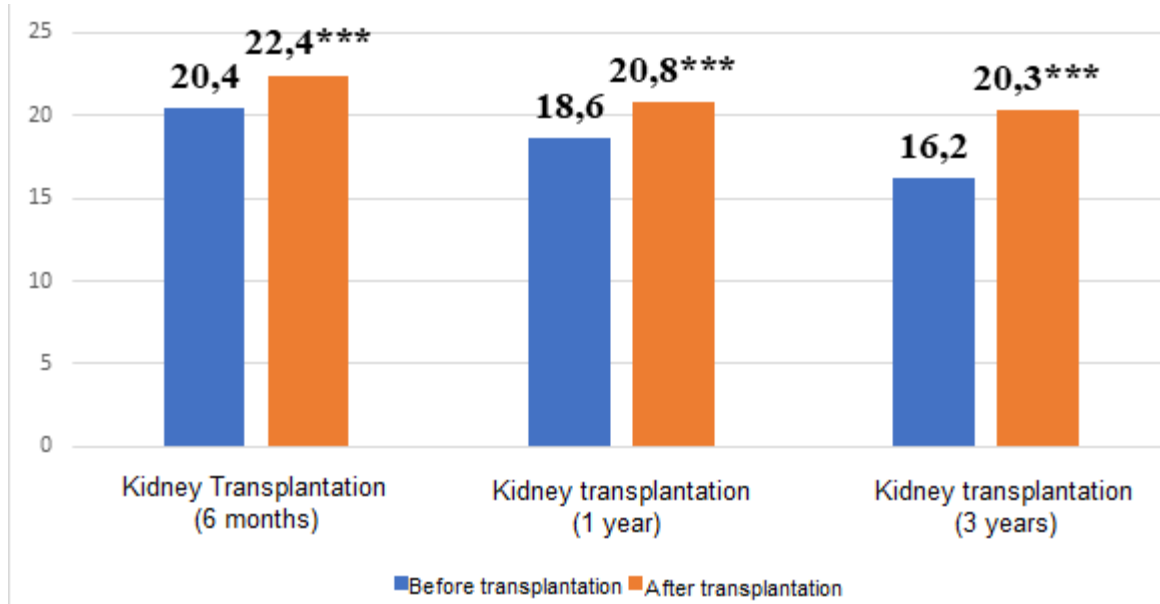
comment: P* <0.05; **<0.01; *<0.001*

As shown in the table, in patients 6 months after kidney transplantation, the leukocyte count was $6.6 \pm 2.0 \times 10^9/l$ before the procedure and $4.8 \pm 2.4 \times 10^9/l$ after. In patients 1-3 years after kidney transplantation, its level changed from $6.8 \pm 2.2 \times 10^9$ to $4.2 \pm 2.3 \times 10^9/l$, and in patients more than 3 years after transplantation, the leukocyte count changed from $7.2 \pm 2.1 \times 10^9/l$ to $5.6 \pm 2.3 \times 10^9/l$. No significant difference was found in all cases ($p > 0.05$). Hemoglobin levels in the first group were $116 \pm 8.5 \times 10^{12}$ g/l before the procedure and $118 \pm 8.2 \times 10^{12}$ g/l after, in the second and third groups they changed from $125.4 \pm 8.4 \times 10^{12}$ to $122.2 \pm 7.8 \times 10^{12}$ and from $115.2 \pm 10.1 \times 10^{12}$ to $118.5 \pm 9.3 \times 10^{12}$ g/l, respectively. However, when compared, no significant difference ($p > 0.05$) was observed. The platelet count between groups before the procedure was $206.2 \pm 10.8 \times 10^9/l$, $192.4 \pm 12.3 \times 10^9/l$, and $167.2 \pm 12.9 \times 10^9/l$, respectively, and after the procedure, it was $218.5 \pm 12.9 \times 10^9/l$, $207.4 \pm 15.4 \times 10^9/l$, and $185.7 \pm 7.7 \times 10^9/l$, respectively. When comparing the obtained results, no significant difference ($p > 0.05$) was found. Urea levels before treatment were 7.3 ± 0.3 , 7.5 ± 0.2 , and 8.0 ± 0.2 $\mu\text{mol/l}$ between the groups, respectively. Although positive changes were observed after treatment, they were not statistically significant. The creatinine level improved from 126.2 ± 4.7 to 102.8 ± 4.2 $\mu\text{mol/L}$ in the first group,

from 128.3 ± 2.9 to 104 ± 3.8 $\mu\text{mol/L}$ in the second group, and from 134.6 ± 5.2 to 108.4 ± 5.4 $\mu\text{mol/L}$ in the third group. A comparative analysis of the obtained results revealed a highly significant difference in all groups ($p < 0.001$). The calculated glomerular filtration rate increased between groups from 66.4 ± 1.3 to 85.2 ± 1.6 , from 64.6 ± 1.5 to 82.4 ± 2.2 , and from 60.6 ± 1.8 to 78.5 ± 1.6 , respectively, per 1.73 m^2 of body surface area per minute. When compared, a highly significant difference was noted in all three groups ($p < 0.001$).

The levels of phosphorus in blood serum decreased significantly in a positive direction after the treatment procedures. However, when comparing the groups, no statistically significant difference ($p > 0.05$) was observed. The calcium levels in blood serum before the intervention were 2.0 ± 0.1 , 2.1 ± 0.1 , and 2.2 ± 0.1 mmol/l among the groups, respectively. After the intervention, these levels changed to 2.1 ± 0.2 , 2.0 ± 0.2 , and 1.82 ± 0.15 mmol/l. When these results were compared, no statistically significant difference ($p > 0.05$) was noted among all three groups.

In addition to the aforementioned, the levels of vitamin D, parathyroid hormone, and fibroblast growth factor 23 were examined before and after the procedure. Figure 1 below illustrates the vitamin D levels in patients.



* comment: $P^* < 0.05$; $** < 0.01$; $*** < 0.001$

Figure 1. Comparative analysis of vitamin D indicators in dynamics in patients who underwent kidney transplantation.

The vitamin D level in the group of patients who underwent kidney transplantation increased from 20.4 ± 0.3 ng/ml to 22.4 ± 0.5 ng/ml, revealing a highly significant difference ($p < 0.001$). In patients who had undergone transplantation one year ago, an increase from 18.6 ± 0.4 to 20.8 ± 0.5 ng/ml was observed before and after treatment. A highly significant difference was noted between these values ($p < 0.001$). For those who had kidney transplantation three years ago, the indicators were 16.2 ± 0.4 ng/ml and 20.3 ± 0.5 ng/ml, respectively, with a highly significant difference ($p < 0.001$) observed between these measurements.

The results obtained confirmed that vitamin D levels in patients who underwent kidney transplantation

changed significantly after complex treatments. A highly significant difference was particularly evident in patients one and three years post-transplantation ($p < 0.001$). The findings demonstrated that the applied procedure and subsequent treatments play a crucial role in addressing vitamin D deficiency, and that vitamin D levels improve positively in correlation with the increasing duration of the post-transplant period. Parathyroid hormone indicators in patients who underwent kidney transplantation were also studied comparatively, and the results obtained are presented in Figure 2.

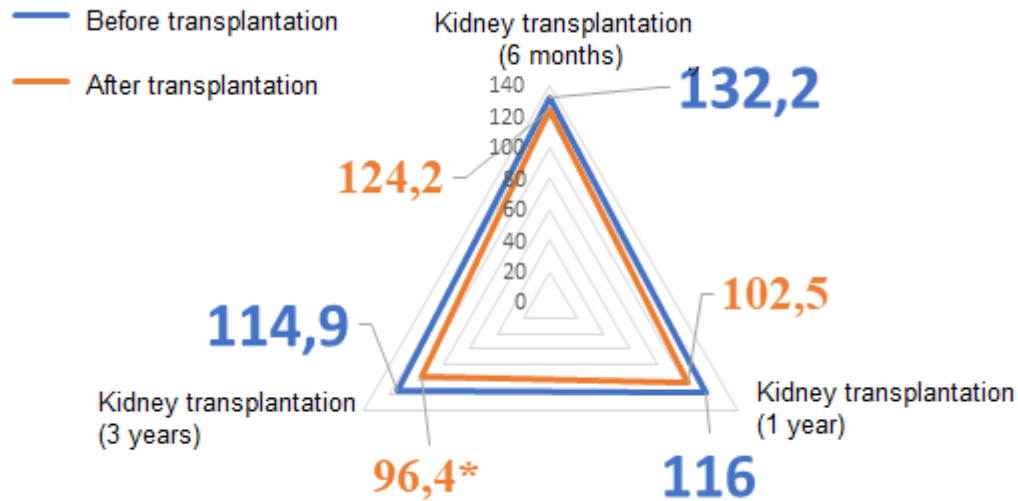


Figure 2. Comparative analysis of parathyroid hormone indicators in dynamics for patients who underwent kidney transplantation.

As shown in the figure, the initial parathyroid hormone levels before the procedure were 132.2 ± 8.2 ng/ml, 116.2 ± 6.3 ng/ml, and 114.9 ± 10.2 ng/ml, respectively, among the groups. After the operation and subsequent treatments, the levels were 124.2 ± 9.8 ng/ml, 102.5 ± 10.3 ng/ml, and 96.4 ± 29.4 ng/ml, respectively, among the groups. When comparing these results, no significant difference ($p > 0.05$) was observed in patients three years after transplantation.

According to the results of the study, the indicators of parathyroid hormone in all groups before surgery were at a high level. After the operation and

treatment, there was a tendency towards a decrease in its level in all groups, but after three years, the differences between them were significant ($p < 0.05$). This confirms that the studied hormone indicators in the recipient's body return to normal after a long period of time.

Recent studies have shown that fibroblast-23 plays an important role in the regulation of phosphorus-calcium metabolism and vitamin D metabolism. Taking this into account, we studied its indicators in patients in various periods after kidney transplantation (Fig. 3).

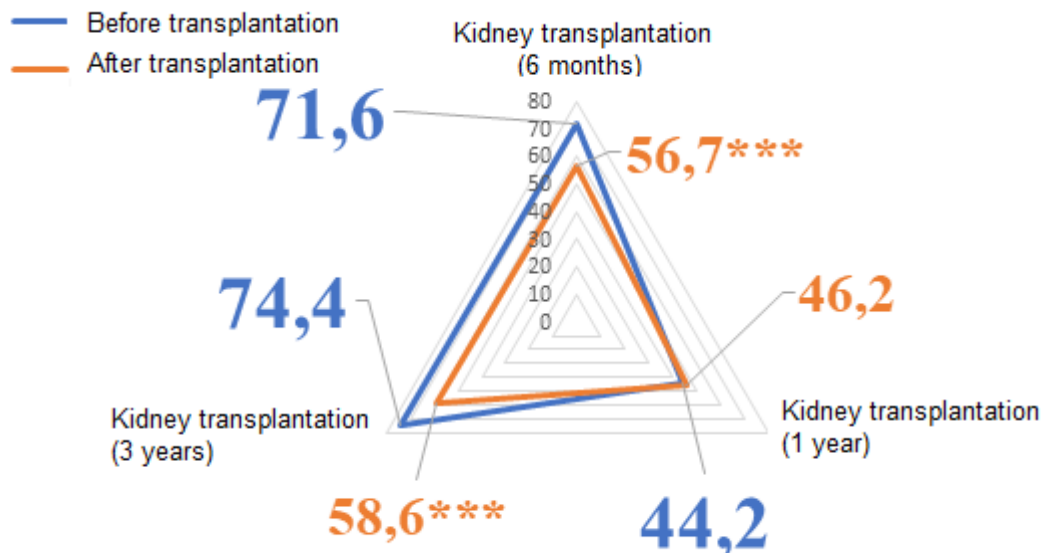




Figure 3. Dynamics of fibroblast-23 indicators in patients who underwent kidney transplantation.

As shown in the figure, the fibroblast content in blood serum was 71.6 ± 6.7 ng/ml in the first six months of transplantation and 56.7 ± 5.2 ng/ml after treatment. When comparing them, a high significance difference ($p < 0.001$) was revealed. In those who underwent kidney transplantation a year ago, before and after the operation, it was equal to 46.2 ± 3.2 and 44.2 ± 3.8 ng/ml, respectively, although the changes shifted to the positive side, but the differences were not significant ($p < 0.05$). In patients after kidney transplantation and 3 years after it, its indicators were 74.4 ± 4.5 and 58.6 ± 3.8 ng/ml, respectively, with a high significance difference ($p < 0.001$).

CONCLUSION. The results obtained demonstrated that fibroblast growth factor-23 (FGF-23) indicators exhibit varying dynamics depending on the post-kidney transplantation period. In the first 6 months following transplantation, patients showed a statistically significant decrease in FGF-23 levels after treatment ($p < 0.001$), indicating treatment effectiveness.

In patients one year post-transplantation, although noticeable positive changes in FGF-23 indicators were observed before and after treatment, the differences were not statistically significant ($p > 0.05$). However, it was found that after kidney transplantation, FGF-23 levels decreased with high statistical significance ($p < 0.001$). The administered treatments proved particularly effective in reducing FGF-23 levels, especially in the early and late post-transplantation periods. As shown in Table 1, this is crucial for correcting phosphorus-calcium metabolism disorders.

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