

A Modern Approach to the Treatment of Chronic Heart Failure with Anemia

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Abstract In the article, a mutual comparison of the effect of standard medical treatments containing glucose sodium cotransporter type 2 inhibitor dapagliflozin on hematological changes and intracardiac hemodynamics was studied in patients diagnosed with anemia with chronic heart failure. The increase in erythropoietin levels in the group of patients who received dapagliflozin after treatment is related to the effect of the drug on stimulating the production of erythropoietin in the kidney. Also, after the treatment procedures, patients' quality of life was evaluated using the Kansas questionnaire.

Keywords Chronic heart failure, Dapagliflozin, Kansas survey

1. Introduction

In recent years, the number of patients with chronic heart failure (CHF) has been steadily increasing. On the one hand, this is due to the increase in the average life expectancy of the population in the world, including Uzbekistan, and on the other hand, to the improvement of treatment methods for patients with cardiovascular disease, among which CHF is the leading one. Anemia is one of the most common syndromes in patients with CHF. A large number of clinical studies confirm that 7-79% of anemia occurs in this group of patients [24]. Wide differences in indicators are due to the lack of a uniform approach to the diagnosis of anemia, different causes of the disease and functional classes (FC) of CHF, demographic conditions, and a number of other factors [20]. The Framingham observations were the first to show that anemia is one of the important risk factors of CHF.

So far, CHF has not been studied until the end of the pathogenesis of the development of anemia. There are opinions about the influence of hemodilution, renal dysfunction, iatrogenic factors [angiotensin-converting enzyme inhibitors (ACEIs), angiotensin II receptor antagonists (ARA), beta-adrenoblockers (BABs), acetylsalicylic acids], proinflammatory cytokines, malabsorption syndrome, and other conditions [3,29]. Several observations show that the drugs used in the treatment of CHF are of particular importance in the development of erythropoiesis and anemia.

It is known that the renin-angiotensin system plays an important role in controlling the number of erythrocytes and the amount of blood plasma [4]. Some data confirm that long-term use of ACEIs in the treatment of CHF leads to

anemia. The role of ACEIs in the development of anemia in CHF was shown by A. Ishani and co-authors. According to him, in patients with CHF who had normal hematocrit indicators during the first period of observation, the number of anemia detected after one year of treatment with enalapril reliably increased [13].

In recent years, Glucose-sodium symporter 2 inhibitor drugs, which have many non-glycemic effective hypoglycemic properties, have also been shown to be effective in anemia in patients without CHF diabetes and low left ventricular ejection fraction. In particular, a reliable increase in hematocrit was found in patients taking dapagliflozin belonging to this group. According to some researchers, this situation can be attributed to the increased synthesis of erythropoietin as a result of the nephroprotective effect of the drug [23,21,8]. There are opinions that it has a positive effect on intrarenal hemodynamics, increases natriuresis, reduces the synthesis of pro-inflammatory cytokines, and has a nephroprotective effect [11,7,9].

In Uzbekistan, a number of scientific studies have been conducted on the diagnosis, treatment, and the impact of this condition on the quality of life of patients with CHF anemia [30,29,2,12].

However so far, the effects of ACEIs and glucose-sodium symporter 2 inhibitors on anemia have not been studied in comparison with CHF with anemia. Taking this into account, we set the following goal.

2. The Purpose of the Study

A comparative study of hemodynamic, antianemic and nephroprotective effects of angiotensin-converting enzyme inhibitors and glucose-sodium symporter 2 inhibitor dapagliflozin in patients with CHF anemia.

3. Research Materials and Methods

This scientific research work was conducted in 2021 and 2022 in the cardiology and cardiorehabilitation departments of the multidisciplinary clinic of the Tashkent Medical Academy in patients with CHF developed on the basis of IHD and arterial hypertension. Based on the goals and tasks set before us, the scientific research work was carried out as follows.

120 patients with CHF II and III FC were recruited and divided into two groups. The first group was composed of patients with iron deficiency anemia CHF II and III FC who received glucose-sodium cotransporter 2 inhibitor (gliflozins) dapagliflozin as part of complex standard treatment, and the second group included patients with iron deficiency anemia CHF II and III FC who received complex standard treatment without gliflozins organized. Both groups of patients were prescribed iron (III) sucrose intravenously.

The first group consisted of 80 patients and their average age was 65.1 ± 1.2 years, 22 (41.5%) men and 31 (58.5%) women. This group, in turn, was divided into two subgroups based on the FC of CHF.

The first subgroup consisted of 40 patients with II FS of SYuE, their mean age was 65.2 ± 1.4 years, 24 (60%) men and 16 (40%) women. 26 (65) had myocardial infarction (MI), 11 (27.5) had coronary artery bypass grafting (ACS) or stenting, 8 (20) had obesity, type II diabetes) - 4 (10%) people.

The second subgroup consisted of 40 patients with III FC of CHF. Their average age was 65.1 ± 1.6 years, males were 19 (47.5%) and females were 21 (52.5%). 21 (52.5%) had MI, 9 (22.5%), 9 (22.5%) had ACS or stenting, 11 (27.5%) were obese, 6 (15%) had QD II.

The second group consisted of 40 patients, their average age was 66.3 ± 2.0 , 20 (50%) men and 20 (50%) women. This group, in turn, was divided into two subgroups based on the FC of CHF.

The first subgroup consisted of 20 patients with II FS of CHF, their average age was 68.4 ± 2.1 years, 10 (50%) men and 10 (50%) women. 11 (55%) had MI, 6 (11.3%) had ACS or stenting, 16 (30.1%) were obese, and 4 (7.5%) had QD II.

The second subgroup consisted of 20 patients with III FC

of CHF. Their average age was 64.4 ± 1.2 years, with 10 (50%) males and 10 (50%) females. There were 17 (85%) who underwent MI, 8 (40%) who underwent ACS or stenting, 16 (30.1%) obesity, 10 (50%) QD type II.

The diagnosis of CHF and its FC in patients is based on the complaints of observers, the study of medical history, objective examination and laboratory-instrumental examinations in accordance with the "Recommendations for the diagnosis and treatment of acute and chronic heart failure" updated by the European Association of Cardiology in 2021 and the New York Society of Cardiology (New York It was determined according to the criteria of Heart Association, 1964).

In follow-up patients, laboratory-instrumental and functional examinations were performed on 1-3 days after admission to the hospital, and after the first and sixth months of treatment.

4. Analysis and Discussion of Research Results

After the various treatment procedures carried out in our patients, they were monitored dynamically for six months, and all laboratory tests were repeated. Tables 1 and 2 below compare the dynamics of hematological changes before treatment and after six months in patients with CHF II-III FC.

The main group of CHF II FC patients included in the study had a hemoglobin level of 120.2 ± 1.8 g/l in the sixth month after complex treatment, and a highly reliable ($P < 0.001$) difference was observed when compared with the values before treatment. In the control group, its amount increased to 106.4 ± 1.2 g/l before treatment and 120.8 ± 1.6 g/l after one month, and after 6 months it decreased to an average of 113.9 ± 2.1 g/l, but there was a reliable difference compared to the initial indicators ($P < 0.01$).

The number of erythrocytes in blood serum in the main group was $3.7 \pm 0.05 \cdot 10^{12}$ before treatments, $4.1 \pm 0.03 \cdot 10^{12}$ in the first month after treatments ($P < 0.001$) and $3.9 \pm 0.04 \cdot 10^{12}$ in the sixth month. ($P < 0.01$). In the control group, there was a highly reliable ($P < 0.001$) 1.1-fold increase from $3.6 \pm 0.03 \cdot 10^{12}$ to $3.9 \pm 0.02 \cdot 10^{12}$ in the first month, but after six months it was $3.7 \pm 0.04 \cdot 10^{12}$ decreased to.

Table 1. Comparative analysis of hematological changes before and six months after treatment in patients with functional class II anemia of chronic heart failure

№	Indicators	Main group, n=40		Control group, n=20	
		Before treatment	After six months	Before treatment	After six months
1	Hemoglobin, g/l	108.8 ± 1.4	$120.2 \pm 1.8^{***}$	106.4 ± 1.2	$113.9 \pm 2.1^{**}$
2	Erythrocytes, 10^{12} /l	3.7 ± 0.05	$3.9 \pm 0.04^{**}$	3.6 ± 0.03	$3.7 \pm 0.04^{*}$
3	Serum iron, $\mu\text{mol/l}$	10.6 ± 0.7	$17.8 \pm 1.4^{***}$	9.4 ± 0.5	12.4 ± 1.4
4	Ferritin, $\mu\text{g/l}$	129.7 ± 5.8	$204.6 \pm 7.4^{***}$	128.6 ± 4.4	$152.8 \pm 5.6^{**}$
5	Erythropoietin, mIU/ml	8.4 ± 1.2	$18.6 \pm 2.4^{***}$	8.6 ± 1.3	11.3 ± 1.8
* - differences are significant compared to pre- and post-treatment scores (* - $P < 0.05$, ** - $P < 0.01$, *** - $P < 0.001$)					

Table 2. Comparative analysis of hematological changes before treatment and six months after treatment in patients with functional class III chronic heart failure anemia

№	Indicators	Main group, n=40		Control group, n=20	
		Before treatment	After six months	Before treatment	After six months
1	Hemoglobin, g/l	102.4±2.1	117.2±3.2***	102.4±2.4	108.4±2.1
2	Erythrocytes, 10 ¹² /l	3.6±0.04	3.7±0.03	3.6±0.06	3.6±0.04
3	Serum iron, µmol/l	8.4±0.4	13.2±1.8*	8.5±0.5	10.6±1.2
4	Ferritin, µg/l	118.6±4.2	140.2±5.8**	116.6±4.2	123.5±4.8
5	Erythropoietin, mIU/ml	6.8±1.4	17.4±1.5***	7.4±1.6	9.8±1.1
* - differences are significant compared to pre- and post-treatment scores (* - P < 0.05, ** - P < 0.01, *** - P < 0.001)					

Serum iron increased from 10.6±0.7 µmol/l to 23.2±1.8 µmol/l one month after treatment in the main group (P<0.001) and decreased to 17.8±1.4 µmol/l after six months, but with pretreatment values. A highly reliable difference (P<0.001) was maintained when compared. In the control group, its amount changed from 9.4±0.5 µmol/l to 12.4±1.4 µmol/l during six months, and no significant difference was noted (P>0.05). In the main group of patients, the ferritin level changed from 129.7±5.8 to 204.6±7.4 µg/l after six months, and a highly reliable difference (P<0.001) remained. In the control group, it was 128.6±4.4 µg/L before treatment and 152.8±5.6 µg/L after six months, and a significant difference (P<0.01) was observed.

Serum erythropoietin in the main group of patients who received the standard treatment of SYuE containing dapagliflozin for six months increased dynamically from 8.4±1.2 mIU/ml in the first month to 13.6±1.5 mIU/ml and was equal to 18.6±2.4 mIU/ml in the sixth month. A highly reliable difference was found when comparing the obtained result with the pre-treatment indicator (r<0.001). In the control group, its amount was 8.6±1.3 mIU/ml, 12.4±2.1 mIU/ml and 11.3±1.8 mIU/ml, respectively. No reliable (r>0.05) difference was noted when comparing the results obtained after the treatment with the indicators before the treatment.

As shown in the table, in the main group with CHF III FC anemia, hemoglobin values increased from 102.4±2.1 g/l to 120.8±1.8 g/l in the first month after anti-anemic treatment (r<0.001), during six months when receiving the standard treatment of CHF containing dapagliflozin, its amount was equal to 117.2±3.2 g/l, and a highly reliable (r<0.001) difference was detected. In the control group, after antianemic treatments, it increased reliably from 102.4±2.4 g/l to 118.2±1.8 g/l, but decreased to 108.4±2.1 g/l during six months and reliably (R>0.05) no difference was noted. The number of erythrocytes in the main group was 3.6±0.04*10¹²/l and 3.7±0.03*10¹²/l before treatment and after six months, respectively (R>0.05). In the control group, the number of erythrocytes did not change dynamically.

Serum iron content in the main group of patients was 17.1±1.5 µmol/l (r<0.001) after the first month of antianemic

treatment and 13.2±1.8 µmol/l (r<0.05) at the sixth month after standard treatment. In the control group, its amount was 14.8±1.4 µmol/l and 10.6±1.2 µmol/l, respectively, and no reliable difference was noted (r>0.05). The amount of ferritin in the main group of patients changed from 118.6±4.2 µg/l to 167.4±6.4 µg/l highly reliable (r<0.001) and 140.2±5.8 µg/l reliably (r<0.01) during the six-month dynamic follow-up. In the control group, after antianemic treatment, its amount increased reliably from 116.6 ± 4.2 µg/l to 168.4 ± 5.6 µg/l, but it decreased to 123.5 ± 4.8 µg/l during the six-month dynamic follow-up and was reliable compared to the initial indicator (r>0.05) no difference was detected.

Erythropoietin levels in patients with CHF III FC showed a highly reliable increase in six-month dynamic follow-up after anti-anemic and standard treatment (from 6.8±1.4 mIU/ml to 17.4±1.5 mIU/ml, increased 2.6 times, r<0.001). In the control group, erythropoietin values increased significantly from 7.4 ± 1.6 mIU/ml to 12.7 ± 1.8 mIU/ml after antianemic treatment, but decreased to 9.8 ± 1.1 mIU/ml after six months (r>0.05).

The effect of dapagliflozin on hemoglobin, blood hematocrit and erythropoietin has not been fully studied. At the same time, the weak diuretic effect of the drug and the stable preservation of the noted changes confirm that other factors are important as well as its effect on hemoconcentration [18,14,10,17,25]. There is information that glucose sodium cotransporter type 2 inhibitors are also associated with the regulatory effect of iron protein administration [11,19]. In particular, dapagliflozin, an erythropoiesis suppressor, inhibits the production of hepcidin by significantly reducing hepcidin and increasing erythropoiesis [11].

In our study, reliable increases in hemoglobin, iron, and erythropoietin after six months of treatment with dapagliflozin are consistent with the data reported in the literature in recent years, as described above.

Intracardiac hemodynamic indicators after six months of standard medical treatments with different components in patients with CHF II FC anemia are presented in Table 3 below.

Table 3. Echocardiographic parameters before and six months after treatment in patients with functional class II anemia of chronic heart failure

№	Indicators	Main group		Control group	
		Before treatment	After six months	Before treatment	After six months
1	Left ventricular end-diastolic size (44-54 mm), mm	55.2±1.2	48.3±1.4***	56.2±1.3	50.2±1.6**
2	Left ventricular end-diastolic volume (88-145 ml), ml	162.4±3.4	145.4±3.2***	166.7±5.0	146.8±4.4**
3	Left ventricular end-systolic size (26-38 mm), mm	39.8±0.8	36.8±1.1*	41.4±1.4	37.8±1.5
4	Left ventricular end systolic volume (45-68 ml), ml	81.6±1.7	72.8±2.2**	86.2±2.2	72.4±3.4**
5	Left ventricular ejection fraction, %	48.2±1.2	54.6±1.8**	47.8±1.4	52.1±1.6*
* - differences are significant compared to pre- and post-treatment scores (*-P <0,05, ** - P <0,01, *** - P<0,001)					

Although the left ventricular end-diastolic size in the main group of patients with CHF II FC decreased from 55.2±1.2 mm to 52.6±1.4 mm in the first month of treatment, it was 48.3±1.4 mm (1.14-fold decrease) after six months of intensive treatment., highly reliable (R<0.001) changes were detected. Significant positive changes in dynamics were also noted in the control group (56.2±1.3 mm before treatment and 50.2±1.6 mm after six months, R<0.01). Left ventricular end-diastolic volume in the main group of patients was 162.4±3.4 ml before treatment and 152.3±3.1 ml after treatment (R<0.05), after six months it was 145.4±3.2 ml and was highly reliable (R<0.001) difference was noted. In the control group, left ventricular end-diastolic volume decreased as reliably as in the main group after the treatments (from 166.7±5.0 ml to 151.4±4.2 ml R<0.05 and 146.8±4.4 ml after six months, respectively) R<0.01). The left ventricular end-systolic size was 39.8±0.8 mm and 36.8±1.1 mm in the main group of patients before and after six months, respectively (R<0.05). In the control group, no reliable difference was detected after six months of treatment (decrease from 41.4±1.4 mm to 37.8±1.5 mm, R>0.05). Left ventricular

end-systolic volume changed dynamically after treatment in the main group: 81.6±1.7 ml before treatment, 74.2±1.6 ml after one month, and 72.8±2.2 mm after six months. A reliable (R<0.01) difference was noted in patients when the results were compared. In the control group, left ventricular end-systolic volume decreased reliably after treatment (from 86.2±2.2 ml to 78.4±2.8 ml and 72.4±3.4 ml after six months, respectively, as in the main group, R<0.01).

Left ventricular ejection fraction increased 1.13 times in the main group to 48.2±1.2% before treatment, to 52.3±1.6% after one month (R<0.05) and to 54.6±1.8% after six months and reliably compared to baseline (R <0.01) difference was noted. In the control group, 47.8±1.4% before treatment and 50.9±1.3% after one month, no reliable (R>0.05) difference was observed, while during six months of treatment, the changes were 52.1±1.6%. It was found to be improved by .08 times (R<0.05). But the indicator change was lower compared to the main group.

Changes in intracardiac hemodynamics after treatment in patients with CHF III FC anemia are presented in Table 4 below.

Table 4. Echocardiographic parameters before treatment and after six months of treatment in patients with functional class III chronic heart failure anemia

№	Indicators	Main group		Control group	
		Before treatment	After six months	Before treatment	After six months
1	Left ventricular end-diastolic size (44-54 mm), mm	60.2±1.4	54.1±1.5**	60.4±1.2	55.6±1.4*
2	Left ventricular end-diastolic volume (88-145 ml), ml	192.4±5.2	166.5±4.6***	190.4±4.8	168.6±5.4**
3	Left ventricular end-systolic size (26-38 mm), mm	45.5±1.6	41.2±1.3*	46.2±1.4	42.2±1.2*
4	Left ventricular end systolic volume (45-68 ml), ml	106.6±2.7	86.5±2.7***	107.4±3.2	89.6±4.2**
5	Left ventricular ejection fraction, %	42.6±0.9	50.5±1.8***	42.1±1.3	47.2±1.6*
* - differences are significant compared to pre- and post-treatment scores (*-P <0,05, ** - P <0,01, *** - P<0,001)					

As shown in the table, the left ventricular end-diastolic size in the main group of patients with CHF III FC anemia decreased 1.12 times from 60.2±1.4 mm to 55.8±1.3 mm (R<0.05) in the first month of treatment and to 54.1±1.5 mm in the sixth month, and higher a reliable (R<0.01) difference was found. In the control group, reliable changes were observed in the first month of treatment (decreased from 60.4±1.2 mm to 56.2±1.1 mm, R<0.05) and after six months of treatment, the changes were further improved to 55.6±1.4

mm left ventricular end-diastolic size 1.08 times. decreased (R<0.05). Left ventricular end-diastolic volume decreased by 1.07 (R<0.05) and 1.16 times in the first and sixth months of treatment in the main group, respectively, and a reliable difference (R<0.001) was found. In the control group, it decreased from 190.4±4.8 ml to 176.8±4.2 ml (R<0.05) in the first month of treatment, and after the sixth month, the left ventricular end-diastolic volume was 168.6±5.4 ml. The left ventricular end-systolic size was 45.5±1.6 mm and

43.2±1.2 mm in the main group before and one month after the treatment, respectively, and no reliable difference was detected ($R>0.05$). In the control group, it was equal to 46.2±1.4 mm and 43.9±1.5 mm ($R>0.05$). After six months of treatment, reliable changes were observed in both groups of patients (41.2±1.3 mm and 42.2±1.2 mm, respectively, $R<0.05$). Left ventricular end-systolic volume improved from 106.6 ± 2.7 ml to 88.4 ± 2.2 ml after one month in the main group and decreased by 1.23 times after six months compared to baseline, a highly reliable ($R<0.001$) difference was noted in both cases. In the control group, a reliable ($R<0.05$) difference decreased from 107.4±3.2 ml to 93.6±4.2 ml after one month of treatment, and after six months, left ventricular post-systolic volume improved further and a high reliable difference was observed (89.6±4.2 ml, $R<0.01$).

In the group that received the main, i.e. standard treatment of CHF containing dapagliflozin, the left ventricular ejection fraction increased by 7.9% from 42.6±0.9% before the treatments to 46.7±1.6% after one month and 50.5±1.8% after six months, and the high a reliable ($R<0.001$) difference was noted. In the control, i.e. those who received the standard treatment of CHF, during the treatment, during the first month, from 42.2±1.3% to 45.5±1.5% unreliable ($R>0.05$), it increased by 5% to 47.2±1.6% in the sixth month, reliable ($R<0.05$) difference was observed.

The analysis confirmed that intracardiac hemodynamics in the main group compared to the control group, in particular, the systolic and diastolic volumes and dimensions, were significantly increased in almost all indicators. Left ventricular ejection fraction also changed to a high confidence positive with a 7.9% increase in the baseline group. The obtained

results showed that the use of dapagliflozin in combination with iron III sucrose drugs in the standard treatment was more effective than the control group without the last drug in the complex treatment. This confirms the positive effect of drugs belonging to the group of inhibitors of glucose sodium cotransporter type 2 on the recovery of the functional state of the heart. Our results are consistent with those obtained in recent years and reported in the literature below.

Treatment with GNKT2i is known to have diuretic and natriuretic effects. As a result of them, the amount of total water and sodium loss in the body increases [15,28,16]. A decrease in circulating serum reduces cardiac preload and left ventricular filling pressure. This, in turn, has a positive effect on myocardial activity and reduces interstitial fibrosis [30]. The above shows the cardioprotective effect of the drug. In addition, the drugs of this group normalize the properties caused by glycation, which increase inflammation and cause endothelial dysfunction, change carbohydrate metabolism in a positive direction, decrease blood pressure and body weight, and cause other positive changes [5]. In addition, they block the production of renin by reducing the activity of the intrarenal renin-angiotensin-aldosterone system. As a result of this effect, the cardioprotective effect of the drug is also manifested [1,6,22,26,27].

At present, the Kansas questionnaire is widely used by world researchers to evaluate the clinical condition of patients with CHF. Because it has a number of advantages over the existing Minnesota questionnaire in terms of comprehensiveness. Therefore, we also conducted this questionnaire before and after treatment in our observation patients. Table 5 below shows the results obtained.

Table 5. Quality of life indicators before and after treatments in patients involved in the study

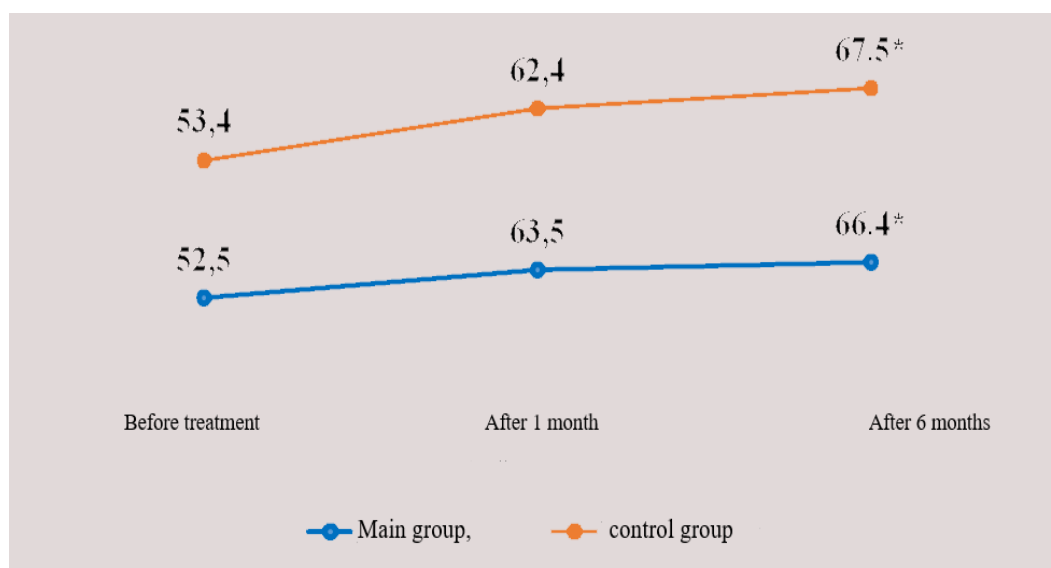
Kansas survey pointers	Main group, n=80			Control group, n=40		
	Before treatment	One month after treatment	Six months after treatment	Before treatment	One month after treatment	Six months after treatment
Physical limitation	53,4±5,3	65,2±4,1	68,5±4,8*	54,1±4,4	62,4±4,5	66,7±3,8*
Complaints	54,5±5,0	69,4±4,5*	71,8±4,5*	56,3±4,1	68,4±3,9*	73,6±4,5**
Social limitation	48,1±2,6	56,4±2,8*	63,2±3,4***	51,8±3,6	66,5±4,0*	68,2±3,8**
Quality of life	54,6±3,8	60,8±3,2	73,6±3,6***	52,4±4,2	64,5±3,5*	68,4±3,9**

Explanation: *-differences are significant compared to pre- and post-treatment values (*- $P<0.05$, ** - $P<0.01$, *** - $P<0.001$)

As shown in the table, in the group that received the standard treatment of CHF containing dapagliflozin, their complaints (from 54.5±5.0 points to 69.4±4.5 points) and social exclusion (from 48.1±2.6 points) in the first month after treatment 56.4±2.8 points) changed positively ($P<0.05$). Social exclusion improved by 30% in patients after six months and a highly reliable difference was found ($P<0.001$). Although positive changes were noted when patients' complaints were observed for six months, no highly reliable difference was observed. No reliable ($P>0.05$) changes were observed in quality of life and physical limitations after the first month, although a significant positive shift was detected. After six

months of treatment, quality of life increased by 73.6±3.6 points reliably ($P<0.001$) and physical limitation increased by 68.5±4.8 points reliably ($P<0.05$).

In the control group that received standard treatment without gliflozin, physical limitation was 54.1 ± 4.4 before treatment, 62.4 ± 4.5 after one month ($P>0.05$), and 66.7 ± 3.8 after six months. ($P<0.05$) changed. In the sixth month of treatment, significant positive changes were found in patient complaints, and a moderate reliable difference ($P<0.01$) was noted. Patients' social marginality and quality of life also increased significantly ($P<0.01$) after treatment.



Explanation; *-differences are significant compared to pre- and post-treatment values (*-P < 0,05)

Figure 1. Changes in the dynamics of the total score of the Kansas questionnaire in patients included in the study

As shown in the figure, significant positive changes in the quality of life according to the Kansas questionnaire were found in the main and control groups after treatment with different composition of CHF in the first month of treatment (52.5 ± 4.6 to 63.5 ± 3.2 and 63.5 ± 3.2 , respectively). from 53.4 ± 3.8 to 62.4 ± 3.2 points, $R > 0.05$). During the six-month dynamic follow-up, the tendency to positive changes was maintained in both groups, and a reliable difference ($P < 0.05$) was noted.

5. Conclusions

It was found that the use of dapagliflozin, an inhibitor of glucose sodium cotransporter type 2, as part of standard treatment, has a positive effect on erythropoietin synthesis in patients with chronic heart failure and anemia. It has also been proven that the drug normalizes iron and ferritin levels in the blood, that is, it has an anti-anemic effect.

After treatment, dapagliflozin had a positive effect on intracardiac hemodynamic indicators and improved quality of life using the Kansas Questionnaire.

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