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# Effect of Coenzyme Q10 on Echocardiographic Parameters in Children with Heart Failure due to Dilated Cardiomyopathy: A Clinical Trial

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## Abstract

**Background:** Heart failure (HF) is one of the most common and complex heart diseases that has a heavy burden on the health care system. Considering the role of supplements in improving heart diseases and increasing the quality of life of patients, in this study we aimed to investigate the effect of coenzyme Q10 on echocardiographic parameters in children with heart failure due to dilated cardiomyopathy.

**Methods:** In this pilot single-arm clinical trial, fifteen children with heart failure were included after obtaining written consent and medical history. They first underwent echocardiography and then were treated with oral coenzyme Q10, 10 mg/kg daily for 2 months. Then they underwent echocardiography again and the information was collected. Data were entered into SPSS ver. 20 software and depending on the data distribution, appropriate paired statistical tests were applied.

**Results:** Out of 15 patients participating in the study, 7 (46.7%) were female and 8 (53.3%) were male. The mean of EF before and after drug administration was 38.87 ± 15.81 and 43.40 ± 15.91, respectively. Also, the mean FS of patients before and after receiving the drug was 23.73 ± 7.81 and 25.73 ± 6.46, respectively ($P < 0.001$).

**Conclusion:** In this study, echocardiographic parameters of patients with HF due to dilated cardiomyopathy significantly improved after receiving coenzyme Q10, which indicates the possible positive effect of coenzyme Q10 on heart function and can probably be used in the treatment program of patients. Due to the pilot design of this study, more studies are needed in this field.

**Keywords:** Heart failure, Echocardiography, Coenzyme Q10, Cardiomyopathy, Dilated

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## Introduction

There are so many diseases that can affect our lives and change the quality of life significantly. Heart failure is one of the most common and complex heart diseases that has a heavy burden on the medical system (1-4). Cardiomyopathies are a group of heart muscle disorders and can be inherited (genetic/familial) or acquired. Dilated cardiomyopathy (DCM) is one of the most common and progressive cardiomyopathies (1-6).

This disease causes a large number of patients to be hospitalized annually, and in fact, the quality of life of people with the disease is low due to the limitations created. Despite many advances in medicine, there are still up to 10% of annual deaths from this disease (3-8). Surgery has significant effects in these patients, but the lack of facilities as well as a suitable donor, causes a lack of this treatment and this treatment cannot be applied to many patients (6).

Drugs used in this disease include diuretics, beta-blockers, and ACEI. These drugs are traditionally common in the treatment of this disease and increase life expectancy and reduce hospitalization (7, 8). However, the study on the main and adjuvant treatments of this disease continues in order to increase the quality of life and longevity of patients (9). Supplements are one of the cases that have recently been considered in many studies to play an effective role in helping to improve the condition of

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***Key Messages:***

***↑What is "already known" in this topic:***

The difference between EF and FS of patients before and after receiving Q10 was significant, indicating probably the positive effect of coenzyme Q10 on heart function.

***→What this article adds:***

Coenzyme Q10 probably can be used in the treatment of patients with heart failure due to dilated cardiomyopathy. Due to the pilot design of this study, more studies are needed in this field.

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these patients (6). In fact, too many studies showed the role of deficiency of supplements or nutrients increases the risk of heart problems, including heart failure (10). These supplements actually play a wide variety of roles, including antioxidants, improving the general health of the body, and co-factoring.

One of these supplements is coenzyme Q10 (ubiquinol or ubiquinone) (11-13). This vitamin-like effect is effective in various organs through its effect on mitochondria as well as its antioxidant properties (14). This supplement acts through the mitochondrial respiratory chain and its deficiency can cause damage to energy production (15). This effect can help patients with heart problems greatly (4, 12, 16).

Considering the role of supplements in improving heart disease and also further study to find a suitable drug to help increase the quality of life of patients in this study, we decided to investigate the effect of coenzyme Q10 on echocardiographic parameters in children with heart failure.

## Methods

### *Design and setting*

This pilot single-arm clinical trial study was carried on children under the age of 16 years old presenting to Bandar-Abbas Children's Hospital in 1398 and 1399 with heart failure due to dilated cardiomyopathy. Convenient sampling method was used to include patients and continued until reaching the desired sample size. The number of samples was estimated by considering type I error of 0.05 and type II error of %20. The level of significancy was considered 0.05 in this study (15).

### *Inclusion and exclusion*

Children with heart failure due to dilated cardiomyopathy under the age of 16 were included. Exclusion criteria were as follows: Any kind of metabolic disorders or other comorbidities that affect the cardiac variables studied in this study.

### *Procedure*

Children who, according to the diagnosis of a cardiologist, had the necessary criteria to enter the study, entered the study after obtaining informed and written consent. First, a complete history of the patient was taken and the variables such as age, sex, weight, duration of the disease, and possible complications of coenzyme Q10 were obtained. The patients then underwent cardiac echocardiography.

Ejection fraction (EF), fractional shortening (FS), tricuspid regurgitation (TR), and mitral regurgitation (MR) were recorded. Patients were then treated with coenzyme Q10 (Golden Life, Australia) 10 mg per kg orally for 2 months. Patients dissolved the drug in water and took it orally. After 2 months, the patients were re-examined and the desired variables were re-examined and possible side effects of the drug were recorded. During the treatment, the patients were contacted every 4 weeks for continuous use of the drug and the patient was also asked to deliver the empty package of drugs.

### *Statistical analysis and Ethics*

In this study, the purpose of the study was stated accurately and informed and written consent was obtained from the patients' parents.

Data were entered into SPSS 20 software (SPSS, Chicago, IL, USA) and analyzed using paired t-test. Quantitative data were reported using mean and standard deviation and qualitative data were reported by frequency and percentage. Significance level in this study was considered 5%.

## Results

Out of 15 patients participating in the study, 7 (46.7%) were girls and 8 (53.3%) were boys. Also, the mean age of the patients was 5.90 ± 3.02 years. The lowest age was 6-month-old girl and the highest age was for 10-year-old boy (Table 1).

The mean EF before and after drug administration was 38.87 ± 15.81 and 43.40 ± 15.91, respectively. Also, the mean FS of patients before and after receiving the drug was 23.73 ± 7.81 and 25.73 ± 6.46, respectively. The majority of patients had mild MR and mild TR before and after receiving the drug.

It seems that the EF of patients increased significantly after receiving Coenzyme Q10 (Table 2). Based on the obtained data, the difference in FS of patients before and after receiving Q10 was significant ($P < 0.001$). It seems that patients' FS increased significantly after receiving coenzyme Q10. Although it appeared that the patients' MR improved clinically after receiving Q10, it was not statistically significant ($P = 0.126$). No side effects were observed with the drug.

## Discussion

Coenzyme Q10 is a fat-soluble molecule, non-prescription nutritional supplement, and antioxidant that has a role in energy production. In fact, the highest concentrations of coenzyme Q10 were found in the heart cells (17). In this study we aimed to investigate the effect of coenzyme Q10 on echocardiographic parameters in children with heart failure due to dilated cardiomyopathy. Echocardiographic parameters of patients significantly improved after receiving coenzyme Q10, which indicates the possible positive effect of coenzyme Q10 on HF due to dilated cardiomyopathy.

Of the 15 patients participating in the study, 7 (46.7%) were female and 8 (53.3%) were male, and all patients received coenzyme Q10 supplementation for 2 months. However, in different studies, the results were contradicto-

*Table 1.* Basic Characteristic of patients included in this study

| Variable | Mean ± SD | N (%) |
|---|---|---|
| Age, years | 5.90 ± 3.02 | |
| Sex, n (%) | | |
| Male | | 8 (53.3) |
| Female | | 7 (46.7) |
| Weight, Kg | 19.50 ± 10.50 | |
| Age of the patient at the time of diagnosis, months | 13.27 ± 18.22 | |



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*Table 2.* Echocardiographic variables before and after Q10 administration

| Variable | N (%) | Mean ± SD | N (%) | *P*-value |
|---|---|---|---|---|
| Ejection fraction | Before | 38.87 ± 15.81 | | <0.001 |
| | After | 43.40 ± 15.91 | | |
| Fractional shortening | Before | 23.73 ± 7.81 | | <0.001 |
| | After | 25.73 ± 6.46 | | |
| Mitral regurgitation | Before | Negative | 1 (6.7) | 0.126 |
| | | Mild | 7 (46.7) | |
| | | Moderate | 6 (40) | |
| | | Severe | 1 (6.7) | |
| | After | Negative | 4 (26.7) | |
| | | Mild | 7 (46.7) | |
| | | Moderate | 4 (26.7) | |
| | | Severe | 0 (0) | |
| Tricuspid regurgitation | Before | Negative | 2 (13.3) | 0.100 |
| | | Mild | 10 (66.7) | |
| | | Moderate | 3 (20) | |
| | | Severe | 0 (0) | |
| | After | Negative | 3 (20) | |
| | | Mild | 10 (66.7) | |
| | | Moderate | 2 (13.3) | |
| | | Severe | 0 (0) | |

ry. A study by Khatta et al., published in 2000, researchers examined the effect of coenzyme Q10 on heart failure in adults. In this randomized double-blind clinical trial study, 55 patients with heart failure with NYHA class 3 and 4 and ejection fraction less than 40% were studied. Patients were divided into two groups of placebo or the study group of coenzyme Q10 200 mg daily. 46 patients completed the study. Finally, in this study, the researchers concluded that coenzyme Q10 has no significant effect on patients and their cardiac variables (9).

However, in a study conducted by Keogh et al., (14) in 2003 investigating the effect of coenzyme Q10 on class 2 and 3 systolic heart failure in adult, 39 patients were randomly divided into two groups. One group was treated with 150 mg per day and the other group received placebo. 35 patients completed the study. The results showed that in the group receiving coenzyme Q10 compared to the placebo group, cardiac function was significantly improved and coenzyme Q10 could have a beneficial effect on improving heart function.

In a pilot study conducted in 2018 by Chen et al. (15) investigating the effect of liquid coenzyme Q10 on children with dilated cardiomyopathy, 10 children were studied. NYHA class and echocardiographic variables were evaluated before and after drug administration. After 4 months, blood coenzyme levels were measured and echocardiographic variables improved compared to baseline measurements. Finally, the researchers concluded that coenzyme Q10 can improve the symptoms of the disease as well as echocardiographic variables.

Also, the effect of coenzyme Q10 supplementation on EF in patients with heart failure has been reported, such as the study of Al Saadi et al. (17) which showed the positive effect of this supplement on EF.

In the present study, findings showed that the EF, FS (statistically and clinically), and MR (clinically) of patients after receiving coenzyme Q10 significantly increased, which is in line with findings of other studies (14, 15, 17). In the study of Samuel et al. (18) it was concluded that coenzyme Q10 intake in patients with heart failure has little effect on the diastolic function of the heart. of In other studies, such as Kurita A. et al. (19) it was shown that the FS component is related to the diastolic function of the heart. However, in our study, it was observed that patients' FS increased significantly after receiving coenzyme Q10, which indicates a positive effect of coenzyme Q10 consumption on cardiac diastolic function.

Although before and after coenzyme Q10 administration, there was no significant statistical difference in relation to MR, before coenzyme Q10 administration, 7 people were in the severe and moderate group, and after its administration, 4 people were in the severe and moderate group, and its intensity had diminished. In fact, clinically it can be considered as an improvement in heart function.

In the study by Samuel et al. (18) showed that although supplementation improves MR but this finding was not statistically significant. In the present study results showed that patients' MR improved after receiving Q10 but was not significant statically. Also, in the study of Samuel et al. (18), it was found that coenzyme Q10 supplementation improves TR, but this finding was not statistically significant. Moreover, this study could be expanded into a larger-scale sudy for patients, similar to previous international studies (20).

### *Limitations and suggestions*

Due to the contradictory results obtained in different studies, it is recommended that further studies be performed with a larger sample size and for a longer period of time with more follow-up. Beside this, having control group can give us a better understanding. It is possible that the effects of drugs on the body vary at different ages. Therefore, it is suggested that this study be performed in other age groups as well. It can be given in divided doses and future studies can examine its effect on HF and dilated cardiomyopathy.

## Conclusion

The difference between EF and FS of patients before and after receiving Q10 was significant, indicating the



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positive effect of coenzyme Q10 on heart function. Although in this study, it appeared that the patients' MR improved after receiving Q10, it was not significant. As a result, coenzyme Q10 probably can be used in the treatment of patients with heart failure due to dilated cardiomyopathy. Due to the pilot design of this study, more studies are needed in this field.

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### Conflict of Interests

The authors declare that they have no competing interests.

### Authors' Contributions

All authors contributed to this project and article almost equally. All authors read and approved the final manuscript.

### Ethical Considerations

This study was reviewed by the ethics committee of Hormozgan University of Medical Sciences, Hormozgan, Iran (ethics code: IR.HUMS.REC.1398.350). All child information was kept confidential and ethical matters related to human experiments (based on the Helsinki Declaration) were taken into account (trial registration code: IRCT20190612043878N1).

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None.

### Data Availability

Data are available upon reasonable request to the corr sponding author.

### AI Use Statement

Artificial intelligence (AI) tools were used solely for language editing and grammatical correction. They were not used to generate scientific content or interpret the study findings.

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