*Bratisl Lek Listy 2008; 109 (11)*
483–485

CLINICAL STUDY

# Rehabilitation protocols in children with corrected congenital heart defects due to the presence of pulmonary complications

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**Abstract:** *Background:* The Aim of our study was to present early rehabilitation protocols for children with and without pulmonary complications after the correction of congenital heart defects and to estimate the optimal time for the initiation of early rehabilitation in both groups of children.
*Methods:* In our study, 176 children treated at the University Children's Hospital in Belgrade were evaluated during the period 2003–2007. All patients were children with the corrected congenital heart defects from birth to 12 months of life.
*Results:* In the group of patients without pulmonary complications we administered 3.64±1.02 exercises and in the group with present pulmonary complications we implemented 2.71±0.79 exercises. The optimal time for the initiation of early rehabilitation is 1.54±1.37 days for the group of children that did not have pulmonary complications, but for the other group the period was longer: 2.27±1.68 days.
*Discussions:* The optimal number of exercises in children younger than one year of life is from 2 to 4 and the early rehabilitation should start as soon as possible. A desirable time for beginning of such program is within 24 to 48 hours post surgery but it cannot be limited to this interval due to possible complications stating that every child should have an individual approach *(Tab. 3, Ref. 14)*. Full Text (Free, PDF) *www.bmj.sk.*
Key words: congenital heart defects, early rehabilitation, pulmonary complications.

Congenital heart defects (CHD) occurs in 1 % of all births with the frequency of approximately 8 in 1000 newborn according to William HG et al (1).

Severity of disease, prognosis and patients level of recovery after the correction of CHD is related to the type of CHD. Therefore, some conditions, that include a mild valvular disease or a small ventricular septal defect, do not require specific treatment, while more complex defects require surgical treatment and lifelong follow up care (2, 3). Past studies have shown an acute improvement in exercise capacity with the implementation of cardiac rehabilitation (4–8). An important aspect for the improvement of physical tolerance is prevention of complications by including children in an early rehabilitation program. Beside excellent surgical results some children usually presents with a depression of physical condition (6, 9, 10, 11).

To avoid pulmonary, vascular and locomotor complications after the correction of CHD, the implementation of early rehabilitation program is of great importance.

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The aim of our study was to present early rehabilitation protocols for children with and without pulmonary complications after the correction of CHD and to estimate the optimal time for initiation of early rehabilitation in both groups of children.

## Methods

*Study group*

We recruited and evaluated 176 children with the CHD treated at the University Children's Hospital in Belgrade, Serbia. The age of participants ranged from birth to 12 months of life. Results were collected in the period from 2003 to 2007.

For the purpose of this study, we implemented exercises for the prevention of pulmonary, locomotor and cardiovascular complications. Patients had exercises daily, in the morning after meal and in the afternoon. For the prevention of respiratory complications, we prescribed exercises for increasing the functional status of the lungs. For the prevention of thrombosis, contractures and decubites, we prescribed exercises that included both passive and active motoric action. Four types of exercises were evaluated: passive relaxing movements (PRM), percussion drainage (PD), breathing exercises (BE) and verticalisation (V).

Recruited children were divided into 2 groups due to presence of pulmonary complications: group of children with pulmonary complications and group of children without pulmonary complications. In these 2 groups we separately evaluated number of exercises and initiation of the rehabilitation program.

Every child was evaluated on daily basis for the monitoring of pulmonary complications during early rehabilitation. For the objective pulmonary status evaluation, we used auscultatory examination and X-ray technique. For the detection of decubites and contractures, a clinical examination was used. For the detection of possible thrombosis, we used ultrasound.

*Statistical analysis*

Every type of exercise is presented as median value with standard deviation. To compare number of exercises in the group of children with pulmonary complications and in the group of children without complications, we used the student t-test. Comparison of the time between operation and initiation of early rehabilitation in the group of children with pulmonary complications and in the group of children without complications was done by the student t-test.

## Results

We evaluated 176 children with the CHD treated at the University Children's Hospital in Belgrade. The length of every exercise is presented in the Table 1. In these children, we had neither locomotor nor cardiovascular complications. Since these patients are younger than one year of life, the walking exercise couldn't be properly implemented and such technique wasn't analyzed.

In the group of patients with pulmonary complications we diagnosed either athelectasis or pneumothorax. The results of number of exercises and initiation of early rehabilitation program implemented due to presence of pulmonary complications are described in the Table 2 and Table 3. The time when early rehabilitation was introduced is expressed in days.

## Discussion

Congenital heart defects are the leading cause of mortality in the neonatal period and present a significant group in the pediatric pathology.

An interdisciplinary approach of optimal care in children with CHD includes an adequate evaluation of anatomical defects and its physiological consequences. A success of therapy is based on the ability of physician to monitor pulmonary hemodynamic state and to correct present pathology (1).

Various studies evaluated acute effects of rehabilitation program in children with cardiac problems. Beside acute benefits, studies from several authors tried to determine steadiness of such success after 3 months from post rehabilitation program as well as 5 years later (12, 13, 14).

In our study we wanted to point out an optimal duration of early rehabilitation as well as number of exercises in children that underwent correction of CHD and to stress the optimal time for starting early rehabilitation program.

Passive relaxing movements and percussion drainage are implemented in all patients with a non-statistical difference between these two techniques ($p>0.05$). However there is a wide range in interval expressed in days from only one day of exercise to 33 days. This interval suggests that every patient should be assessed individually with every day monitoring of the progress. In majority of cases, the optimal length of early rehabilitation is one week. During this period we expect our patients to boost its condition that will allow them to be transferred to pediatric cardiology department for further monitoring and treatment. For the breathing exercise, we demonstrated that there is a slight decrease in the frequency of implementation due to possible complications or hemodynamic instability after operation. Compared to the two techniques above there is a statistical difference in the implementation of BE but not significant ($p<0.05$) when median values are compared. Beside these findings, the optimal duration of this technique is one week, too.

Verticalisation as an exercise technique was significantly less frequent because majority of children were newborns. But for those that underwent this exercise we found a statistically significant decline in median duration due to the abovementioned techniques ($p<0.01$). It can be noticed that there is a statistical shrinkage in range interval, too.

During the early rehabilitation there were only pulmonary complications with the frequency of 9.09 %.

There is a correlation of number of exercises between the group without complications and the group with pulmonary complications. Group with complications had less exercises than other group of patients. Less number of exercises can be explained by

**Tab. 1. Duration of exercises in the group of patients in days.**

| Type of exercise | Number of participants | Median value | Standard deviation | Minimal duration | Maximal duration |
|---|---|---|---|---|---|
| PRM | 176 | 7.13 | 4.71 | 1 | 33 |
| PD | 176 | 7.05 | 4.68 | 1 | 33 |
| BE | 133 | 6.47 | 3.95 | 2 | 33 |
| V | 32 | 4.79 | 2.08 | 2 | 11 |

**Tab. 2. Number of exercises due to the presence of pulmonary complications.**

| Pulmonary complications | Number of participants | Median value | Standard deviation |
|---|---|---|---|
| No | 160 | 3.64 | 1.02 |
| Yes | 16 | 2.71 | 0.79 |

**Tab. 3. Initiation of early rehabilitation program due to the presence of pulmonary complications after correction expressed in days.**

| Pulmonary complications | Number of participants | Median value | Standard deviation |
|---|---|---|---|
| No | 160 | 1.54 | 1.37 |
| Yes | 16 | 2.27 | 1.68 |

the severity of CHD and condition in post correction period and that more intensive techniques requiring more energy cannot be properly assessed.

According to our results, the optimal number of rehabilitation techniques is between 2 and 4. While these patients are on early rehabilitation program, there is a constant monitoring of vital parameters, since mild misbalances can cause fatal complications.

The optimal time for the beginning of cardio rehabilitation program after the defect correction varied between these two groups. It was longer in patients with pulmonary complications with a statistical difference from the group without pulmonary complications. This can be explained by an unstable state, predominantly hemodynamically and respiratory.

In conclusion, the termination of rehabilitation program was in correlation with general well being and complete resolution of pulmonary complications.

We believe that results of this study stress the value of cardiac rehabilitation program in children, and we strongly suggest that this therapy can provide benefit to many children with CHD and should be regularly implemented.

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Received May 6, 2008.
Accepted September 20, 2008.