The Physical Exercise Program during Post-Surgery Rehabilitation of Elderly Patients Diagnosed with Thrombophlebitis of the Lower Limbs in Jordanian Hospitals

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Abstract

Deep vein thrombosis (DVT) or thrombophlebitis is frequently found in human limb veins and it is a manifestation of venous thrombembolism (VTE). Thrombosis is a process of intravital blood clot formation inside blood vessels. This may be lethal. The mortality rate associated with this disease is higher than that of many extremely dangerous disorders. In most countries, statistical figures provided by healthcare systems regarding thrombosis patients are high. Aim of the study is checking the physical exercise program efficiency designed for post-surgery rehabilitation of elderly patients diagnosed with lower-limb thrombophlebitis in Jordanian hospitals. Research methodology was based on theoretical analysis and scientific and methodical literature, pedagogical observation, medical and biological research methods, as well as on statistical methods. The studied group was formed by elderly patients diagnosed with lower-limb thrombophlebitis. They underwent surgery and were sent to restore with a one-year (2014-2015) rehabilitation program in the Physiotherapy Department of the AL-Karak State Hospital (Jordan). The patients were in the age of 55-60 years. Before doing exercises, patients have not been feeling pain or distress. The rehabilitation program was applied for 30 minutes three times per week. Each session was attended by four patients. Results were processed by means of mathematical statistics and by calculating significant differences with the Student's t-test. We have substantiated the use of a physical exercise program designed for post-surgery rehabilitation of elderly patients with thrombophlebitis of the lower limbs. This program has improved a number of patient characteristics: body weight, blood pressure, heart rate, physical condition index, the adaptive capacity of cardiovascular system.

Keywords: Diagnosis, Thrombophlebitis, Physical Rehabilitation, Exercise, Elderly Patients.

Introduction

Deep vein thrombosis (DVT) or thrombophlebitis is frequently found in human limb veins. Thrombosis develops mostly in gastrocnemius muscles and biceps femoris. In rare cases, thrombosis is found in human arms. According to medical data [1-3], thrombosis is a process of intravital blood clot formation inside blood vessels; the clots may gradually grow in size and hinder the free blood circulation. Furthermore, there is a high chance that these clots may be transferred with blood into the midline organs, such as heart, lungs or brain. This may be lethal. The mortality rate associated with this disease is higher than that of many extremely dangerous disorders. For instance, according to [4], in Great Britain (2005), the House of Commons Health Committee recorded a mortality rate associated with thrombosis of more than 25,000 persons. In most countries, statistical figures provided by healthcare systems regarding thrombosis patients are similarly high. Cardiovascular diseases are the main cause of death in Jordanians, while thrombosis is one of the most prevalent one. In Jordanian hospitals, 70% of thrombosis patients are people over the age of 55: 38% of Jordanian population are individuals under the age of 15, 28% are people of working age (15-64) [5]. The last category includes our surveyed patients. Then, 20% of people are young adults (15-24), "another 4% – elderly people [6].
Changing diet and style of living may be the reasons for increasing number of cardiovascular diseases. During the period from 1960 to 2000, population was consuming more fatty foods instead of grain bread, milk and fresh vegetables. Thus, their daily intake of calories exceeds the value in 3000kcal [7-8].

In the Middle East, 300 thousand people die from cardiovascular diseases every year. Since Jordan is one of world countries with the highest mortality rates of body system disorders, we should pay more attention to prevention and treatment [9]. Studies have shown that the risk of cardiovascular disease is higher among men rather than women. Generally, this is because men perform more hard work, are more likely to smoke and drink alcohol, weakening own blood system [10].

Surgery is most frequently used treatment, which efficiency is substantiated in studies [11]. Post-surgery leg recovery to its natural size is a lengthy process. In some cases, edema remains for the rest of the life. Drugs that alter blood coagulation facilitate quick recovery and reduce the chances of recurrent thrombosis. However, patient has to monitor his or her blood tests and undergo a long-term follow-up by a phrenologist after the hospital treatment.

During the rehabilitation period, doctor chooses a daily activity complex for patients. In general, static load and running is ruled out. Walking, swimming, and inverted poses are very healthful. For instance, walking strengthens the suction function of chest excursions. According to researchers [1, 2, 12, 13], skeletal muscle pump pumps the blood upwards with each step, having a positive effect on the contracting gastronomies muscles and on the lower limb veins.

Swimming exercises also have a positive effect of exterior water pressure on blood vessel walls. However, general recommendations for the rehabilitation of thrombosis patients are unsuitable for wide use in medical practice. This necessitates research in this area.

Literature Survey

There are several studies that cover the peculiarities of rehabilitation of patients with various diseases [1, 2, 7, 14] and treatment of lower limb injuries [15, 16]. Studies [17, 18] describe the outpatient therapy and surgical management of lower-limb thrombosis. There are only general recommendations on postoperative care that include simple physical exercises. Jordanian researchers have studied the positive effect of physical exercises on young healthy persons [17]. Researchers of other countries [18-20] have found that blood pressure of elderly persons is improving while doing physical exercises with subsequent relaxation. According to specialists studied modern fitness techniques and oriental recreational systems [21-25], vital blood vessels and centers that supply the legs are located in the thighs and the hip. Therefore, rehabilitation program may include exercises that tense and stretch thighs and gluteal muscles. Aspirin, heparin or mechanical intermittent pneumatic compression (IPC) can be used to prevent post-operative complications [26-27].

Objectives

- Substantiating the use of physical exercise program designed for post-surgery rehabilitation of elderly patients diagnosed with lower-limb thrombophlebitis.
- Checking the efficiency of the physical exercise program during a yearlong rehabilitation of elderly patients that underwent surgical management of lower-limb thrombophlebitis.

Method

1. Theoretical analysis and generalization of scientific and methodological data. 2. Medical and biological research methods. 3. Mathematical statistics methods.

Jordanian population is represented mainly by people in the age of 15-64 (about 62%), 4.1% of population is over 64 years old and 32.2% is under the age of 15 [38]. Hospitalization to the Physiotherapy Department of the Al-Karak State Hospital (Jordan) was the selection criteria of our study. The examined group included elderly patients diagnosed with thrombophlebitis of the lower limbs. They underwent surgical management and spent one postoperative year (2014-2015) at the Physiotherapy Department of the Al-Karak State Hospital (Jordan). Patients were in the age of 55-60...
years. They have not been feeling acute pain or malaise before doing the exercises. The rehabilitation program was performed three times per week; the session lasted 30 minutes. Four persons participated in each session.

Thus, 16 patients performed within two hours. Medical and biological methods were used to examine elderly patients with lower-limb thrombophlebitis to determine the dynamics of studied characteristics over the year and to draw a conclusion on whether the physical exercise program is effective during the yearlong rehabilitation. Methods and indexes used to determine the physical condition of Jordanian patients with lower-limb thrombophlebitis were as follows: age (years), body weight (kg), height (cm), blood pressure (BP) (mm Hg), heart rate (contractions per min\(^{-1}\) (bpm\(^{-1}\)).

In our study, patients had slight obesity. Body mass index (BMI) was equal to 28.8 and average (28-31 diagnosed with first-degree obesity). Patients were elderly, but not bedridden. The results were treated with mathematical statistics methods and with a Student's t-test. The significance level was \(p<0.05\). In terms of numerous recommendations of specialists, the following experimental physical exercise program was designed for the rehabilitation of elderly patients after surgical management of lower-limb thrombophlebitis.

**Supine Exercises**
- Relaxation with legs raised on a stepper;
- Stomach suction;
- toe flexion;
- head raising;
- Foot motion (forward-backward, left-right, rotation);
- Alternate knee raise (to the chest with subsequent foot holding in hands);
- Alternate knee raise (to the chest with subsequent leg straightening);
- “bicycle” leg motions;
- “scissors” leg motions;
- Hip rising.

**Standing Exercises**
- Toe-up (feet together, toes split, heels split) - rhythmic body lifting on the toes;
- Shoulders and head pulling backwards-tilts head and shoulders back and forth.

These exercises should be done slowly. Before doing the exercise, patients should put on compression garments that improve venous insufficiency. After physical exercises, patients should swill each leg for 10-15 minutes, alternating between warm and cool water. A rational diet and optimal body weight preservation are also important components of the rehabilitation process.

Pirogova physical condition level (PCL) (UA) allows assessing patient's physical condition according to cardiovascular system parameters and R.M. Baevsky's adaptive potential (AP) assessment (AU). The decrease in AP is accompanied by a certain shift in the parameters of myocardial-hemodynamic homeostasis within its so-called normal values; the tension experienced by regulatory systems increases, as well as the "price for adaptation".

High stress and depletion of regulatory mechanisms in older people lead to the disruption of adaptation process. It comes with a sharp decline in the reserve capacity of the heart. At a young age, we observe a greater cardiovascular system performance. Arbitrary unit (AU) characterizes the values obtained by calculations. It is accepted as a standard unit to indicate the value measured under the same conditions.

**Determining Physical Condition by E.A. Pirogova**

LFC = \((700-3 \times \text{HR} - 2.5 \times \text{MAP} - 2.7 \times 0.20 \times W.) / (350 - 2.6 \times A + 0.21 \times \text{height})\), where:

HR – heart rate, beats/min. at rest;
MAP – Mean arterial pressure at rest, mm Hg.

It can be found by the formula:

MAP = DBP + (SBP - DBP)/3;
ABP – Diastolic blood pressure, mm Hg
SBP – Systolic blood pressure, mm Hg
A – Age in years;
W – Weight in kilograms;
Height – height;

The digital value is estimated according to the table with a 5-level graduation: 0.255-0.375 – "low"; 0.255-0.375 – "below average"; 0.376-0.525 – "average"; 0.526-0.675 – "above average"; over 0.826 – "high".28
Baevsky Index provides 71.8% of recognition accuracy (in comparison with peer review), based on the most simple and common research methods – measuring the pulse rate and blood pressure, height and weight:

\[ \text{AP} = 0.011 \times (\text{HR}) + 0.014 \times (\text{SBP}) + 0.008 \times (\text{DBP}) + 0.009 \times (\text{W}) - 0.009 \times (\text{H}) + 0.014 \times (\text{A}) - 0.27; \]

Where: AP – adaptive potential of the cardiovascular system in points,

HR – heart rate (beats / min);
SBP and DBP – systolic and diastolic blood pressure (mmHg);
H – Body height (cm); W – body weight (kg);
A – age (years).

AP values are determined by the functional status of the patient.

Sample analysis: below 2.6 – satisfactory adaptation
2.6 - 3.09 – adaptation mechanisms are in stress; 3.10 - 3.49 – unsatisfactory adaptation; over 3.5 – disruption of adaptation process.

Table 1: Physical condition dynamics of elderly patients (n=16) diagnosed with lower-limb thrombophlebitis during the yearlong rehabilitation period (x – average value)

<table>
<thead>
<tr>
<th>Control indexes</th>
<th>Start of rehabilitation</th>
<th>six months into rehabilitation</th>
<th>12 months into rehabilitation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( \bar{X} )</td>
<td>m</td>
<td>SD (standard deviation)</td>
</tr>
<tr>
<td>Age, years</td>
<td>57.82</td>
<td>0.95</td>
<td>1.3</td>
</tr>
<tr>
<td>Body weight, kg</td>
<td>85.73</td>
<td>2.38</td>
<td>5.4</td>
</tr>
<tr>
<td>Height, cm</td>
<td>168.31</td>
<td>1.02</td>
<td>4.56</td>
</tr>
<tr>
<td>SBP, mm Hg</td>
<td>154.87</td>
<td>0.93</td>
<td>9.456</td>
</tr>
<tr>
<td>DBP, mm Hg</td>
<td>92.44</td>
<td>1.96</td>
<td>3.12</td>
</tr>
<tr>
<td>Heart rate, bpm</td>
<td>88.09</td>
<td>2.76</td>
<td>4.96</td>
</tr>
<tr>
<td>PCL, AU</td>
<td>0.28</td>
<td>0.02</td>
<td>0.003</td>
</tr>
<tr>
<td>Baevsky’s AP  assessment, AU</td>
<td>4.41</td>
<td>0.03</td>
<td>0.5</td>
</tr>
</tbody>
</table>

At the start of the rehabilitation period, PCL was 0.28 AU (low level), 0.38 AU after the second measurement and 0.49 AU after the yearlong rehabilitation. This indicates the general physical improvement from the low level to the below average level. However, these parameters changed with Pirogova index showing that it had rose more than in 2.5 times since the start of rehabilitation. Thus, we can assume there is a significant physical improvement of patients and the developed exercise program is effective. R.M. Baevsky’s assessment of the cardiovascular system adaptive potential indicated a disruption of adaptation in patients (4.41 AU). At the time of the second measurement, results indicated an unsatisfactory adaptation (3.93 AU). At the end of the rehabilitation period, AP increased up to 3.51 AU. Reduction of AP value in AU indicates a cardiovascular system improvement. There is a gradual return to normal physical condition and functional status of cardiovascular system.

**Discussion**

Physical training of patients with cardiovascular disease has a curative and preventive effect on its development. Exercise activity helps to reduce the risk of coronary disease.
heart disease, to hold or eliminate angina. Generally, good physical development has a beneficial effect on the cardiovascular system of the human body. Effective postoperative care requires a complex of physical exercises and healthcare personnel training to conduct physical therapy during rehabilitation [31]. Physical activity improves the condition of vascular endothelium, contributing to its normal work. Improved hemodynamic parameters contribute to the normalized body state.

This improves nutrient supply to the tissues. According to research results; exercise training favourably affects the fibrinolytic system. In the case of elderly patients, 6 months of strenuous endurance exercises significantly improved the hemostatic parameters: reduction in plasma fibrinogen levels by 13%, an increase in mean tissue plasminogen activator by 39%, an increase in active tissue plasminogen activator by 141% and reduction of plasminogen activator inhibitor-1 by 58%. Platelet activation is important for pathophysiological mechanisms of unstable coronary syndromes and acute myocardial infarction. As in the case of our study, authors confirm the beneficial effect of physical exercise. They promote the DVT treatment and may increase the effect of pharmacological treatment [33].

Epidemiological studies prove that regular physical activity is effective in reducing the risk of atherosclerosis, diabetes and obesity. However, physical activity is only one of many factors affecting the function of cardiovascular system. Thus, patients have to adhere to balanced diet and undergo regular check-ups with their doctor [34]. The authors of one study in the same area offer to include aerobic, resistance and flexibility exercises into sport activity. In their studies, they have proven the efficiency of such exercises for restoration after myocardial infarction. They noted a significant improvement in oxygen consumption and an increase in physical exercise duration. This makes it possible to say that complex exercises have a positive effect [35]. Studies have shown that some activities can be preventive to avoid the risk of cardiovascular diseases.

In this case as in the case with preventing ASVD and myocardial infarction, experts advise to stick to a balanced diet, to minimize the amount of fatty foods, alcohol, to smoke less and to do more exercises. These recommendations can be applied to patients undergoing post-operative rehabilitation. A balanced diet and regular exercises can promote the healing processes [36]. Our complex of exercises includes not only exercises for lower limbs, but training exercises for the upper body. According to different studies [37] upper body exercises also increase blood flow, providing a therapeutic effect. There are exercise guidelines for patients with thrombosis, which are also suitable for recumbent patients. We suggest that programs with 30 seconds of intense exercise are an optimal variant to recover the lower extremity venous system of patients.

Low intensity and short duration of exercise makes it ideal for lying patients. Studies show that people with a lack of fitness that are on the run all day due to their specific job have a greater risk of cardiovascular disease than people with regular physical training. Thus, exercises will help reduce the risk of DVT and help in treating patients with this problem [39]. If we continue to improve our complex of exercises it will be possible in the future to create specialized guidelines for patients with different physical fitness levels. Based on physical condition (whether it is a bed case or there are chronic pains or other indications), it will be possible to create a complex of exercises for specific groups of patients.

**Conclusion**

- The physical exercise program for postsurgery rehabilitation of elderly patients diagnosed with lower-limb thrombophlebitis was substantiated in terms of its use.
- The physical exercise program efficiency for one-year rehabilitation of elderly patients that underwent surgical management of lower-limb thrombophlebitis was checked. We have found that the following patient characteristics were improved: body weight, blood pressure, heart rate, physical condition level and adaptive potential of the cardiovascular system.

Prospects for Follow-Up Studies we plan to compare the values of PCL among one age people with cerebral palsy: athletes and persons that are not engaged in sports activities.
References


