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ORIGINAL ARTICLE

Effect of resistance and aerobic exercises on bone mineral density, muscle strength and functional ability in children with hemophilia

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Abstract *Background and purpose:* Children with hemophilia are at risk for reduced bone mineral density (BMD), muscle strength and functional ability as a result of reduced leisure-time activity and less involvement in intense activities. So, the purpose of this study was to investigate the effect of resistance and aerobic exercise program on BMD, muscle strength and functional ability in children with hemophilia.

Materials and methods: Thirty boys with hemophilia A ranging in age from 10 to 14 years had participated in this study. They were assigned randomly into two equal groups (control and study groups). Control group received a designed physical therapy program and aerobic exercise in the form of treadmill training, while the study group received the same program as the control group in addition to resistance training program in the form of bicycle ergometer training and weight resistance. Both groups received treatment sessions three times per week for three successive months. BMD, muscle strength of knee flexors and extensors and functional ability were evaluated before and after the 3 months of treatment program.

Results: There was no significant difference between both groups in the pre-treatment mean values of all measured variables. Significant improvement was observed in BMD, knee extensors and flexors strength, and functional ability in the study group when comparing pre and post treatment

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measurements. There was a significant improvement in functional ability of the control group. Significant difference was also observed between both groups when comparing the post treatment measurements in favor of the study group.

Conclusion: Based on obtained data, it can be concluded that, resistance and aerobic exercise training program is effective in increasing BMD, muscle strength and functional ability in children with hemophilia.

1. Introduction

Hemophilia is an X-linked inherited recessive bleeding disorder that is characterized by a deficiency of clotting factor VIII (classic hemophilia, or hemophilia A) or IX (hemophilia B). Hemophilia "A" has a frequency of 1 in 5000 male births, where hemophilia "B" has a frequency of 1 in 30,000 male births [1]. The severity of the disease depends upon the level of clotting factor activity. Children with severe hemophilia (clotting factor activity $<1\%$) are characterized by spontaneous bleeding, moderately affected children (clotting factor activity 1–5%) have a great risk of bleeding with minor trauma and children with mild hemophilia (clotting factor activity 5–40%) bleed excessively only during surgery or trauma [2].

Because of hemarthroses, subsequent synovitis and arthropathy, children with hemophilia often have a sedentary lifestyle [3]. Although, children are more active than adults, children with hemophilia are at risk of developing hypokinesia due to decreased motor fitness and passive leisure activities [4]. Also, children with hemophilia often avoid any physical activity in their everyday life as a result of parental or medical restrictions. Therefore, active lifestyle is essential to maintain musculoskeletal health, reduce the risk of complications and ensure better quality of life in patients with hemophilia [5]. It was recognized that the attitude toward sports among children with hemophilia has improved, and the range of sports practiced has increased, as a result of improved medical treatment [6,7].

Despite increasing sport activity, children with hemophilia still tend to be less physically fit than their healthy peers. Physical fitness of children with hemophilia whose age ranged from 8.3 to 15.5 years was evaluated by Koch et al. [8] and reported a significant reduction in exercise capacity, possibly because of insufficient intensity of daily physical activities. Also, children with hemophilia have a decreased aerobic capacity and decreased ability to involve in higher intensity activities compared to their healthy peers [9]. Children with hemophilia often demonstrate a significant reduction in muscle strength and anaerobic power, especially in the lower limbs [10]. Furthermore, decreased activity level may result in overweight or obesity in children with hemophilia because of joint bleedings and overprotection [11]. The need for a physically active lifestyle in hemophilic children is further highlighted by the finding that bone mineral density (BMD) in children with hemophilia is lower than in healthy peers [12]. Also Falk et al. [13] reported a lower muscular anaerobic power and dynamic strength among children with hemophilia compared with age-matched controls. The reduced muscular performance capacity among children with hemophilia was explained by a lower level of physical activities in which lower performance capacity was apparent in both lower and upper limbs. Muscle weakness reduces bone loading, leading to demineralization and osteoporosis [14,15].

Children with hemophilia, who are less physically active than healthy peers, often suffer from acute or chronic orthopedic injuries which may further limit their physical activities. Indeed, it was noted that the lower level of physical fitness in hemophilic children was associated with reduced muscular strength [13]. So, the purpose of this study was to determine the effect of resistance and aerobic exercise training program on BMD, muscle strength and functional ability in children with hemophilia.

2. Materials and methods

2.1. Subjects

Thirty boys with hemophilia A whose ages ranged from 10 to 14 years were enrolled in this study. They were selected from Abo El-Rish pediatric hospital, Cairo university hospitals, Cairo, Egypt and assigned randomly into two equal groups (control and study groups). Children in both groups were under medical treatment in the form of replacement therapy with recombinant factor VIII which is considered the first and essential step in the treatment of hemophilia. The work is carried out in accordance with The code of Ethics of the World Medical Association (Declaration of Helsinki) for experiments involving humans. Parents of the children signed a consent form prior to participation as well as acceptance of the Ethics Committee of the University was taken.

All patients in both groups were selected according to the following inclusion criteria:

(1) Patients who were diagnosed as having moderate hemophilia.
(2) Patients who were free from severe tightness or any congenital deformities or cardiopulmonary dysfunctions.

Exclusion criteria:

(1) Patients with advanced radiographic changes as bone erosions, destruction, bony ankylosis or joint subluxation.
(2) Children who had surgical procedures performed six weeks prior to or during the exercise program.

2.1.1. Control group

Consisted of fifteen children who received a designed physical therapy program in the form of:

- Gentle stretching exercises for tight muscle groups around elbow, knee and ankle joints for 15 min.