The Annals of the "Ştefan cel Mare" University of Suceava.
Physical Education and Sport Section. The Science and Art of Movement
eISSN 2601 - 341X, ISSN 1844-9131

LIMITING THE PROCESSES OF DECONDITIONING OF THE MUSCULOSKELETAL SYSTEM IN PEOPLE WITH DIABETES THROUGH PHYSIOTHERAPY APPLICATIONS

Mihai Constantinescu
Stefan cel Mare University of Suceava, Romania
mihai.constantinescu@usm.ro

Keywords: diabetes, deconditioning, pathophysiology, physical therapy, health

Abstract

The case study presented aims to analyze the pathophysiological mechanisms and dynamics of the processes of deconditioning of the musculoskeletal system in people with diabetes, morphophysiological changes of major cardio-respiratory and neuro-endocrine functional systems. We will also present a kinetic approach in order to limit these deconditioning processes in order to maintain the best health status.

Introduction

On this direction are available methods, algorithms and instruments came from informatics, very different as form and quality, which was improved significant during the last years concerning the technical possibilities, the importance of the applications and the ease with which these can be used. Using of these in practical is still scanty, from reasons generated by financial problems, by the absence of specialized personnel, by the insufficient knowledge of the possibilities to use these, and also by the reasons which stick by those acceptances [10].

Diabetes develops when the body does not produce the necessary insulin or does not respond properly, leading to too much blood sugar [6].

Diabetes is the consequence of the total or partial absence of insulin secretion that causes increased blood sugar, causes disorders of lipid, protein and hydro electrolytic metabolism, also develops during its evolution, formidable micro and macroangiopathic complications [7].

From an etiopathogenesis point of view, they can be incriminated as diabetic syndromes secondary to pancreatic lesions or extra pancreatic causes; excess STH, ACTH, thyroid hormones, physical, emotional stress, medication, massive glucose intake [4.5].

The beta cells of the Langerhans Islands in the pancreas secrete insulin, the most important hormone with hypoglycemic action (lowering circulating glucose), so its presence is essential for anabolic processes (assimilation) in the body and energy balance.

Type II diabetes is the most common, on average about 90% of patients suffer from this disease, it is associated in most cases with overweight / obesity.

In general, the typical symptoms of diabetes occur when the insulin defect is very important, most of the time the diabetic does not recognize these symptoms although they are quite clear and the patient is often unsure about the disease that has set in [7].

The most common symptom is *polyuria* (elimination in very large amounts of urine, over 2 liters per day). This is because circulating glucose exceeds the kidney's ability to recover when it reaches 160-180 mg% and is excreted in the urine.

The second important symptom is increased thirst, *polydipsia,* because glucose has a high osmotic power that is eliminated with an appropriate amount of water that dehydrates the body.

This dehydration causes dry mouth and lips, and this thirst seems to be endless, nothing can calm it. Once the patient consumes a lot of fluids, it is accentuated, and their elimination takes place without other urinary symptoms only if there are no possible infections [3].

All the sugars (carbohydrates) consumed by the diabetic patient are eliminated in the urine, this leads to somatic-functional changes of the musculoskeletal system.

In these patients, the need for energy support creates a permanent hunger, *polyphagia,* but paradoxically, the more they eat, the more they lose weight. Both adipose tissue and muscle tissue melt progressively because in the absence of glucose, which can no longer be used efficiently or eliminated in the urine, the body, in order to achieve its energy material, is helped by its fat reserves and finally proteins. structural [3].

Another symptom encountered in diabetes is the state of weakness, physical and intellectual *asthenia* this is due to decreased energy metabolism, dehydration, loss with urine of important salts in the body, such as: potassium, sodium, magnesium. Just as the patient's capacity for physical and intellectual effort decreases, so does his memory and ability to concentrate [7].

Pain and decrease of mobility on cervical and lumbar spine, are showed by degenerative joints processes and postural changes of the spine, influencing the quality of daily life [9].

If the patient's diagnosis is not found in time, his condition deteriorates rapidly, and the symptoms we have listed will worsen very quickly, dehydration, asthenia and of course weight loss.

Often the patient complains of lower limb pain, this pain worsens at night which makes him wake up at night and walk around the house.

Other manifestations of diabetes that can occur paresthesia (mild numbness) of the lower limbs, they can again be too hot or too cold, due to touching the nerves of the legs as complications of diabetes. And also related to the lower limbs we can remember that even lesions can appear that spread rapidly (diabetic gangrene). In men, it is quite common to have another manifestation, namely the appearance of hypotension [7].

Therefore, in quite common cases, diabetes is discovered on the occasion of acute coronary or stroke and very rarely blood glucose control tests are performed.

For anticipation of the health condition, we can use the prognosis which represents an anticipation of the events or results in view of reducing the uncertainty concerning the future evolution of the process; most of the times this thing implies the use of some complex mathematical methods [11].

The diagnosis for diabetes is given by the tests that will lead to the treatment that will be glycemia, glycosuria, hemoglobin, glycosylated or abbreviated-HbAlc. Blood glucose is expressed in mg / dl, mmol / l or g / l [1].

The treatment of type 2 diabetes is also called the "insulin independent" treatment, it is the expression of the disruption of insulin activity at the periphery and subsequently its beta-pancreatic secretion.

The essential aspects in the care of people with diabetes, regardless of the type of diabetes are the improvement of lifestyle, diet, exercise and specific education [8].

- Oral treatment - medications;
- Recovery treatment in diabetes - physical activity;
- Nutritional treatment - nutritional medical therapy (TMN)
- Outpatient treatment.

Aim of the work is the limitation of the processes of morpho-physiological deconditioning of the musculoskeletal system in people with diabetes by carrying out an adapted physiotherapy program.

Research objectives:

- analysis of the specialized literature regarding the recovery of people with diabetes;
- identification and understanding of the pathophysiological mechanisms of diabetes;
- carrying out a program of physical activities through physical therapy in order to maintain the best health status in people with diabetes.

Materials and methods

In order to understand the pathophysiological aspects regarding the positive influence of the implementation of a kinetic program in people with diabetes we will present a classic case study of a person with this disease.

Except from the patient observation file:

- 48-year-old male, occupation: worker, referral diagnosis: Type II diabetes; Associated diseases: cervical spondylosis, lumbar disc herniation, chronic hepatitis, mixed dyslipidemia.
- Current treatment - insulin therapy;
- Recommendations - Indications for recovery from the specialist: diet (with food allowed by the doctor), physical therapy (specialized treatment is recommended, individualized to your own needs);
- In addition to a healthy diet and exercise that was recommended, our patient had to take insulin 4 times a day, and every morning on an empty stomach to monitor their blood sugar, so as not to increase the value. normal.

Normal value <100 mg / dl; Suspicion of prediabetes 100-125 mg / dl; Type II diabetes> 125 mg / dl

Table no.1 first evaluation

Initial Clinical Evaluation		
1	Hight	186
2	Weight	95 kg
3	BMI	27.46 (overweight)
4	Insulin administration / 4 times / per day	(07.00- 18 units; 12.00 - 18 units; 18.00- 18 units; 10- 28 Lantus units)
5	Glycemia	134 mmol / l
6	Heart rate	85 beats / min.in resting 160 after 15 squats 98 after 1 min. effort
7	Respiratory rate	17 resp./min. in resting 30 after 15 squats 21 after 1 min. effort

The physiotherapy program will be performed after establishing the functional residual in terms of effort capacity and will consist of a set of adapted analytical exercises.

As main objectives, the program will aim at maintaining the remaining functional but also a possible improvement of the targeted morpho-physiological parameters.

Program objectives:

- Maintaining body weight in nominal parameters;
- Maintaining exercise capacities, respectively heart rate and respiratory rate;

- Maintaining joint mobility and muscle strength throughout the musculoskeletal system;
- Prevention of accidents and installation of de-conditioning mechanisms in the musculoskeletal system.
- Adjusting and improving metabolic mechanisms regarding the regulation of blood glucose homeostasis.

The exercises will be performed according to the specific principles of recovery in diabetes. Physical effort acts by increasing peripheral glucose utilization, decreases insulin requirements, lowers triglycerides and circulating cholesterol, increases exercise capacity, decreases weight, improves respiratory and cardiovascular function, reduces depressive states [2]

The segments of the scapulohumeral girdle/ upper limbs, the trunk, respectively the spine, then the pelvic belt with the lower limbs will be mobilized in turn, in orthostatism with slow movements, then in dorsal / ventral decubitus where weights can be added.

It will also be possible to use different objects made of wood, plastic, elastic bands and other devices. During the program, the patient's condition, facies, sweating, coordination, stability and response to effort will be constantly monitored.

Even moderate exercise causes hyperglycemia, so it is recommended for the patient to consume 10-20 g of carbohydrates to prevent hypoglycemia.

Results

Following the implementation of the program we will present the reference values, that formed the basis of the study, specifying that the model presented has a general character and changes can be made depending on the functional remnant of each patient. We have previously specified the symptoms and effects of diabetes on the musculoskeletal system; therefore, we have selected some reference elements, which we will analyze and expose. The effort capacity expressed by the evolution of the heart rate and the respiratory rate, from a somatic point of view, BMI is followed, and from endocrine metabolic point of view, the dynamics of the glycemic index will be followed.

Table no. 2 The evolution of Heart rate and Respiratory rate.

Stage	Heart rate-beats per minute (bpm)			Respiratory rate - per minute (rpm)		
	Normal Heart rate	Effort Heart rate (after15 squats)	Heart rate (after 3 min)	Normal Respiratory rate	Effort Respiratory rate (after15 squats)	Respiratory rate (after 3 min)

.Initial	85 bpm	160 bpm	98 bpm	15 rpm	30 rpm	21 rpm
Second	80 bpm	150 bpm	85 bpm	13 rpm	27 rpm	18 rpm
Final	78 bpm	138 bpm	72 bpm	12 rpm	25 rpm	16 rpm

Table no. 3 The evolution of BMI

	Indicator	initial	second	final
1	Hight	186 cm	186 cm	186 cm
2	Weight	95 kg	89 kg	86 kg
3	BMI	27.46 uc. (overweight)	25.25 uc. (overweight)	25.00 uc. (normal weight)

Insulin administration - after the physiotherapy sessions the patient ended up self- administering only fewer insulin units.

Initial evaluation → 07.00-10 units; 12.00-8 units; 18.00-8 units; 22.00-18 units Lantus, at a blood glucose of 134 mmol / l

Final evaluation → 07.00-8 units; 12.00-8 units; 18.00-8 units; 22.00-16 units Lantus, at a blood glucose of 105 mmol / l

Regarding the body mass index BMI has a positive dynamic the patient reaching 25 u BMI respectively 86 kg. table no.3

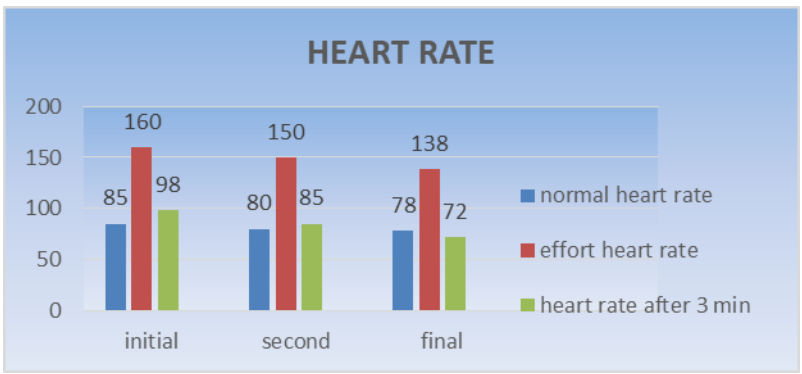

Fig. 1 the evolution of the heart rate

Regarding the dynamics of the capacity of the respective effort heart rate, the representation of the values in graph no.1 results that the patient can perform physical activities without reaching maximum values of the respective heart rate 138 b / min and the return from effort is also done in a timely manner.

According to Astrand formula:

F max allowed = 220-age (48 years) x 85%

F max allowed = 146.2 rpm.

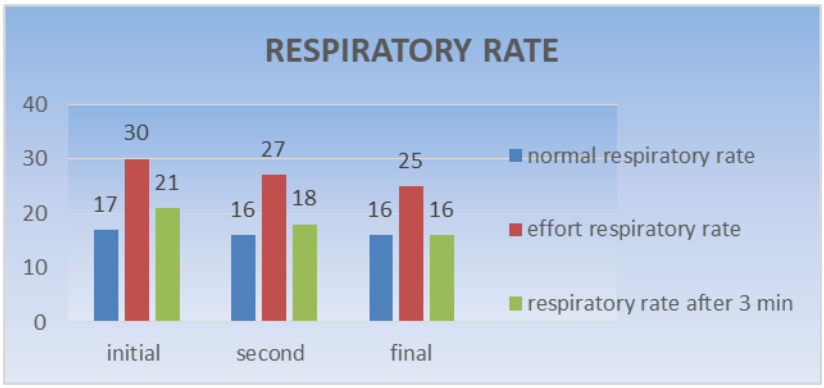

Fig. 2 the evolution of the respiratory rate

Regarding the evolution of the respiratory index, it also has a positive evolution of respect, the respiratory rate in effort decreases from 30 resp. / min to 25 resp. / min. The effort recovery capacity achieves a respective positive trend from 21 resp / min to 16 resp / min.

Insulin administration - after the physiotherapy sessions the patient ended up self-administering fewer insulin units.

Initial evaluation → 07.00-10 units; 12.00-8 units; 18.00-8 units; 22.00-18 units Lantus, at a blood glucose of 134 mmol / l

Final evaluation → 07.00-8 units; 12.00-8 units; 18.00-8 units; 22.00-16 units Lantus, at a blood glucose of 105 mmol / l

Conclusions

- Insulin administration after physiotherapy sessions, decreases from 4 times a day to 3 times a day and the glycemic index from 134 mmol / l to 105 mmol / l;
- BMI - body mass index parameters reach 25 uc.,
- which represents a status of normal weight, with a weight of 86 kg.
- The effort capacity has positive dynamics, the heart rate in effort decreases from 160 b / min to 138 b / min compared to the allowed F max of 146.2 b / min;
- The respiratory frequency in effort decreases to 30 resp. / min to 25 resp. / min and the return from effort from 21 resp. / min to 16 resp. / min.

Bibliography:

[1] American Diabets Association (ADA) (2003) Clinical Practice Recommendations;

[2] Corneliu Borundel, (1995) Manual de medicină internă, pentru cadre medii, Ed.ALL, București p. 581;

[3] Leonard Domnișoru, Dumitru Cristea, Nicolae Bacalbașa, Gheorghe Buceag, (2004) Compediu medicină internă, editura NAȚIONAL, pag.480;

[4] Mihai Constantinescu, (2019) Fiziologie Suport de studiu pentru lucrări de seminar, ed. Universității „Ștefan cel Mare Suceava" Suceava, p 68;

[5] Mihai Constantinescu,(2018) Kinetoterapia în Geriatrie-Gerontologie, ed. Universității „Ștefan cel Mare Suceava" Suceava;

[6] Prof. Dr. N.C. Paulescu-Istoria diabetului și istoria Institutului Național de Diabet, Nutriție și Boli Metabolice, Articol Istorie 26.iunie.2019;

[7] Prof. Dr. Constantin Dumitrescu-(2003) Diabetul pe înțelesul tuturor, Editura M.A.S.T. p.11, 42, 43, 44;

[8] Rodica Perciun, (2019) Diabet zaharat ghid practic, editura SAECULUM I.O. București p.75;

[9] Silişteanu Sînziana Călina, Antonescu Elisabeta, (2015) Study on pain, quality of life and disability relation in patients with degenerative cervical spine disorders, Balneo Research Journal Vol.6, No.3, Septembrie;

[10] Raţă, E., & Milici, L. D.(2009), Analysis Methods for Computerized Forecasting in the Athletes' Sportive Performances for Term of the Competitional Period. Elektronika Ir Elektrotechnika, 95 (7), p 99-102. Retrieved,from,https://eejournal.ktu.lt/index.php/elt/article/view/10056;

[11] Rata, Elena.(2007), Conceptul prognozarii activitatii sportive in baza pregatirii psihomotrice pe durata unui mezociclu de antrenament la inotatoarele de varsta 14-16 ani - demers investigativ,Gymnasium; Bacau.